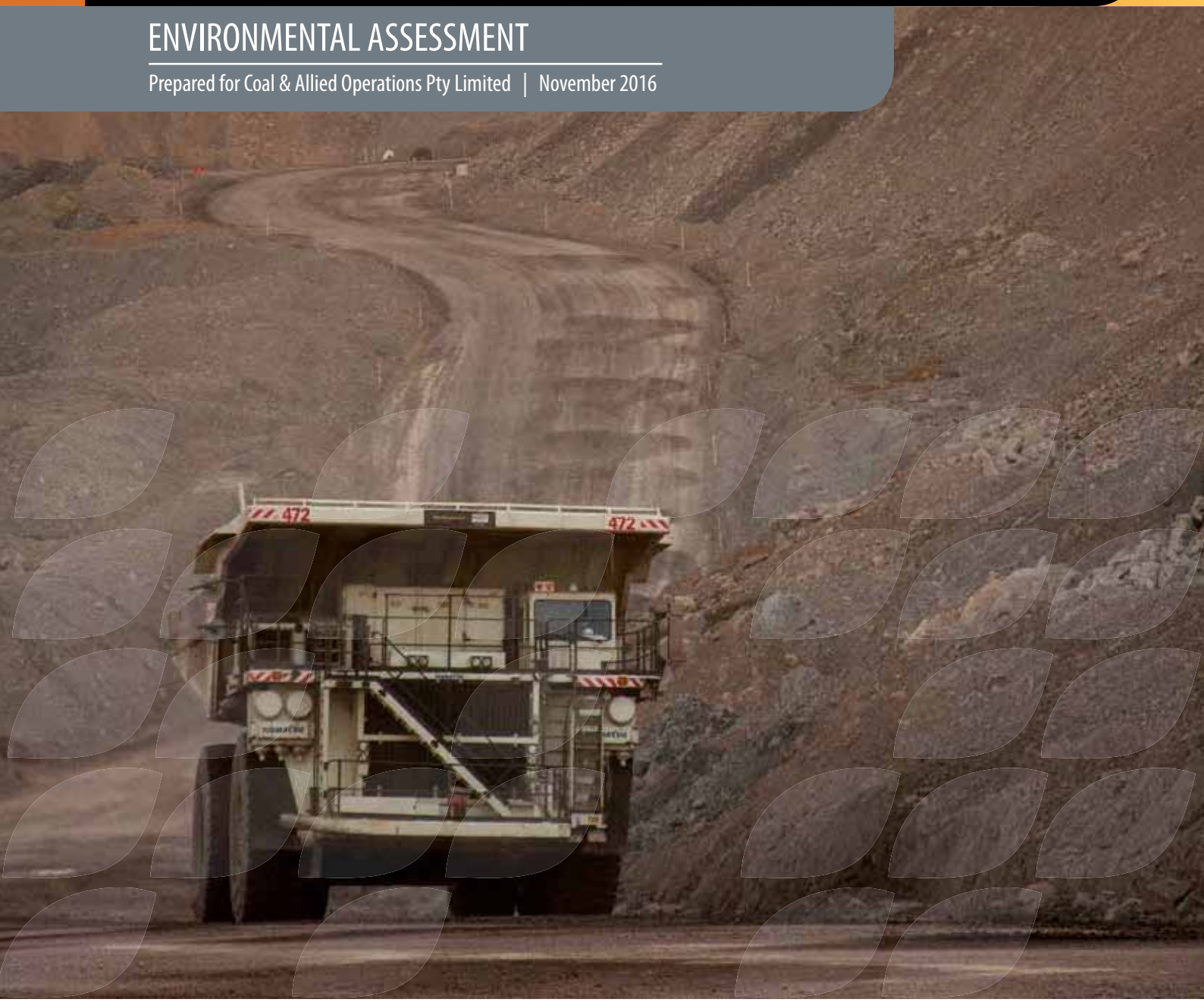
Hunter Valley North Operations – Modification 6

ENVIRONMENTAL ASSESSMENT

Prepared for Coal & Allied Operations Pty Limited | November 2016



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Hunter Valley Operations North - Modification 6

Section 75W Modification to DA 450-10-2003 | Carrington In-Pit Fine Reject Emplacement

Prepared for HV Operations Pty Ltd | 8 November 2016

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Hunter Valley Operations North - Modification 6

Final

Report J15014RP1 | Prepared for HV Operations Pty Ltd | 8 November 2016

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Date	8 November 2016	Date	8 November 2016

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Executive Summary

ES1 Proposed modification

Coal & Allied Operations Pty Limited and HVO Resources Pty Limited own the Hunter Valley Operations (HVO) mining complex, which is managed by HV Operations Pty Ltd (Coal & Allied).

Situated 24 kilometres north-west of Singleton, HVO is the oldest mine in Coal & Allied's portfolio, operating since 1949. HVO operates under two planning approvals, one for HVO North and one for HVO South, geographically divided by the Hunter River. However, the two operate as one site, HVO, and provide work for approximately 1,500 employees and contractors.

Fine reject management is integrated across HVO, and emplacement capacity is critical to the viability of the mining complex. The currently approved option, the Carrington out-of-pit fine reject emplacement (COOP FRE), must be deferred as the cost of construction and operation is not feasible in the current economic climate and market conditions.

Additional storage is required in Quarter 1 2018 to enable the continued processing of run-of-mine coal and, hence, the continuation of mining operations beyond this period.

Coal & Allied is seeking to modify the existing development consent DA 450-10-2003 under Section 75W of the NSW *Environmental Planning and Assessment Act 1979* to permit the emplacement of fine reject within the Carrington Pit void. The emplacement of fine reject within Carrington Pit is an important component of the approved HVO Life of Mine Fine Reject Emplacement Strategy.

The proposed modification will simply change the material to be emplaced in the Carrington Pit void from overburden, as is currently approved, to fine reject, in order to meet a requirement for additional fine reject storage capacity. There are no economically viable alternative options for fine reject emplacement.

The commissioning and operation of the proposed emplacement would commence as soon as it is available, should it be approved, providing an additional approximately eight years of fine reject storage capacity and be completed within the existing development consent period.

ES2 Environmental considerations

Potential environmental and social impacts from the proposed modification were assessed as generally being indiscernible from approved operations.

The change in backfill in the Carrington Pit final void from overburden to fine reject material will, however, result in a change in the hydraulic properties of the approved final landform. Therefore, an assessment of potential groundwater impacts of the proposed CIP fines emplacement was undertaken by AGE Consultants Pty Ltd.

Factors that control the long term flow of water into and out of the groundwater system at and surrounding the fine reject emplacement facility are the grain size and hydraulic conductivity of the fine reject material, and climatic conditions such as rainfall. The emplacement of fine reject, rather than overburden, does not change the groundwater system and Carrington Pit void's long term function as an evaporative sink. An evaporative sink is an open pit lake that draws water toward it, and is of a sufficient area that evaporative loss are greater than overall influxes, for the management of groundwater post-mining for the two currently approved final void rehabilitation options. The proposed modification will not impact groundwater levels or groundwater quality.

No additional specific management measures are warranted as a result of the proposed modification. Existing management and monitoring measures currently implemented through the relevant management plans required by DA 450-10-2003, such as the HVO Water Management Plan, will continue under the proposed modification, with regular review, optimisation and reporting.

ES3 Justification and conclusions

It was considered that the proposed modification is justified, for the following reasons:

- effective fine reject management is critical to the ongoing viability of the mine;
- there are no other viable options for the management of fine reject at HVO North in the current economic environment;
- the site is suitable for the proposed modification given that it is an approved final void and there will be no change to the approved disturbance footprint and rehabilitation outcome;
- the method of proposed fine reject emplacement has consistently been successfully implemented at HVO;
- potential environmental and social impacts are largely indiscernible with those approved under the existing development consent (DA 450-10-2003) such that the existing management controls implemented by HVO North require only minor administrative amendments; and
- it is aligned with the principles of ecologically sustainable development, consistent with the contemporary legislative requirements and meets all relevant government policies.

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1 Introduction

1.1 Modification overview

Hunter Valley Operations (HVO) mining complex is approximately 24 kilometres (km) north-west of Singleton, New South Wales (NSW). Coal & Allied Operations Pty Limited and HVO Resources Pty Limited own the HVO mining complex, which is managed by HV Operations Pty Ltd (Coal & Allied). While HVO is managed as one operation, HVO North and HVO South each have separate planning approvals; one for HVO North and one for HVO South, geographically divided by the Hunter River (Figure 1.1).

Mining operations first commenced at the now HVO over 65 years ago, in 1949. Since its inception, HVO has been, and continues to be, an important economic driver in the Hunter Valley economy with approximately 1,500 employees and contractors from the Hunter region.

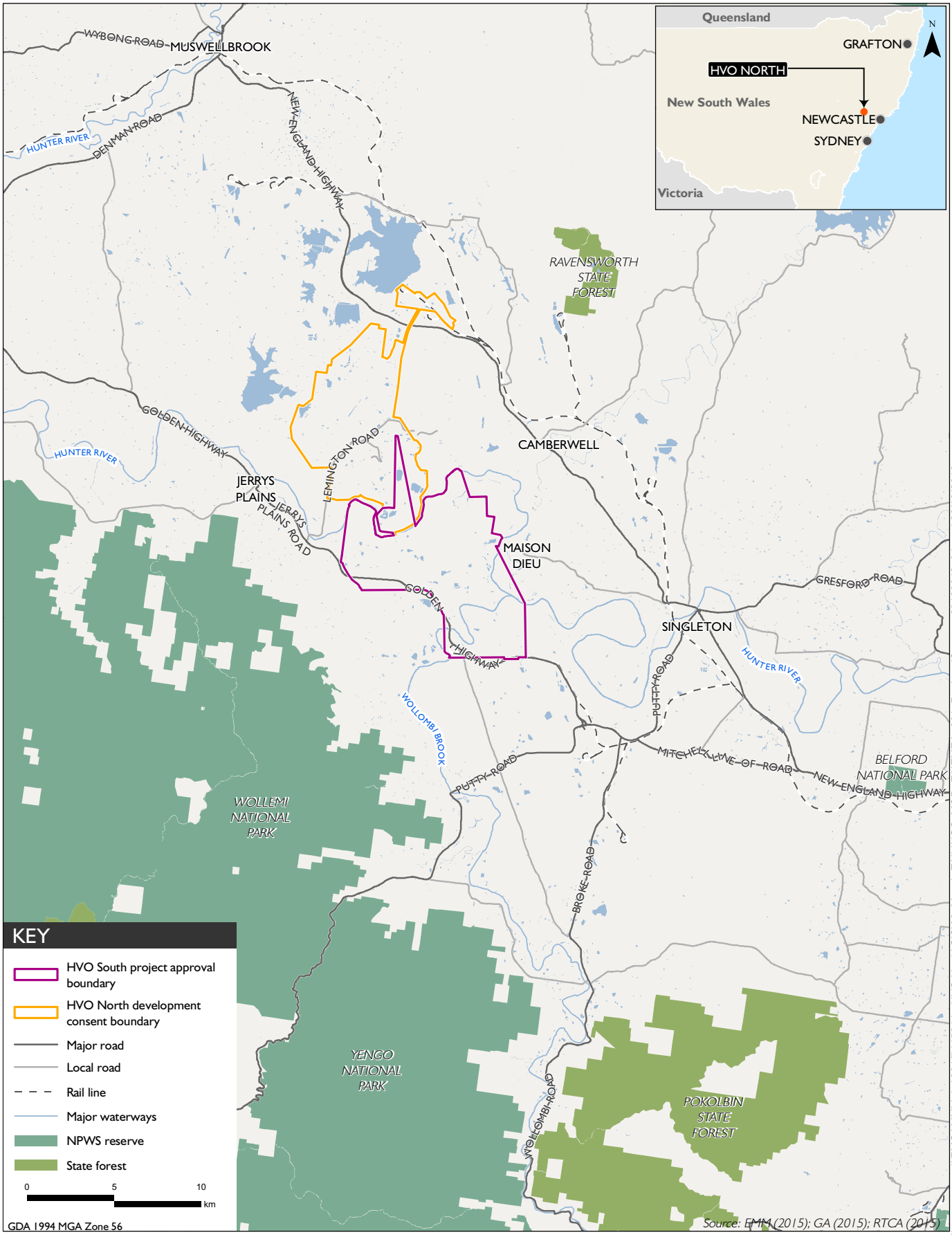
HVO North operates under Development Consent No. DA 450-10-2003 (DA 450-10-2003), which was issued by the then Minister for Infrastructure, Planning and Natural Resources in 2004, under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The original development consent has since been modified a number of times, the most recent being Modification 5 in 2016 following the submission of the Hunter Valley Load Point (HVLP) Sediment Basin and HVO North Communication Towers project.

Fine reject management is integrated across HVO, and emplacement capacity is critical to the viability of the mining complex. As part of the approval granted by the Minister for Planning for Modification 4, Condition 28A Schedule 4 requires Coal & Allied to develop a Life of Mine Fine Reject Strategy detailing how fine reject material and storage facilities would be managed throughout the life of the operation. The HVO Life of Mine Fine Reject Management Strategy (ATC Williams on behalf of Rio Tinto Coal Australia 2015) was submitted to DP&E in June 2015. The Strategy applies to the entire HVO complex and outlines multiple options for fine reject emplacement facilities across the operation; including the use of the existing Carrington Pit void as a potential emplacement.

Coal & Allied is proposing to modify DA 450-10-2003 under Section 75W of the EP&A Act to allow for fine reject emplacement in the approved void within Carrington Pit. The emplacement of fine rejects in the void will replace the approved emplacement of overburden in the void. Therefore, the proposed modification relates to the change in material type to be emplaced within the Carrington Pit void.

Figure 1.2 shows the location of the proposed fine reject emplacement in the local context. There are no other changes to HVO North proposed under the modification. The proposed modification elements are referred to collectively as 'HVO North – Carrington in-pit fine reject emplacement' (CIP FRE). The modification 'project area' comprises the CIP FRE and is shown in Figure 1.3. Further detail on the proposed CIP FRE is provided in Chapter 3.



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Regional context

Hunter Valley Operations North – Modification 6
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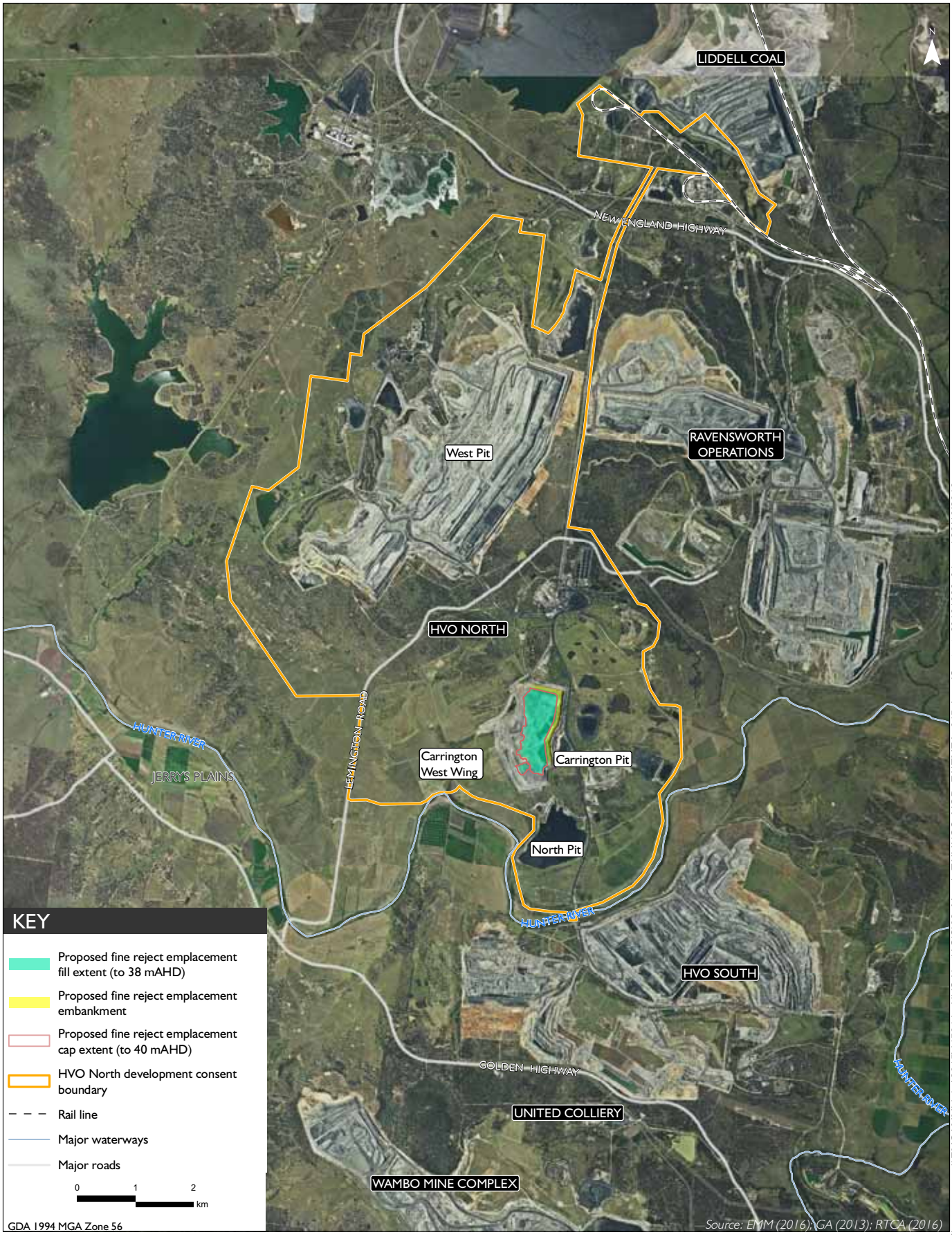
Figure 1.1



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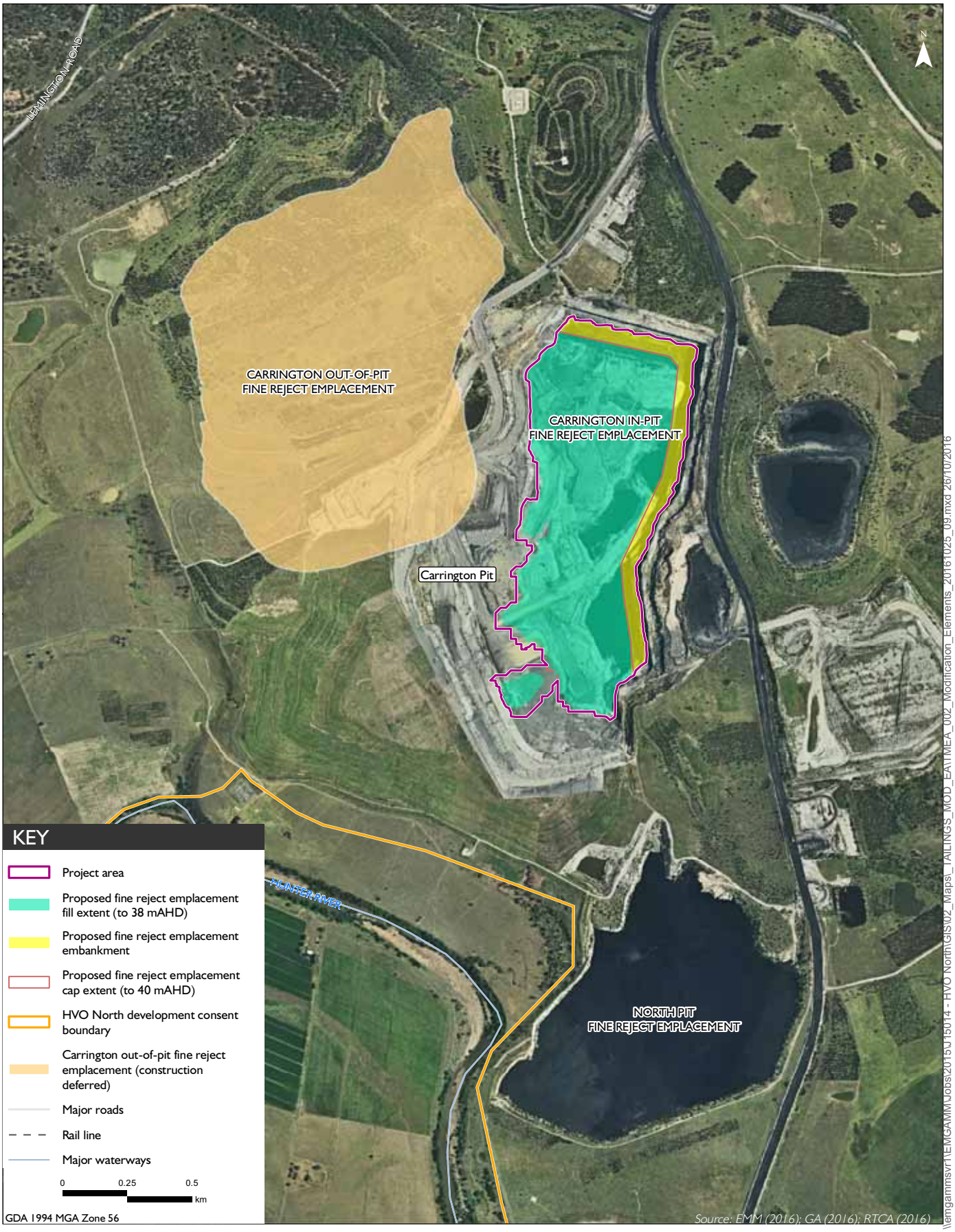
Local context

Hunter Valley Operations North – Modification 6
Environmental Assessment
Figure 1.2



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Project area

Hunter Valley Operations North – Modification 6
Environmental Assessment
Figure 1.3

1.2 The proponent

Coal & Allied Operations Pty Limited and HVO Resources Pty Limited own the HVO mining complex, which is managed by HV Operations Pty Ltd (Coal & Allied). Coal & Allied operates HVO with management services provided by Rio Tinto Coal Australia. Further information on Rio Tinto Coal Australia can be found at:

http://www.riotintocoalaustralia.com.au/

1.3 Sites and surrounds

The site (Carrington Pit void) has been previously disturbed at HVO North for mining activities and partially backfilled with mine overburden, and is approved as an evaporative sink following the cessation of mining. Carrington Pit is discussed in further detail in Section 2.3.

As shown in Figures 1.2 and 1.3, mine operations and related infrastructure in the surrounding area of the site include the previously mined Carrington Pit to the east, Carrington West Wing Pit (yet to be mined) to the west and the current fine reject emplacement facility at North Pit and Hunter River to the south. Other approved HVO North mining areas and infrastructure are further north and north-west of the site.

Dominant features of the HVO North landscape comprise the existing open cut pits, mine-related infrastructure and rehabilitated former mining areas, to the north, east and south. Topography is generally undulating and ranges from 130mAHD to 200mAHD to the north of West Pit and from 20mAHD to 120mAHD to its south.

1.4 Need for the modification

The current approved Life of Mine Fine Reject Management Strategy for HVO, prepared in accordance with Condition 28A Schedule 4 of the existing development consent (DA 450-10-2003), identifies the most practical and efficient means of utilising existing and proposed facilities for the deposition of fine rejects for the HVO mining complex. Mine sequencing is an influencing factor in the strategy, as the current HVO North development consent period ceases prior to the HVO South project approved period, with final voids remaining at West Pit and Carrington Pit.

The strategy considered the use of the currently approved FRE capacity in the HVO South complex; however these facilities were deemed impractical due to the distance from the coal handling and preparation plants (CHPPs) currently in operation.

To address the fine reject storage capacity limitations within HVO, the strategy focuses on two schedules for fine reject emplacement. The first schedule utilises the currently approved COOP FRE with pumping to start in 2018, and the proposed CIP FRE with pumping to begin after 2021. The second schedule contemplates the use of the CIP FRE starting in 2018, and defers the COOP FRE. The deferral of the COOP FRE is the result of internal analysis undertaken by Coal & Allied, which indicated that cost of construction and operation of the COOP FRE was not feasible in the current economic climate and market conditions. As a result, deferring the construction of the COOP FRE is preferred; as per the second schedule of the strategy.

Due to the COOP FRE construction deferment, mine planning has identified that fine reject storage capacity will be reached at HVO North in 2019 – 2020. Accordingly, additional storage is required in Quarter 1 2018 to enable the continued processing of run-of-mine (ROM) coal and, hence, the continuation of mining operations at HVO North beyond this period. Ideally, a new facility will be in operation 1-3 years before the current North Void facility reaches capacity in 2019-2020 as this will allow HVO to slow the rate of fill in the final layers of the North Void facility. Slowing the rate of fill has the advantage of allowing for greater density of fines, which increases the strength of the fines and increases the rate of drying which, in turn, enables allowing capping and rehabilitation to occur faster than if the facility is filled to capacity at the full fill rate.

Therefore, Coal & Allied is seeking to modify the existing development consent for the emplacement of fine reject within the Carrington Pit void, rather than emplacing overburden within the void as is currently approved. The overburden approved for emplacement in Carrington Pit is able to be accommodated in existing approved overburden emplacements elsewhere at HVO and will not lead to an increase in emplacement heights above what is already approved.

The proposed modification will provide an additional eight years of fine reject storage capacity, and enable the ongoing substantial regional and local economic benefits to be realised from HVO, such as local and regional supplier spend, community contributions, and the continued employment of approximately 1,500 employees and contractors. In 2015, HVO spent $229 million with 198 suppliers in the local region (comprising Singleton, Muswellbrook, Upper Hunter, Cessnock and Maitland LGAs), and $241 million with 283 suppliers in the rest of NSW. In addition, between 2015 and 2016, HVO's spend in the local region increased by $35 million. HVO, through Coal & Allied is also a significant contributor to the local community through the Coal & Allied Community Development fund and site donations which totalled over $1.6 million in 2015.

A strategy for fine reject storage beyond the additional eight years afforded by the proposed modification is being developed, and will be assessed and approval sought at the appropriate time. At that time, it is expected that the Life of Mine Fine Reject Management Strategy would be updated.

As substantiated in Chapters 7 and 8, potential environmental impacts from the operation of the proposed CIP FRE will be generally indiscernible from approved operations.

1.5 Purpose of this report

The purpose of this Environmental Assessment (EA) is to accompany an application by Coal & Allied to modify DA 450-10-2003 for the proposed CIP FRE, in accordance with Section 75W of the EP&A Act.

This document provides a description of the existing environment, an assessment of the potential impacts resulting from the proposed modification and details measures that would be implemented to avoid and/or minimise potential impacts. The EA provides information to allow NSW government authorities to assess the merits of the proposed modification and make a determination as to whether or not to grant approval. The document also informs the community about the modification and is available for public comment during the public exhibition process.

This EA was prepared by EMM Consulting Pty Limited (EMM), with technical specialist input from Australasian Groundwater and Environmental Consultants Pty Ltd (AGE).

2 Context

2.1 Introduction

This chapter provides an overview of the approvals history at HVO and its current operations that are relevant to the proposed modification; namely, Carrington Pit, fine reject management and environmental management.

2.2 Development consent history

The current development consent at HVO North is DA 450-10-2003. There have been five modifications to DA 450-10-2003, as detailed in Table 2.1 below. In addition, an access road was approved in 2005 by Singleton Council under a separate development consent. A high level summary of the consents and modifications is provided in Table 2.1. A copy of DA 450-10-2003, as modified, constitutes Appendix A.

Table 2.1 High level summary of approvals for HVO North

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
450-10-2003	Consent	12/6/2004	Minister for Infrastructure, Planning and Natural Resources (Minister)	Extension of open cut mining to the east of existing development. Production rate of 12Mtpa ROM coal from West Pit, 10Mtpa ROM coal from Carrington Pit and 4Mtpa from North Pit. Coal haulage of 16Mtpa from HVO South to the Hunter Valley CHPP. Total processing capacity of 20Mtpa at HVCHPP, 6Mtpa at HCHPP and 4.5Mtpa at NCHPP. Movement of coal and rejects between areas of HVO, including between HVO South and HVO North. Temporary crossings of the Hunter River for heavy equipment too heavy for the existing bridge. Consolidation of 15 existing development approvals applying to HVO North, into a single consent.
884/2004	Consent	02/2/2005	Singleton Council	Construction and use of an access road to the former EnergyAustralia (now Ausgrid) substation.
450-10-2003 MOD1	Mod 1[(1)] of DA 450-10-2003	16/8/2005	Minister	Upgrade of Hunter Valley Load Point to increase the loading rate from 4,000 tonnes per hour (tph) to an average rate of approximately 5,100tph with a peak load of up to 7,200tph.
450-10-2003 MOD2	Mod 2[(1)] of DA 450-10-2003	25/6/2006	Minister	Extension of open cut mining to the south and east of Carrington Pit to access approximately 19Mt of ROM coal. Construction of up to three levees and potential construction of groundwater barrier walls. Diversion of an existing drainage channel. Construction of a service corridor and modification of the development consent boundary.

Table 2.1 High level summary of approvals for HVO North

Approval No.	Approval Type	Issue Date	Consent Authority	Summary of Approved Activity
450-10-2003 MOD3	Mod 3 of DA 450-10-2003	19/3/2013	Minister	Extension of the Carrington Pit to the west (in an area known as the Carrington West Wing) to allow an additional 17 million tonnes of ROM coal to be extracted over a period of 6 years. Development of an out-of-pit overburden emplacement area to the north of the extension area. Construction of flood levees, a groundwater barrier wall, a temporary watercourse diversion and a service corridor to the south of the extension area. Rehabilitation the site. Modification of the development consent boundary to include the extension area. Realignment and increase in size of the approved Carrington Pit final void to 100ha.
450-10-2003-MOD4	Mod 4 of DA 450-10-2003	16/01/2014	Minister	Construction and operation of a fine reject emplacement to the north of the existing Carrington Pit. Installation of overland pipelines to transport fine reject slurry. Modification to the HVO North development consent boundary to encompass Cumnock void 3, located to the north-east of West Pit.
450-10-2003 MOD5	Mod 5 of DA 450-10-2003	Yet to be determined	Delegate	Upgrade of a sediment dam at the HVLP. Approval for communication towers.

2.3 Carrington Pit

2.3.1 Overview

Mining within Carrington Pit in the vicinity of the proposed CIP FRE is complete and the operation at Carrington is currently on standby pending the extension of Carrington into Carrington West Wing. The extension of Carrington into Carrington West Wing was approved in 2013 to access additional coal resources to the south west.

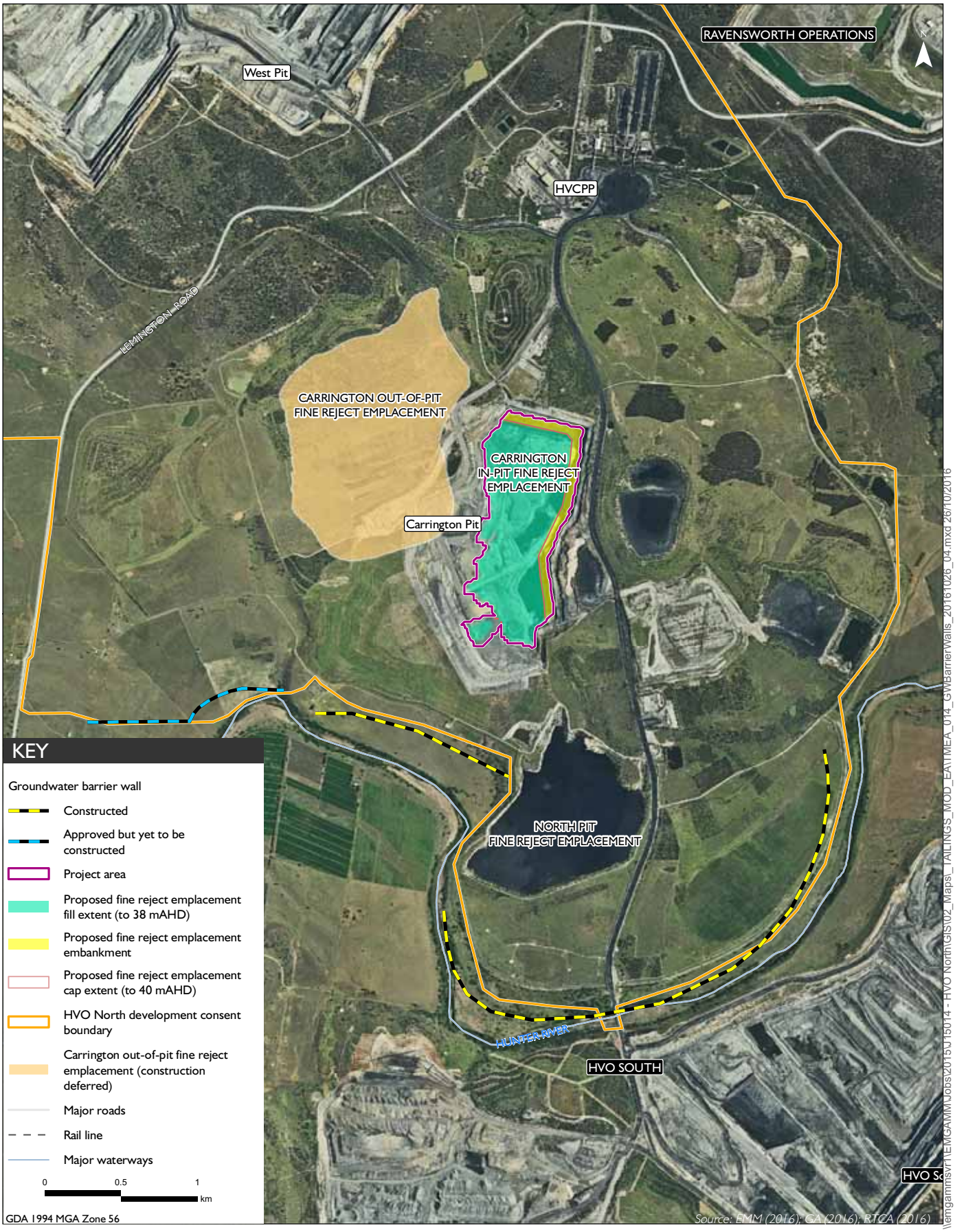
The land behind the low wall is being rehabilitated in accordance with the HVO North Mining Operations Plan (MOP).

To the west of Carrington Pit is a former meander of the Hunter River. This meander, known as a palaeochannel, incorporates permeable braids in the alluvium that would connect the river and the alluvium to the mine hydrologically. In 2005, MER reported that leakage from the river to the existing Carrington Pit via the alluvium could be mitigated by installation of impermeable barrier walls across the palaeochannel. Such walls would also inhibit long term leakage of leachate from the emplaced waste rocks within the mine void, southward into the undisturbed alluvium and the Hunter River.

The barrier wall in the eastern arm of the palaeochannel, in proximity to Carrington Pit, has been constructed. Monitoring results, through nested piezometers, have shown this wall to be effective during active mining. Modification 3 of DA 450-10-2003 (Carrington West Wing) also included construction of a realigned barrier wall in the western arm of the palaeochannel, which will add a further physical barrier between the palaeochannel alluvium and Hunter River alluvium when the Carrington West Wing is mined.

The groundwater barrier walls are shown in Figure 2.1 in the context of Carrington Pit void and the Hunter River.

Condition 62 of DA 450-10-2003 details the rehabilitation objectives for HVO North, including Carrington Pit, with a Rehabilitation Management Plan to be prepared in accordance with Condition 62C. This plan has been prepared and submitted to DRE, as part of the HVO North MOP. The final landform at Carrington Pit is planned to comprise a series of hills, ridges and minor valley systems designed to be consistent with the surrounding pre-mining landscape. It will have a mix of pasture and native habitat areas. The final void at Carrington Pit is approved to act as an evaporative sink to manage groundwater post-mining. An evaporative sink is an open pit lake that draws water toward it and designed to facilitate evaporative losses at a rate greater than the accumulation of groundwater, rainfall runoff and final landform infiltration within the pit shell. Further information on the final void is provided in Section 2.3.2.



Groundwater barrier walls

Hunter Valley Operations North – Modification 6
Environmental Assessment
Figure 2.1

2.3.2 Final void and long term water recovery

Carrington Pit will be reshaped with a final void of some 100ha and water levels in the final void will begin to recover. The final void has been designed and approved to be an evaporative sink to manage groundwater post-mining with the long term water recovery expected to be approximately 40mAHD (MER 2010).

Two options are approved for the post-mining design for the Carrington Pit final void. These are described below and shown in Figure 2.2.

- An open water void above the capped emplaced materials that would generate an evaporative sink over an elevated range of 40 to 45mAHD.

- A tree planted void, a filled and reshaped pit with a depression designed to facilitate evapotranspiration at an elevation above 45mAHD.

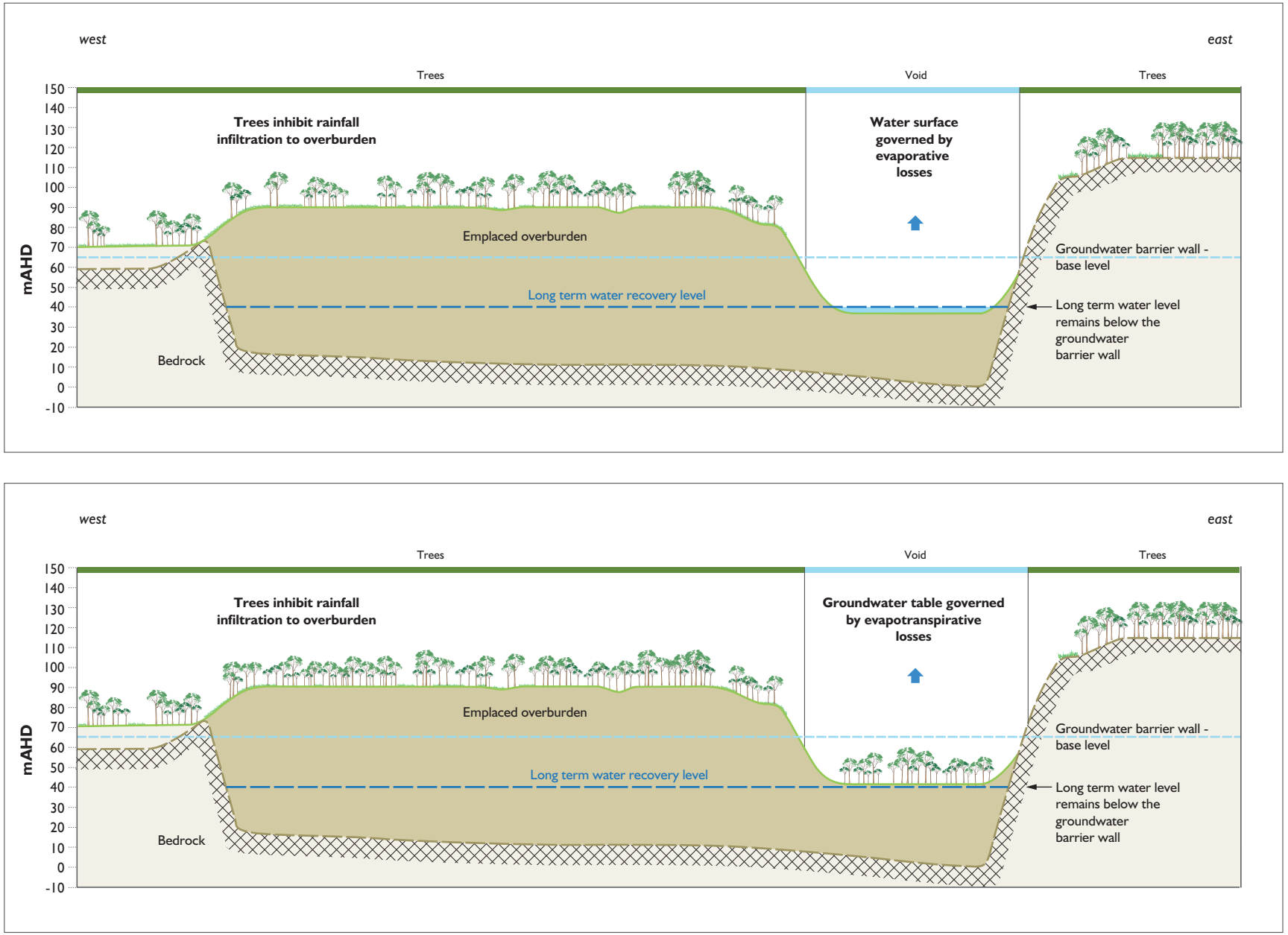
The open water void option would ensure that an evaporative sink would develop at the long term recovery level of approximately 40mAHD following the emplacement of overburden to this level in Carrington Pit. The evaporative sink would maintain the hydraulic gradient toward the open void, balancing evaporative losses with void influxes. The void has the potential act as an evaporative concentrator, with salinity in the open water void increasing over time, however this is dependent on the composition and mobility of the salts.

The tree planted void option would involve extensive tree planting within the shaped void following the emplacement of overburden in Carrington Pit. Species with high evapotranspiration rates would be selected in order to maintain the void water level below ground level. The advantage of this approach is that while the overall salt load of the groundwater in the final void will remain the same across both options, the tree planted void would result in a lower rate of evaporative concentration of the salts.

The long term water recovery level is shown in Figure 2.2 in the context of the two final void design options for Carrington Pit.

The equilibrated level of approximately 40mAHD to 45mAHD is 25m below the elevation of the crests of the barrier walls (at 65mAHD) and up to 20m below the prevailing Hunter River level (58 to 60mAHD). This long term recovery level results from a combination of processes including direct rainfall to the final void, rainfall infiltration-percolation through overburden within the pit void, regional groundwater seepage toward the void from the underlying coal measures, and evaporative losses from the open water surface.

The Director-General's Assessment Report for the *Carrington Pit Extended SEE* (ERM 2005) identified the tree planted void as the preferred option, warranting further assessment. Accordingly, a Final Void Management Plan (FVMP) will be prepared for Carrington Pit five year prior to the cessation of mining, the completion of mining of Carrington West Wing in this case, in accordance with Condition 28 Schedule 4 of DA 450-10-2003. The FVMP will assess locations, designs and final land use options in detail. The plan will be prepared in consultation the Department of Primary Industries – Division of Resources and Energy and NOW (now Office of Water), and to the satisfaction of the Director-General (now Secretary) and will be integrated with the HVO Water Management Plan (WMP) and Rehabilitation Management Plan.



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Approved Carrington Pit final void options
Hunter Valley North Operations – Modification 6
Environmental Assessment
Figure 2.2

2.4 Processing and fine rejects management

2.4.1 Overview

A brief overview of HVO's ROM coal processing and fine reject management process is provided below and shown in Figure 2.3.

ROM coal contains overburden and interburden material from above and below the target coal seams. The coal washing process in the CHPPs processes the ROM coal to generate reject material. Two forms of reject material are produced; coarse and fine. The coarse material is hauled to active overburden emplacement areas, whilst the fine reject material is pumped via pipelines as slurry from the CHPP to fine reject emplacement facilities.

The current fine reject disposal strategy satisfies the predicted storage requirements until the end of the current development consent period by utilising approved and constructed facilities: Dam 6, North Void and Cumnock Void, the approved but not yet constructed COOP FRE and proposed facilities that are yet to be approved; including the CIP FRE facility. The Cumnock Void is operated under a Joint Facility Agreement with Glencore.

All fine reject emplacement facilities are capped and rehabilitated at completion of filling. The main elements of closure and rehabilitation are:

- reducing the deposition rate (towards end of filling) to provide for development of a fine reject crust up to 5m thick to support closure activities;
- water management during operation and for a period of time following the completion of filling – to allow the facility to dry, increasing the strength of the surface crust to support capping activities;
- placement of layers of inert fill material (capping), typically mine overburden; and
- rehabilitation.

i Fine reject emplacement

Emplacement of fine reject within the approved HVO facilities is managed on a day to day basis by HVO CHPP personnel under the direction of the CHPP manager, in accordance with the Coal & Allied Operational and Assistance Manual (Coal & Allied 2013) and requirements from the NSW Dam Safety Committee.

Fine reject is deposited from discharge points (via relocatable pipes extending from the CHPP) on the crest of the main embankment of the emplacement facilities (usually at more than one location). Deposition points within the emplacement facility are not necessarily operated simultaneously, but may be alternated as required to control the beach profile. This process is described further in Section 3.2.3 for the proposed modification.

ii Decant water management

Fine reject emplacement facilities generally incorporate a decant pond, usually down gradient of the initial deposition locations. The decant pond acts as a collection point for excess water from the fine reject slurry that is not lost via evaporation. Decant water control infrastructure is near the decant pond with the system comprising relocatable pump off-takes and return water pipelines.

The aims of the decant water management system are:

- to maximise the return of the decant water to the CHPP for use as process water;
- to minimise the volume of water within the fine reject emplacement. This results in maximisation of the fine reject emplacement surface area and hence maximisation of density. This in turn maximises the useable volume within the storage during the life of the facility;
- to minimise the loss of decant water as seepage into overburden material; and
- to ensure acceptable stability conditions within the facility embankment and overburden, by maintaining a low seepage surface.

The level of the decant pond is monitored visually on a regular basis as part of the routine inspections carried by CHPP personnel.

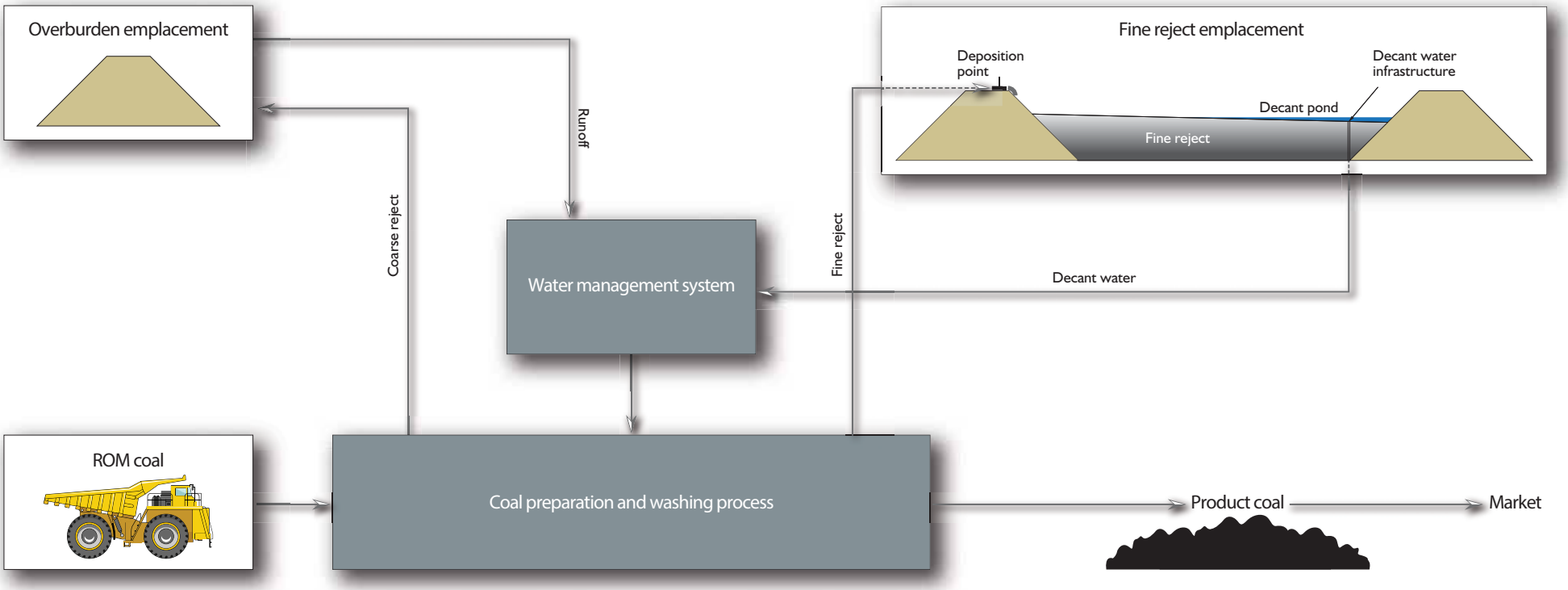
2.4.2 Management and monitoring

i Management

The management of fine reject at HVO is well understood and guided by the following management plans, guidelines and policies:

- HVO North MOP;
- HVO Life of Mine Fine Reject Management Strategy (ATC Williams 2015); and
- internal Rio Tinto standards across environment, health and safety, including but not limited to:
  - RTCA Standard – Management of Tailings and Water Facilities;
  - HVO Slope and Dump Management Plan;
  - HVO Water Management Plan;
  - HVO Dam Safety Emergency Response Plan;
  - HVO Dumping and Tipping Guidelines;
  - Design, Construction and Operational Reports (for individual facilities); and
  - Annual Surveillance Reports (for individual facilities).

The approach to management is consistent with the provisions of NSW *Work Health and Safety (Mines and Petroleum Sites) Act 2013*.



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ROM coal processing and fine reject management
Hunter Valley North Operations – Modification 6
Environmental Assessment
Figure 2.3

ii Monitoring

Monitoring requirements for fine reject emplacement facilities at HVO include collecting data necessary for the day-to-day operation of the facility. More generally, this data enables compliance against the intent of the design to be measured. The data also forms part of the input for the annual inspection, as required in the Operational and Assistance Manual, Coal & Allied 2013, to ensure that the facility is developing as intended, as well as providing a basis for the development of strategies to rectify departures from expectations, if required.

Monitoring includes:

- weekly estimation of the fine reject surface level (with daily visual inspection as previously noted);
- weekly monitoring of the decant water pond level and location;
- weekly monitoring of the water level in nearby identified bores; and
- quarterly surveying of the settlement monitoring points.

2.5 Environmental management

Environmental aspects of the integrated operations at HVO are managed under Rio Tinto Coal Australia's accredited ISO 14001 Environmental Management System (EMS) which forms part of the HSEQ Management System.

The HSEQ Management System enables the operations to apply specific tools that support the implementation, execution and effectiveness of the Rio Tinto health, safety, environmental and community performance standards.

The HSEQ Management System is designed on the principles of continuous improvement and generally follows the layout of common international standards (including ISO14001) and the Plan, Do, Check and Review cycle:

- Plan – identify what is required;
- Do – implement the activities;
- Check – monitor performance through checking and corrective action; and
- Review – evaluate the suitability, adequacy and effectiveness of the system through the management review.

The EMS relies upon an environmental policy, a series of regulatory required management plans, a monitoring programme and environmental standards and procedures. The EMS forms the basis for rigorous and consistent environmental management. It is regularly internally and externally audited to assess environmental performance. The effectiveness of the system has been demonstrated through these audits, which have shown a consistent trend of environmental improvement throughout the business.

Environmental management at HVO North is undertaken in accordance with a number of approvals, licences, policies and procedures, including, but not limited to:

- development consent DA 450-10-2003;
- Environment Protection Licence (EPL 640);
- water licences;
- various mining authorities;
- MOPs;
- various environmental management plans; and
- dam licences.

As per existing policies and procedures, an extensive air quality, noise and vibration, surface and groundwater monitoring network supports environmental management at HVO. Two real-time meteorological stations are also at HVO: HVO Corporate Meteorological Station and the Cheshunt Meteorological Station.

Independent environmental audits are undertaken every three years to assess the environmental performance of the development and determine whether it is complying with the requirements of the development consent and any other relevant approvals, EPLs and mining leases, including any assessment, plan or programme required under these approvals. The audits also review the adequacy of any strategy, plan or programme required under the above mentioned approvals and recommend measures or actions to improve the environmental performance of the development and/or any strategy, plan or programme. The audits are to be conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Director-General (now Secretary) and include consultation with relevant agencies.

An annual review is produced each calendar year in accordance with the existing consent conditions. The operations environmental performance with respect to the relevant monitoring requirements is documented in the annual review and made available to the community on the Rio Tinto Coal Australia website.

3 Proposed modification

3.1 Introduction

This chapter describes the proposed modification of DA 450-10-2003 to enable the continued practical and efficient storage and management of fine reject at HVO North. The proposed modification seeks the emplacement of fine reject within the approved Carrington Pit void (to be known as the CIP FRE), which is consistent with the current HVO Life of Mine Fine Reject Management Strategy.

As discussed in Section 1.4, the Carrington Pit void is currently approved to be filled with overburden. The proposed modification seeks to fill the void with fine reject rather than overburden. The overburden approved for emplacement in Carrington Pit is able to be accommodated in existing approved overburden emplacements elsewhere at HVO and will not lead to an increase in emplacement heights above what is already approved. The commissioning of the proposed CIP FRE will be completed within the existing development consent period, which is currently to 2025.

As shown in Table 3.1, there are no other changes to DA 450-10-2003 under the proposed modification.

Table 3.1 Overview of the proposed modification

Project element	Current approval	Proposed modification
ROM coal extraction limit	22 million tonnes per annum (Mtpa) ROM coal (Carrington Pit = 10Mtpa ROM coal)	No change
Project approval period	Up to June 2025	No change
Operating hours	Seven days per week, 24 hours per day	No change
Number of employees	Approximately 1,500	No change
Mining methods	Dragline; and truck and shovel	No change
Mining areas	As per approved disturbance boundary	No change
Infrastructure	As detailed in original EIS and subsequent modifications	No change
Coarse reject	Ability to emplace coarse rejects within overburden emplacement areas across HVO	No change
Fine reject	Approved and integrated fine reject management with HVO South	No change to integrated management with HVO South Emplacement of fine rejects in the approved void within Carrington Pit
Water	Approved and integrated water management with HVO South Approved water transfers with other mining operations	No change
External coal transport	Transport of coal via rail	No change

3.2 Carrington in-pit fine reject emplacement

3.2.1 Overview

The management of fine reject at HVO is well understood and guided by a number of management plans, guidelines, policies and the development consent. As discussed in Section 2.3, the emplacement and decanting processes are managed on a day to day basis in accordance with the Coal & Allied Operational and Assistance Manual (Coal & Allied 2013) and requirements from the NSW Dam Safety Committee. Further, monitoring requirements for fine reject emplacement facilities at HVO include collecting data necessary for the day-to-day operation of the facility.

The proposed CIP FRE will fill the existing void within Carrington Pit with fine reject, rather than overburden. The fine reject will be supplied predominantly from the HVCHPP via existing and available infrastructure (such as pipelines) within previously disturbed areas, with additional fine reject supplied by the HCHPP, should the integrated HVO fine reject management system require it. The proposed emplacement will hold approximately 12.6 million bulk cubic metres (BCM) of fine reject, up to a maximum height of 38mAHD where it will be capped and rehabilitated. The proposed CIP FRE has been designed to enable the operation of the evaporative sink, as approved.

As described in Section 2.3, a final void is approved within Carrington Pit upon completion of mining. The final void will be an evaporative sink comprising a maximum surface area of 100ha with long-term water recovery level equilibrium of 40mAHD with two options for final void design post-closure. As noted in Section 2.3.2, a FVMP will be prepared for Carrington Pit to further assess design and management options five years prior to the cessation of mining in the Carrington West Wing extension. However, final void design and management options may be assessed in detail in an EIS to accompany a future development application or, should it come first. The proposed modification to emplace fine reject, rather than overburden, does not change the void's function as an evaporative sink.

The commissioning and operation of the proposed emplacement would commence as soon as it is available, should it be approved, and be completed within the existing development consent period.

3.2.2 Commissioning

The proposed CIP FRE requires the construction of an embankment within the pit to separate the fine reject from the highwall of Carrington Pit. The embankment will be comprised of overburden sourced from current stockpiles at HVO North and constructed to ensure its and stability. The embankment ensures the fine reject are not in contact with the exposed highwall.

Over time the emplaced fine reject will dry and result in a consolidation of material restricting available drainage paths and movement of water within the emplaced fine reject. The nature of the materials used for the embankment will allow for infiltration of water and its movement through available drainage paths at the base of the embankment to the base of the pit, rather than rising up through the deposited fine reject as it is settling and consolidating through the drying process. This water will enter the mine water of the HVO WMS and be pumped back to the CHPP for reuse. The embankment also maintains potential future access to the adjacent coal measures within the highwall should mining these previously non-mined locations at the northern and eastern ends of the pit (ie mining away from the Hunter River) become viable in the future.

3.2.3 Operation

The proposed CIP FRE will operate as a settling pond, primarily under the principle of gravity settlement. A slurry mixture of fine reject and water will be fed from HVCHPP to the emplacement via a pipeline.

The fine reject will be deposited via deposition points; nominally at the northern end of the Carrington Pit void, with deposition building up on the pit floor creating the 'beach'. The water will continue down the north-south gradient and accumulate at the southern extent of the void, in a decant pond. The water in the decant pond will be pumped out to other dams at HVO North, and re-used within the CHPPs as part of the HVO WMS. The exact position of deposition and decant water points will be determined as part of a detailed engineering design prior to construction of the facility.

Emplacement activity may alternate between deposition points to ensure the creation of an even beach. These deposition points will initially be a short distance above the pit floor. As the fine reject accumulates and consolidates and the beach grows and strengthens, the discharge points will be moved up the embankment in stages, as the northern extent of the beach is raised, until it reaches approximately 38mAHD.

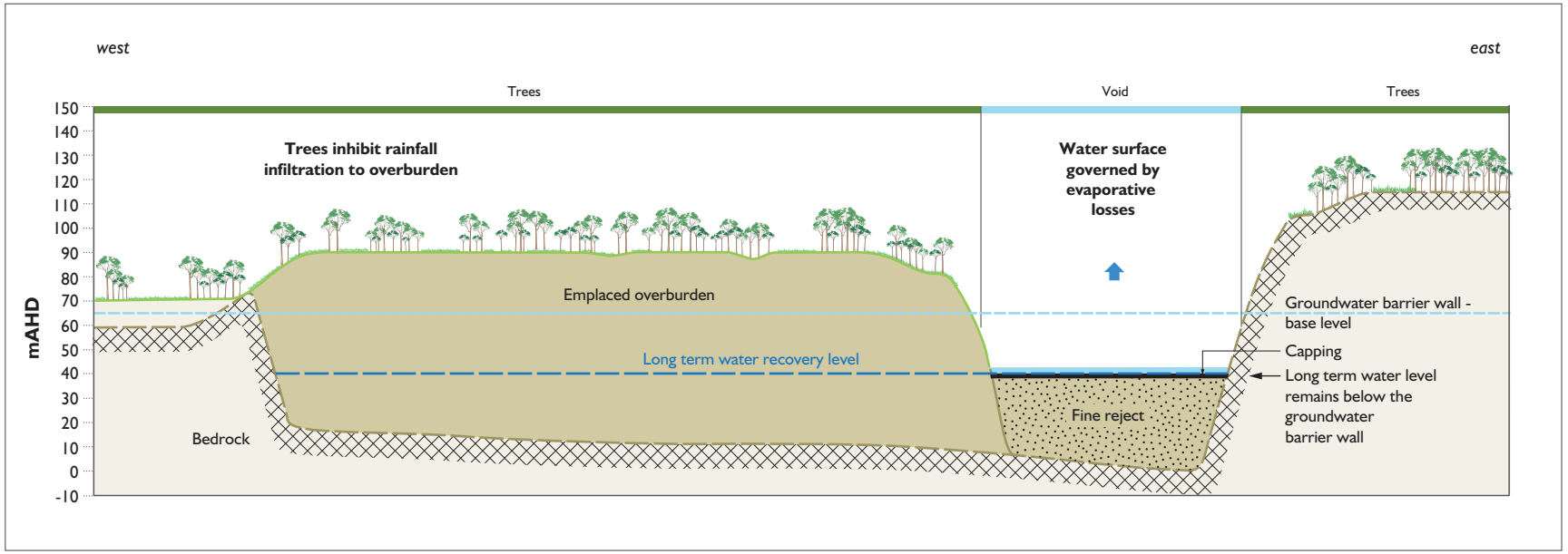
The southern extent is designed to reach approximately 35.5mAHD, leaving a beach slope of approximately 1.5 per cent. At this time the remaining water will travel down gradient and continue to be decanted from the emplacement, leaving the fine reject to air dry over time. This estimate will be confirmed during operation of the facility.

Ongoing monitoring will determine when the emplacement is dry and stable. Following this, the proposed CIP FRE will have at least 2m of capping material at the northern end (near the deposition points) and up to 6m at the southern extent; to create the approved final landform. The capping material will be drawn from either surrounding dumps or the Carrington out-of-pit emplacement area (which currently stockpiles capping material for the surrounding dams). Indicative cross-sections of proposed CIP FRE showing operation, capping and rehabilitation are provided in Figure 3.2.

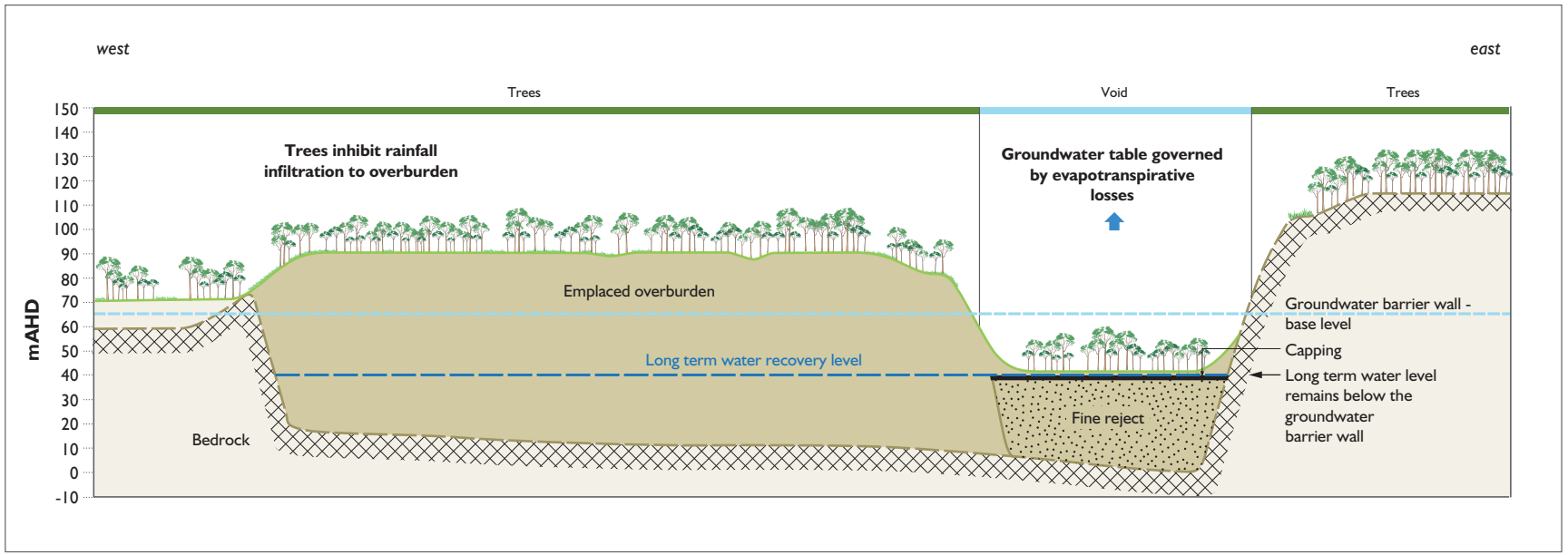
3.2.4 Rehabilitation

As noted in Section 3.2.1, following capping of the proposed CIP FRE the area will be rehabilitated to enable operation of the evaporative sink, as approved. Rehabilitation will generally be in accordance with either of the two final void options approved as part of the Carrington Pit Extended Project (ERM 2005). These options are shown in Figure 3.1.

Modelling predictions indicate groundwater levels within the final void (including the emplaced material) will recover to equilibrium over a period of more the 100 years (MER 2005). Interim rehabilitation, primarily the planting of appropriate groundcover will be undertaken to ensure that optimal environmental outcomes can be achieved over the recovery period.



OPEN WATER VOID



TREE PLANTED VOID

KEY

- Grassland rehabilitation area (with trees)
- Void

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Carrington Pit final void with fine reject emplacement
Hunter Valley North Operations – Modification 6
Environmental Assessment
Figure 3.1

As stated in Section 2.3.2, DP&E has requested further investigation of the treed void design within the FVMP at least 5 years prior to mining ceasing in Carrington Pit (DPI 2006). The proposed change of material emplaced within Carrington Pit void does not alter the final void post-closure design options to be investigated within the FVMP.

For the treed void design, tree planting would be undertaken using species with high transpiration rates to maintain the void water level below ground level. Due to the capping layer being established just above the long term water recovery level, it is likely that the void will experience some rising of water into the root zone as well as temporary inundation from surface flows. Species selected would need to be tolerant of these conditions.

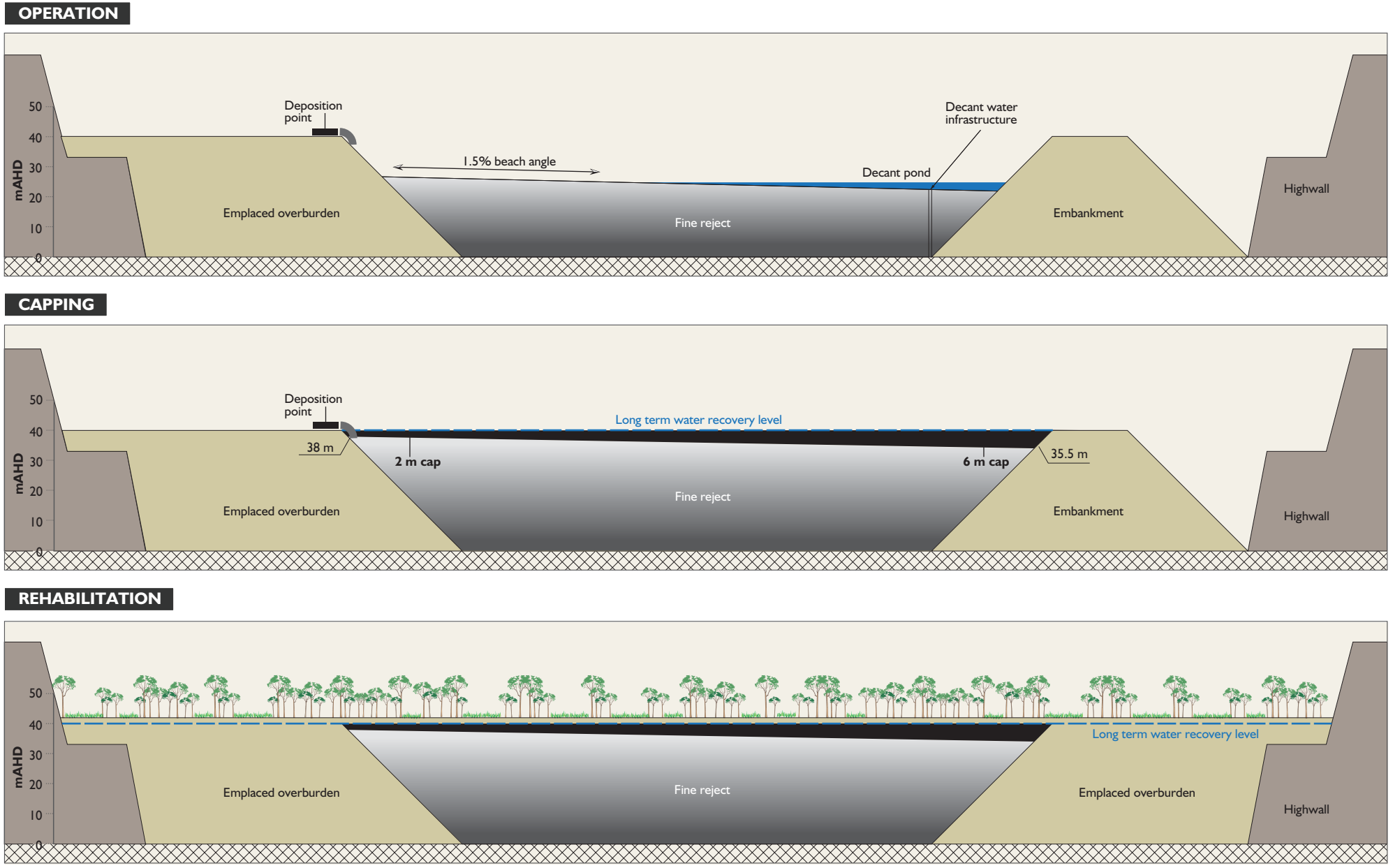
Species such as *Eucalyptus camaldulenis* (also known as River Red Gums), which are found in the local area, possess deep sinker roots which grow towards zones of higher water supply, and are very effective conductors of water (CSIRO 2004) may be suitable. Soils regularly inundated or saturated with groundwater are usually low in oxygen. Seedlings have the capability to develop adventitious roots and aerenchymatous tissue, which is a spongy tissue that forms air channels in the leaves, stems and roots that allows oxygen to move from the leaves to the roots (Scunthorpe 1967, Heinrich 1990 and MESA 1999). These high transpiration rate species are salt tolerant with the *Eucalyptus camaldulenis* (or River Red Gums) moderately tolerant of salinity between 8 to 16dS/m (or TDS of 12,800mg/L) (DPI and UNE 2010).

Material placed within the void (capping material and fine reject) will interact with water flows over time and accumulate within evaporative sink within the final void. The capping material for the proposed CIP FRE will be sourced from overburden. Analysis of HVO North soil samples demonstrate that the soil has low natural salinity with electrical conductivity ranging from 0.05 to 0.92 dS/m, or total dissolved solids (TDS) of 32mg/L to 589mg/L, for West Pit (ERM 2003) and 0.05 to 1.10 dS/m, or TDS of 32mg/L to 704mg/L for Carrington Pit (ERM 2005).

The average salinity of water within spoil, fine reject and Permian coal measures is moderately saline (AGE 2016). Spoil water has an average TDS of 5,242mg/L, fine reject water is 6,446mg/L, coal is 6,405mg/L and interburden is 5,873mg/L. The long term salinity predictions within the void range from 1,000mg/L increasing to about 3,000-4,000mg/L TDS (MER 2010). The measured salinity within the soil and water quality samples at HVO and the long term void water quality indicate that species with high transpiration rates and tolerance for salinity such as the *Eucalyptus camaldulenis* may be suitable for the treed void design, however further detailed investigations are required to ensure the viability of this final void design in the longer term. This is consistent with the DPE assessment report for the Carrington Pit Extended SEE (DPE 2006):

> An evapotranspiratory solution to mine void salinisation problem offers long term benefits to both the environment and the community (ie inter-generational benefits). The Department accepts that insufficient research has been done to date to support firm adoption of the second option as the preferred solution at Carrington.

Consequently, Coal & Allied will provide further detail regarding final void design and management as part of the FVMP in accordance with Condition 28 of DA 450-10-2003, or an EIS accompanying a future development application involving Carrington Pit, whichever is sooner.



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Conceptual cross-section of proposed fine reject emplacement
Hunter Valley North Operations – Modification 6
Environmental Assessment
Figure 3.2

3.3 Alternatives considered

3.3.1 Overview

The need for the modification, as described in Section 1.4, is driven by the requirement for economically viable fine reject storage capacity at HVO to enable the continued processing of ROM coal and hence, the continuation of mining operations for the remainder of the development consent period.

As outlined in Section 1.4, HVO has approval for the construction and operation of the COOP FRE. Although the COOP FRE remains part of the planned LOM integrated management of fine reject at HVO, its development has been deferred due to high construction costs. With the deferment of the COOP FRE, the proposed modification seeks to emplace fine rejects within Carrington Pit final void, bringing this storage facility on line earlier than originally anticipated in the HVO Life of Mine Fine Reject Management Strategy.

Following the analysis demonstrating that construction of the COOP FRE is not economically viable in the current economic climate, the construction of an in-pit fine reject emplacement within West Pit was examined. This option was discounted due to the inability of the West Pit operation to advance sufficiently for the in-pit fine reject facility not to impede the existing approved operations.

As previously discussed, the management of coarse and fine rejects is integrated across HVO. The potential to use approved fine rejects storage capacity at HVO South was also investigated. The use of Eastern Riverview TSF, Glider Club TSF and South Lemington TSF for fine reject disposal is approved (ERM 2008) and would be able to contribute to storage capacity requirements. These facilities are not currently active and would be primarily for the disposal of fine reject generated by the Lemington CHPP (approved, not yet constructed). The use of the South Lemington Pits 1 or 2 as additional storage capacity for the fine reject was also discounted due to the mine schedule and these voids not being available within the required timeframe.

The proposed CIP FRE is the preferred design option. It is contemplated in the current HVO Life of Mine Fine Reject Management Strategy, the method of emplacement has consistently been successfully implemented at HVO, and it optimises the use of Carrington Pit void and requires no additional disturbance.

3.3.2 Do-nothing option

As described above, there are no alternative economically viable options for fine reject emplacement. Fine reject emplacement capacity is critical to the viability of the HVO North, and HVO as a whole. As such, the do nothing option could lead to the cessation of mining activity at HVO.

4 Legislative considerations

4.1 Introduction

This chapter describes the relevant Commonwealth and State legislation and regulatory framework under which the proposed modification has been assessed and will be determined. Given the limited scope of the proposed modification, only pertinent considerations are described.

4.2 NSW legislation

4.2.1 Environmental Planning and Assessment Act 1979

While the development consent for HVO North was a consent issued under Part 4 of the EP&A Act, transitional provisions within the NSW *Environmental Planning and Assessment Regulation 2000* (NSW) (EP&A Regulation) allow for a consent to be modified under Section 75W of the EP&A Act as if the consent were an approval under the now repealed Part 3A.

Pursuant to the transitional provisions under clause 12 to Schedule 6A of the EP&A Act, Section 75W of Part 3A continues to apply to modifications of certain development consents provided for under Clause 8J(8) of the EP&A Regulation.

Clause 8J(8)(c) of the EP&A Regulation states:

> For the purposes only of modification, the following development consents are taken to be approvals under Part 3A of the Act and section 75W of the Act applies to any modification of such a consent:
>
> c) a development consent granted by the Minister under Part 4 of the Act (relating to State significant development) before 1 August 2005 or under clause 89 of Schedule 6 to the Act,

DA 450-10-2003 was issued by the then Minster for Infrastructure, Planning and Natural Resources in 2004, under Part 4 of EP&A Act, and therefore, Clause 8J(8)(c) applies.

The main elements of the approved development and operations at HVO North will not be affected by the proposed modification. The proposed modification does not represent a radical transformation of the previously approved project, in effect it is change to the material emplaced within the void. Further, as demonstrated by the assessments in Chapters 7 and 8, the proposed modification will not result in significant environmental impacts beyond those previously assessed and approved in the current development consent. Accordingly, Coal & Allied seeks to have the proposal approved as a modification of DA 450-10-2003, as provided for under Clause 8J (8)(c) of the EP&A Regulation and Section 75W of the EP&A Act.

4.2.2 Other state legislation

Table 4.1 summarises other NSW legislation that is of relevance to the proposed modification.

Table 4.1 Summary of other applicable legislation

Legislation	Requirement	Comment
Protection of the Environment Operations Act 1997 (NSW) (POEO Act)	Section 48 of the POEO Act requires that a premises-based EPL be held for the activities listed in Schedule 1.	A premises-based EPL, EPL 640, applies across HVO as a whole. No update to the EPL will be required as a consequence of the proposed modification.
Mining Act 1992 (NSW)	This Act regulates the granting of Mining Leases and mining activities generally and, amongst other legislative instruments, places controls on methods of exploration and mining, the disposal of mining waste, and rehabilitation and environmental management activities.	The following titles are held by HVO and cover the project area: CML4, ML1474, ML1482. In line with Section 6 of the Mining Act, the proposed modification will be undertaken in accordance with authorisations in force in respect of the land where the proposed modification will occur. The HVO North MOP will be reviewed and updated as required to incorporate the proposed modification.
Water Management Act 2000 (NSW) *(WM Act)*	The WM Act governs the issue of new water licences and the trade of water licences and allocations for those water sources (rivers, lakes and groundwater) in NSW where water sharing plans have commenced, such as within the project area.	The proposed modification will not affect any water source regulated by a Water Sharing Plan in force under the WM Act 2000.
National Parks and Wildlife Act 1974 (NSW) (NPW Act)	A permit under Section 87 or a consent under Section 90 of the Act is required to disturb or destroy an Aboriginal object.	No Aboriginal objects are assessed to be disturbed or destroyed under the proposed modification.
Threatened Species Conservation Act 1995 (NSW) (TSC Act)	If a planned development or activity will have an impact on a threatened species, population or ecological community listed under the Act, this must be taken into account in the development approval process.	No threatened species, population or ecological community is assessed as being impacted under the proposed modification.
Dams Safety Act 1978 (NSW)	The Act requires that the NSW Dam Safety Committee periodically review large dams that may constitute a hazard to human life and property. These dams are prescribed dams and are to be designed to the satisfaction of the NSW Dam Safety Committee.	Whilst in-pit fine reject emplacement presents a low safety risk, consultation with NSW Dam Safety Committee will be undertaken as part of the approvals process to determine if the CIP fine reject emplacement will be a prescribed dam.

4.2.3 Singleton Local Environmental Plan 2013

The site is zoned RU1 Primary Production under the *Singleton Local Environmental Plan 2013*. Notwithstanding clause 7(1)(b) of the Mining SEPP, open cut mining is permissible with development consent within this zone. The proposed modification is consistent with the RU1 zone objectives which are:

- to encourage sustainable primary industry production by maintaining and enhancing the natural resource base;
- to encourage diversity in primary industry enterprises and systems appropriate for the area;
- to minimise the fragmentation and alienation of resource lands; and
- to minimise conflict between land uses within this zone and land uses within adjoining zones.

4.2.4 Upper Hunter Strategic Regional Land Use Plan

The Upper Hunter Strategic Regional Land Use Plan (DP&I 2012) (the Plan) aims to minimise potential land use conflict between mining and coal seam gas proposals and key land values such as strategic agricultural land. The Plan includes a gateway process for State significant development applications for mining on biophysical strategic agricultural land. This gateway process takes place prior to submission of development applications to the consent authority and is conducted by an independent panel of experts (Mining and Coal Seam Gas Gateway Panel). The Plan excludes the requirement for gateway certification provided the project area is entirely within an existing mining lease. As the entire project area is within existing lease areas (refer to Table 4.1), the proposed modification is exempt from the gateway process.

In accordance with the Plan, an Agricultural Impact Statement (AIS) is required for all State significant development applications for mining proposals in the region that would potentially impact on agricultural resources or industries. The proposed modification will not impact on agricultural resources or industries and, accordingly, an AIS has not been prepared for the proposed modification.

4.2.5 NSW Aquifer Interference Policy

The *NSW Aquifer Interference Policy* (AIP) clarifies the requirements for obtaining water licences for aquifer interference activities under NSW water legislation including the Water Act and WM Act. The AIP considers and defines minimal harm criteria for productive and less productive aquifers. The AIP is associated with the *Strategic Regional Land Use Policy*, discussed above.

The proposed modification does not constitute an aquifer interference activity and, therefore, the AIP does not apply (refer to Chapter 7).

4.3 Commonwealth legislation

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) aims to protect Matters of National Environmental Significance (MNES), namely:

- world heritage properties;
- places listed on the National Heritage Register;
- Ramsar wetlands of international significance;

- threatened flora and fauna species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- actions of development for coal seam gas or large coal mining on water resources.

If an action will, or is likely to, have a significant impact on any matters of MNES (known as a controlled action), then the action must be referred and approved by the Commonwealth Environment Minister or the Minister's delegate before that action is taken. To determine whether a proposed action would or is likely to be a Controlled Action, an action may be referred to the Department of the Environment and Energy (DoEE). The proposed modification is limited to a change in material to be emplaced in the final void of Carrington Pit, and will not be a controlled action. Therefore, referral to the DoEE is not required.

5 Stakeholder engagement

5.1 Introduction

Coal & Allied's approach to community and stakeholder engagement is focused on building enduring relationships based on mutual respect, active partnership and long term commitment. This is achieved through engaging in meaningful consultation and dialogue with stakeholders to better understand their positions, aspirations, concerns and avoiding or mitigating potential impacts.

An ongoing stakeholder engagement strategy is in place for HVO. The key goals of the strategy are to:

- ensure timely provision of relevant and clear information on HVO's activities, including development changes;
- create a process that encourages stakeholders to express their views and ensure these are considered; and
- provide timely feedback on any matters raised.

Engagement tools implemented by the proponent on an ongoing basis include:

- a freecall information line (1800 727 745) to provide the community with the opportunity to provide feedback or gather information relating to Coal & Allied's operations in the Hunter Valley;
- Rio Tinto Coal Australia's website (www.riotintocoalaustralia.com.au) which contains information on mine operations and management, environmental monitoring results, project applications, community investment and engagement and contact details;
- advertorials in the Singleton Argus and Hunter Valley News which provide information on Coal & Allied's mining operations, including the upcoming projects;
- HVO's Community Consultative Committee (HVO CCC) which is used to discuss mining operations and environmental performance, and comprises representatives of the community, Singleton Council and Coal & Allied;
- one on one engagements with near neighbours on activities that may directly or indirectly affect them;
- community BBQs and information sessions to provide local communities with operational updates, project applications and provide an avenue for community feedback;
- regular letters to residents in the areas surrounding HVO which include updates on HVO's activities, environmental results and community programmes; and
- regular formal and informal updates to HVO employees from the general manager and site leaders.

As outlined in the subsequent sections, consultation has been, and will continue to be supplemented by activities that relate specifically to the proposed modification. The nature and extent of these stakeholder consultation activities reflect the nature and scale of the proposed modification and its potential impacts.

5.2 Consultation with government

The proponent has engaged with the DP&E regarding the proposed modification and the scope of the assessment to be undertaken. Meetings were held in September and October 2016. Items discussed during the consultation process included the public exhibition submission process, groundwater assessments and preferred final land use.

5.3 Consultation with community and special interest groups

As noted above, community consultation for HVO North is ongoing. Information specific to the proposed modification will be publicised through the channels under the strategy outlined above and also presented on Rio Tinto Coal Australia's website (www.riotintocoalaustralia.com.au) and presentations related to the proposed modification were made to the HVO CCC in October 2016.

The community will also be notified of the proposed modification through an advertisement placed in a local newspaper following lodgement, and through the public exhibition process where community members will be invited to comment and provide feedback either directly to Coal & Allied or through DP&E.

6 Environmental risk assessment

6.1 Methodology

An environmental risk assessment was undertaken for the proposed modification, using two variables, namely:

- the potential severity or consequences of the environmental impact; and
- the likelihood of that impact occurring.

The variables were evaluated for the construction and operation of the proposed modification assuming that appropriate mitigation measures would be in place.

The following definitions were applied.

- Severity or consequences of impact:
    - **Minor:** Near-source confined and promptly reversible impact on-site with little or no off-site impact expected.
    - **Medium:** Near source confined and short-term reversible impact on-site with little, promptly reversible, off-site impact.
    - **Serious:** Near-source confined and medium-term recovery impact on-site with near-source and short-term reversible off-site impact.
    - **Major:** Impact that is unconfined and requiring long-term recovery, leaving residual damage on-site with near-source confined and medium-term recovery of off-site impacts.
    - **Catastrophic:** Impact that is widespread and unconfined and requiring long-term recovery, leaving major residual damage on-site with off-site impact that is unconfined and requiring long-term recovery and leaving residual damage.
- Likelihood of impact:
    - **Rare:** Impact that is very unlikely to occur during the lifetime of the project.
    - **Unlikely:** Impact that is unlikely to occur during the lifetime of the project.
    - **Possible:** Impact that may occur during the lifetime of the project.
    - **Likely:** Impact that may occur frequently during the lifetime of the project.
    - **Almost Certain:** Recurring event during the lifetime of the project.

Table 6.1 below shows the risk matrix used to identify environmental risks associated with the emplacements. In each case, a score of 1 to 5 is given for the consequence and likelihood of impact and the scores are added to determine the environmental risk rating. There are four classes of environmental risk utilised in this assessment, as indicated below.

- **Low:** Risks that are below the risk acceptance threshold and do not require active management. Certain risks could require additional monitoring.
- **Moderate:** Risks that lie on the risk acceptance threshold and require active monitoring. The implementation of additional measures could be used to reduce the risk further.
- **High:** Risks that exceed the risk acceptance threshold and require proactive management. Includes risk for which proactive actions have been taken, but further risk reduction is impractical.
- **Critical:** Risks that significantly exceed the risk acceptance threshold and need urgent and immediate action.

Table 6.1 Environmental assessment matrix

Likelihood of Impact	Consequence					
	1 Minor	2 Medium	3 Serious	4 Major	5 Catastrophic
5 Almost Certain	6 (Moderate)	7 (High)	8 (Critical)	9 (Critical)	10 (Critical)
4 Likely	5 (Moderate)	6 (High)	7 (High)	8 (Critical)	9 (Critical)
3 Possible	4 (Low)	5 (Moderate)	6 (High)	7 (Critical)	8 (Critical)
2 Unlikely	3 (Low)	4 (Low)	5 (Moderate)	6 (High)	7 (Critical)
1 Rare	2 (Low)	3 (Low)	4 (Moderate)	5 (High)	6 (High)

6.2 Risk ratings

The results of the risk assessment for the proposed CIP FRE are provided in Table 6.2. The risk ratings assume application of standard mitigation and were derived by considering the proposed CIP FRE and how it would affect the environmental attributes listed in the table in terms of the likelihood and consequences of its impacts on those attributes.

Table 6.2 Environmental risk rating

Environmental attribute	Consequence	Likelihood	Rating
Groundwater			
Impact on groundwater quality	2	3	5 (Moderate)
Impact on long term recovery levels	1	1	2 (Low)
Surface water			
Impact on local watercourses and the Hunter River	1	1	2 (Low)
Biodiversity			
Impact on threatened flora species and their habitat	1	1	2 (Low)
Aboriginal heritage			
Impact on Aboriginal artefacts	1	1	2 (Low)
Impact on cultural heritage	1	1	2 (Low)
Acoustics			
Incremental noise impacts on residential receptors	1	1	2 (Low)
Cumulative noise impacts	1	1	2 (Low)
Air quality and greenhouse gases			
Incremental air quality impacts on residential receptors	1	1	2 (Low)
Cumulative air quality impacts	1	1	2 (Low)
Greenhouse gas impacts	1	1	2 (Low)
Soils and land capability			
Erosion and soil disturbance	1	1	2 (Low)
Impact on agricultural land	1	1	2 (Low)
Rehabilitation			
Changes to landform	1	1	2 (Low)
Visual amenity			
Impact from modified landform	1	1	2 (Low)
Socio-economic			
Impact on general amenity of residential receptors	1	1	2 (Low)
Economic impacts of proposed CIP fine reject emplacement	1	1	2 (Low)
Historic heritage			
Impact on historic heritage	1	1	2 (Low)
Traffic and transport			
Impact on local and regional road networks	1	1	2 (Low)

As shown in Table 6.2, all environmental risks from the proposed CIP FRE were considered low, with the exception of potential impact on groundwater quality. Environmental assessments of the environmental aspects have been undertaken commensurate with their risks. The groundwater assessment is provided in Appendix B, and with summary in Chapter 7. The remaining environmental attributes are assessed in Chapter 8.

7 Groundwater

7.1 Introduction

A groundwater assessment by Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) is presented in full in Appendix B. A summary of the assessment is provided below.

The proposed modification does not include any excavation of insitu material and has been designed to maintain the approved final landform within Carrington Pit. Under the proposed modification, the backfill material will change from overburden to fine reject. This change in backfill material will result in a change in hydraulic properties within the Carrington Pit final void.

The proposed modification does not involve any interference with an aquifer and does not result in an obstruction of flow that would affect the functioning of aquifers.

Based on the extensive knowledge of the site and subject matter, a qualitative assessment was conducted to identify the potential of the proposed modification to impact on water quality and water levels. The proposed modification will not impact upon groundwater users (private bores or groundwater dependent ecosystems) and an assessment of these was not required.

The existing groundwater regime at HVO is well understood with the assessment based on a review of extensive site data, previous studies conducted at site and surrounding areas, as well as relevant literature from academic sources. The review included:

- extensive water level and water quality data from Coal & Allied's surface water monitoring system, as well as the integrated groundwater monitoring network that comprises 283 monitoring points with data dating back to 2000;
- routine groundwater monitoring reports and annual groundwater reviews for HVO North and HVO South;
- previous groundwater assessments conducted at site and in the region, including (but not limited to):
    - *Hydrogeological Characterisation of coal measures and overview of impacts of coal mining on groundwater systems in the Upper Hunter Valley*, PhD thesis by Mackie (2009) that includes extensive field data and analysis specific to HVO North;
    - *Alluvial Lands Project Environmental Assessment* (1992), which includes a groundwater assessment conducted by MMA (1992);
    - *Carrington Pit Environmental Assessment* (1999), which includes a groundwater impact assessment with numerical groundwater modelling conducted by MER (1999);
    - *Carrington Pit Extended Environmental Assessment* (2005), which includes a groundwater impact assessment with numerical groundwater modelling conducted by MER (2005);
    - *Carrington West Wing Environmental Assessment* (2010), which includes a groundwater impact assessment with numerical groundwater modelling conducted by MER (2010);

- *Fine Reject Emplacement Environmental Assessment* (2013), which includes a groundwater impact assessment with numerical groundwater modelling conducted by AGE (2013); and

- *HVO South Environmental Assessment* (2008), which includes groundwater impact assessments with numerical groundwater modelling conducted by ERM (2008).

- scholarly articles relevant to the groundwater assessment (ie articles on fine reject properties).

7.2 Existing environment

7.2.1 Geology

HVO North is within the Sydney Basin which formed in the Late Carboniferous – Early Permian due to igneous rifting and crustal thinning, which resulted in the deposition of Permian and Triassic aged sedimentary sequences.

HVO extracts coal seams within the Permian aged Jerrys Plains Subgroup of the Hunter Coalfields. The Jerrys Plains Subgroup comprise economic coal seams, along with overburden and interburden consisting of sandstone, siltstone, tuffaceous mudstone and conglomerate. The Permian coal measures are stratified (layered) sequences that have undergone deformation resulting in strata dipping at a shallow angle of 2^{o} to 5^{o} to the south-west at HVO North. Regionally, the stratigraphy dips in a general south-westerly direction, towards the Hunter River from Carrington Pit void.

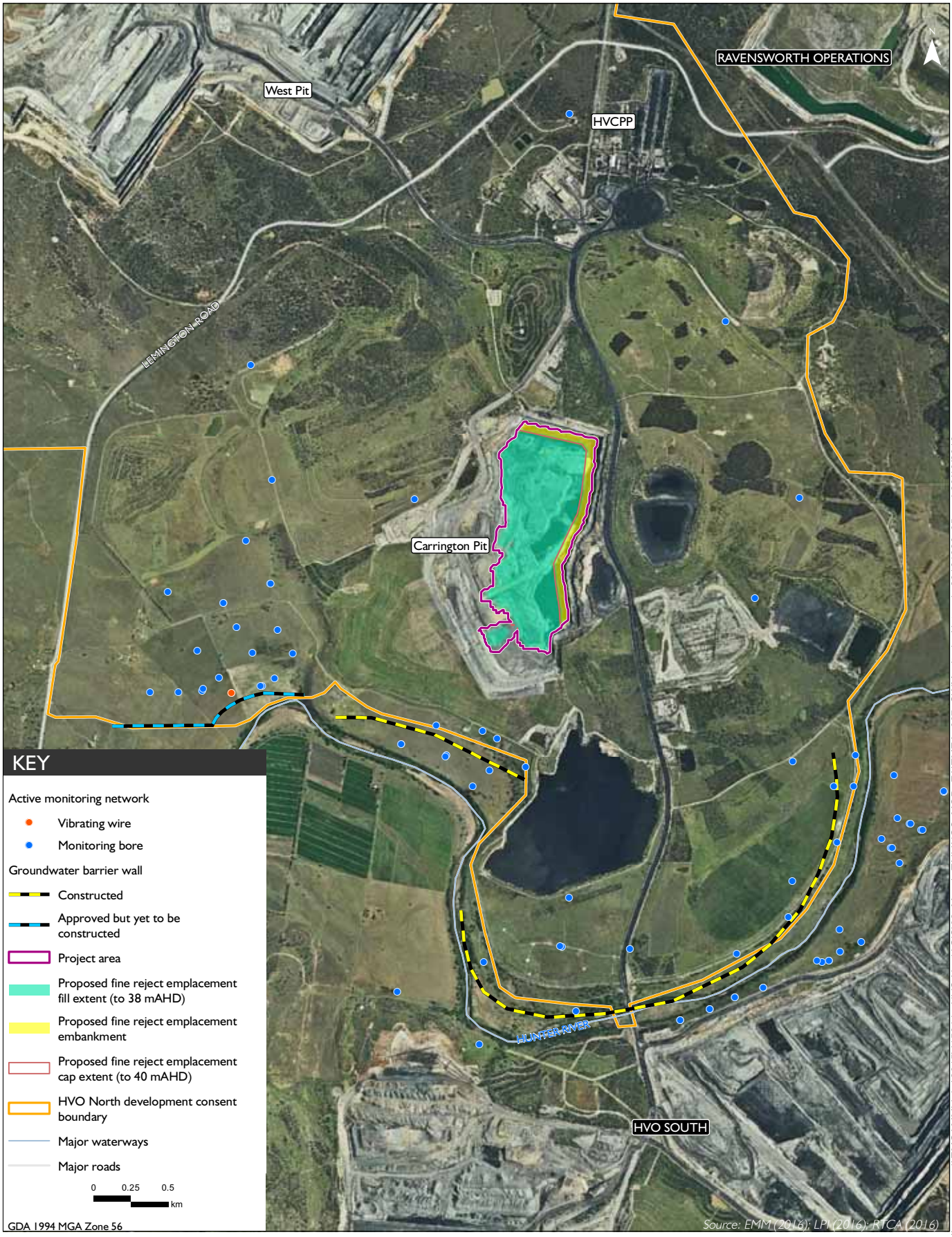
7.2.2 Palaeochannnel and groundwater barrier walls

Palaeochannel alluvium is present north of the Hunter River and south of the proposed modification. The alluvial palaeochannel is generally 12m to 20m thick and is comprised of unconsolidated gravels, silts and clays. Previous mining of Carrington Pit intersected the palaeochannel sediments to the west of the proposed modification. Palaeochannel sediments remain to the north of the backfilled Carrington Pit, but are isolated from the palaeochannel sediments to the south by the overburden backfilled within the Carrington Pit and a groundwater barrier wall. In addition, construction of the approved western Carrington West Wing barrier wall will add a further physical barrier between the palaeochannel alluvium and the Hunter River alluvium. These groundwater barrier walls are shown in Figure 7.1.

7.2.3 Hydrogeology

i Existing monitoring

The proponent established an extensive groundwater data network from the year 2000, which extends across HVO North and HVO South. The proponent currently monitors 155 bores and two VWP sensors, with an additional 126 monitoring points that are no longer monitored (due to the progression of operations) but have available historical data. The location of the current monitoring network in the vicinity of the project area is shown in Figure 7.1. As shown in Figure 7.1, there are 18 monitoring points within overburden (previously mined area) surrounding the proposed CIP FRE. There are also over 10 bores within the coal measures and over 20 bores within the alluvium along the barrier walls and palaeochannel, within approximately 2km of the proposed CIP FRE.



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COAL & ALLIED

Groundwater monitoring network at HVO

Hunter Valley Operations North – Modification 6
Environmental Assessment
Figure 7.1

ii Hydraulic parameters

Alluvium has a relatively high hydraulic conductivity, which ranges between $5.3x10^{-2}$m/day and $3.70x10^{2}$m/day. The coal seams are typically moderately to slightly permeable, with hydraulic conductivity readings generally around $1x10^{-2}$m/day, and ranging between $5.24x10^{-7}$m/day and 12m/day. The hydraulic conductivity of the interburden material is generally lower than coal but is highly variable, ranging between $1.87x10^{-7}$m/day and 1m/day, depending on the predominance of fractures in the rock mass.

The hydraulic conductivity of fine reject is generally recorded between $1.0x10^{-4}$m/day and $1.0x10^{-2}$m/day, which decreases with increased compaction/settlement (Aubertin *et al*, 1995; Wickland *et al*, 2010).

Recently emplaced overburden material records a high drainable porosity of around 20 per cent, and field tests of overburden at HVO North have estimated a hydraulic conductivity of between 0.7m/day and 1.6m/day (AGE, 2013; Mackie, 2009). Wickland *et al* (2010) also identified that the hydraulic conductivity of overburden material reduces with increased compaction, but to a lesser extent compared to fine reject.

The difference in hydraulic conductivity for fine reject and overburden material is largely due to consolidation behaviour and particle structure. The particle size of fine reject material recorded at HVO ranges between $3.8x10^{-2}$mm and 2mm, which is finer than overburden material that ranges from $1.0x10^{-1}$ mm to $2.0x10^{+3}$mm. These measurements roughly correspond with studies conducted by Wickland *et al* (2010), which gave a fine reject particle size range of $1x10^{-3}$mm and $5x10^{-2}$mm, and a overburden particle size range of $5x10^{-2}$mm and $5.0x10^{+1}$mm. In essence the fine reject have a particle size similar to silt and clay, whilst overburden can have a wider particle size range through from clay to gravel.

iii Groundwater levels, flow directions and sub-surface recharge

The proposed CIP FRE is positioned within the existing Carrington Pit, which comprises in-situ Permian coal measures, overlain by overburden material in places. There is no direct connection between the proposed emplacement and alluvial sediments, with groundwater barrier walls further separating overburden from the Hunter River alluvium beyond the mining area (refer to Section 2.3.3 and Figure 7.1).

Groundwater levels allow vertical and lateral hydraulic gradients and flow directions to be determined. They can also be used to infer relative hydraulic conductivity between units. Groundwater level trends from nested bores in the alluvium and Permian coal measures were analysed to examine flow directions and subsurface recharge. Monitoring results show variability in groundwater levels within the alluvium, Permian coal measures and overburden in Carrington Pit.

As predicted in past assessments, groundwater within the overburden generally appears to be flowing towards the Carrington Pit void. Groundwater to the east, through the former North Pit and Alluvial Lands, flows in southerly direction, which is likely driven by drawdown from active mining at HVO South. Westerly flow of water within the North Pit overburden towards Carrington Pit appears to be inhibited by a band of undisturbed Permian coal measures between the two mined out areas, which acts as a natural barrier.

iv Groundwater quality

Water quality monitoring is undertaken at HVO in accordance with the approved WMP. This includes quarterly field measurements of EC and pH and annual sampling at selected bores for more extensive water quality analysis.

Monitoring results indicate that groundwater within the alluvium is not suitable for stock water supply (excluding sheep) in accordance with the ANZECC (2000) guidelines. However, alluvial groundwater is occasionally used for stock (cattle) water supply within the region. The results for the alluvium ('highly productive' and 'less productive') also indicate that the groundwater is not suitable for long term irrigation according to the ANZECC (2000) due to concentrations of manganese.

The Permian stratigraphy (coal and interburden) is not suitable for stock water supply due to elevated salinity levels and total aluminium concentrations. Overall, the monitoring results indicate that water within the Permian coal measures, overburden and fine reject is not suitable for stock water supply or irrigation according to the ANZECC (2000) guidelines.

v Conceptual groundwater model

The processes that control and influence the storage and movement of groundwater in the hydrogeological system at HVO are summarised below and shown in Figure 7.2.

- The main groundwater bearing unit occurring near HVO North is the Quaternary alluvium with less productive groundwater occurring within coal seams of the Jerrys Plains Sub-group.
- Groundwater flows from areas of high head (pressure plus elevation) to low head. Recharge occurs from direct rainfall to the ground surface, infiltrating into the formations through the thin soil cover and weathered profile. The coal measures also occur at subcrop in localised zones beneath alluvium associated with the Hunter River, where the unit is recharged by downward seepage.
- Groundwater within the Hunter River alluvium flows in an easterly direction. The direction of groundwater flow for the Permian coal measures is influenced by the local geomorphology and structural geology, as well as the long history of mining within the region. This includes discharge of Permian groundwater via evaporative processes within low elevation void areas that act as groundwater ‘sinks’.
- The Quaternary alluvium is an unconfined groundwater system that is recharged by rainfall infiltration, streamflow and upward leakage from the underlying stratigraphy, particularly in undisturbed areas (ie away from active mining).
- Most agricultural producers (crop and cattle) utilise surface water resources (Hunter River) in preference to alluvial groundwater. There is no significant usage of groundwater from the Permian coal measures.

7.3 Impact assessment

7.3.1 Overview

The CIP FRE is designed to fill the Carrington Pit void with fine reject, rather than overburden as currently approved. The CIP FRE will hold approximately 12.6M BCM of fine reject and is proposed to commence in 2018 and cease in 2026 consistent with the second schedule outlined in the HVO Life of Mine Fine Reject Management Strategy (refer to Section 1.4). Filling of the CIP will commence at around 0mAHD and cease when the CIP FRE reaches a level of 38mAHD. When operation is complete, it will be capped to an elevation of 40mAHD or 45mAHD, based on the rehabilitation options.

Following capping of the CIP FRE, the area will be rehabilitated to enable the formation of a groundwater 'sink' over time. Rehabilitation will generally be consistent with the requirements of the development consent. This area will form an evaporative sink with a surface elevation of approximately 40mAHD. Assessment of the potential for the CIP FRE to impact on water levels and quality is provided in the following sub-sections.

7.3.2 Groundwater levels

Factors that control the long term flow of water into and out of the groundwater system at and surrounding the fine reject emplacement facility are the grain size and hydraulic conductivity of the fine reject, climatic conditions, such as rainfall, as well as the impoundment geometry and thickness (Lottermoser 2010).

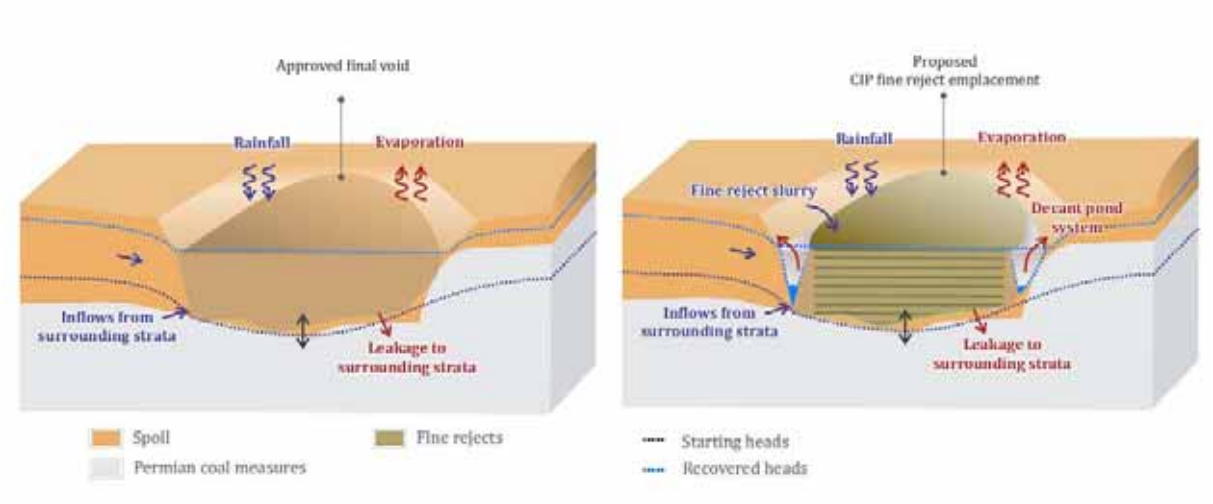

Figure 7.2 Hydraulic features of the CIP FRE

Figure 7.2 compares the hydraulic features of the proposed modification with the approved operations and demonstrates that both the approved void and CIP FRE will be surrounded by overburden and low permeability coal measures. As a result, there is no direct connection between the void area and alluvial sediments, with barrier walls further separating overburden from the Hunter River alluvium. The approved final void and proposed modification have similar inputs (ie rainfall and inflows from the surrounding strata) and outputs (ie evaporation) which result in the function of the void as a groundwater sink.

The fine reject to be emplaced comprises a slurry mixture of coal fines and water, which can introduce additional water to the groundwater system if seepage exceeds evaporation rates. The gentle and inward hydraulic gradient from the surrounding geology to the CIP FRE reduces the risk of leakage out of the facility to surrounding strata. In addition, as described in Section 3.2, the fine reject management practices, which include decanting to promote beaching and allow excess water to be removed effectively, will further reduce the potential for leakage.

Infilling Carrington Pit with fine reject, instead of overburden material introduces a change to the hydraulic properties of the fill material. The particle size and hydraulic conductivity of fine reject is lower than overburden, as described in Section 7.2.3.ii, and will potentially reduce the hydraulic gradient from surrounding strata to Carrington Pit. This could result in a short term increase in groundwater head within the coal measures and overburden surrounding the CIP FRE; however, movement of water into Carrington Pit is influenced by the wider regional groundwater levels and hydraulic gradients which have resulted in the Carrington Pit void acting as a groundwater 'sink'. As a result, the change in hydraulic conductivity would not obstruct flow to the final void.

The CIP FRE is designed in accordance with the approved final landform, with the maximum fine reject fill level set at 38mAHD and the cap to approximately 40mAHD. MER (2010) predicted that groundwater levels within the mined out area of Carrington Pit and Carrington West Wing would stabilise at approximately 40mAHD to 45mAHD within Carrington Pit final void (refer to Section 2.3.2). As a result, water levels within the approved final landform would be maintained below the crest of the groundwater barrier walls (65mAHD) that separate the mine from the Hunter River alluvium.

7.3.3 Groundwater quality

As outlined in Sections 3.2.4 and 7.2.3.iv, water quality data indicates that groundwater from the Permian coal measures, overburden and fine reject is moderately saline, and accordingly, is not suitable for irrigation or stock water supply (ANZECC 2000). The average salinity of water within spoil, fine reject and Permian coal measures is moderately saline (AGE 2016). Spoil water has an average TDS of 5,242mg/L, fine reject water is 6,446mg/L, coal is 6,405mg/L and interburden is 5,873mg/L. The CIP FRE is not expected to result in any changes to groundwater quality over time. The predictions of MER (2010) regarding mine seepage and final void groundwater quality are considered applicable to the modification.

With regards to mine seepage, MER (2010) predicted that water quality within the final void would reflect contributions from the coal measures, overburden and rainfall runoff entering the void. MER stated:

> ... the long term void water quality is considered most likely to exhibit a pH range from 7.5 to 9.5, a TDS range from 1,000mg/L increasing to about 3,000-4,000mg/L in the long term with a speciated signature Na>Mg>Ca and HCO_3>Cl>SO_4 if rejects are not emplaced.

MER (2010) also stated that should fine reject be emplaced within the Carrington Pit void, water quality would become more SO_4 dominant, which is consistent with analysed samples from fine reject compared to those from overburden (refer to Appendix B). However, the difference in sulphate concentration does not alter the beneficial use of water within the final void (ANZECC 2000).

As noted previously, this gradually increasing salinity will not pose a risk to the surrounding groundwater regime as the final void will remain a permanent sink.

7.4 Management and monitoring

Management of water resources is integrated at HVO. In accordance with Condition 27 of Schedule 4 of DA 450-10-2003, HVO developed the WMP (Coal & Allied 2016) in consultation with the now DPI Water and EPA. The WMP (Coal & Allied 2016) covers management of active and inactive fine reject facilities, in accordance with Condition 29 of DA 450-10-2003, including monitoring of fine reject emplacement water quality. The WMP also covers monitoring of groundwater levels and quality.

The plan fulfils the requirements of the HVO EPL 640, project approval for HVO South (PA 06_0261), development consent for HVO North (DA 450-10-2003) together with commitments made in the respective environmental assessments, environmental impact statements and relevant legislation, standards and guidelines.

Groundwater will continue to be managed in accordance with the WMP under the proposed modification. Yearly reporting of the water level and water quality results from the monitoring network will be continue to be included in the annual review. The annual review will also identify if any additional monitoring sites are required, or if optimisation of the existing monitoring sites should be undertaken.

7.5 Conclusions

As a result of the long history of mining at HVO and associated groundwater monitoring, the hydrogeology within and surrounding the Carrington Pit void is well understood.

The groundwater assessment considered all previous groundwater assessments in order to understand the current groundwater conditions and approved groundwater impacts. The assessment also included review of extensive baseline data from the HVO surface and groundwater monitoring network. The proposed modification seeks to change the properties of the material used to fill Carrington Pit to achieve the approved final landform.

The groundwater response to a FRE is controlled by the grain size and hydraulic conductivity of the fine reject material, and climatic conditions, as well as the impoundment geometry and thickness. The CIP FRE will continue to allow Carrington Pit final void to act as a groundwater 'sink' in perpetuity, maintaining a large surface area at a level below the pre mining water table. The proposed modification will not impact groundwater levels or groundwater quality.

The approved final void and the proposed modification have similar water balance inputs (ie rainfall and inflows from surrounding strata) and outputs (evaporation). Both the approved final void and proposed CIP FRE will be impounded within the Carrington Pit void, surrounded by overburden and low permeability coal measures and physically separated from the alluvium.

Existing management and monitoring measures currently implemented through the relevant management plans required by DA 450-10-2003, such as the WMP, will continue under the proposed modification, with regular review, optimisation and reporting.

8 Other environmental considerations

8.1 Introduction

As previously described, the potential environmental impacts from the proposed modification will be generally indiscernible from approved operations. An assessment of potential impacts on environmental aspects, other than groundwater, as a consequence of the proposed modification is provided in Table 8.1. The level of assessment is commensurate with the negligible levels of projected impacts on each aspect arising from the proposed modification.

No additional specific management measures are warranted as a result of the proposed modification. Management of these aspects will continue in accordance with requirements of the HVO North development consent, EPL, mining authorities and other various plans, policies and procedures (see Section 2.4).

8.2 Other environmental considerations

Table 8.1 below provides an assessment of potential impacts on environmental aspects, other than groundwater, as a consequence of the proposed modification.

Table 8.1 Other environmental considerations

Environmental aspect	Description
Rehabilitation and final landform	*Existing environment* Rehabilitation objectives are integrated into early mine planning to ensure compatibility with site constraints, mining operations, conservation objectives, community expectations, pre-mining land use, final land use, drainage, stability, soils, erosion control and visual compatibility. Condition 62 of DA 450-10-2003 details the rehabilitation objectives for HVO North with a Rehabilitation Management Plan to be prepared in accordance with Condition 62C. This plan has been prepared and submitted to DRE. Coal & Allied has developed performance criteria, measures and associated indicators in accordance with the range of project related documentation and the requirements of the development consent. These performance or completion criteria are objective target levels or values that can be measured to quantitatively demonstrate the progress and ultimate success of a biophysical process. These criteria have been developed for each phase of the rehabilitation so that the rehabilitation success can be quantitatively tracked throughout the life of the mine. Mining within Carrington Pit has been completed and the operation is currently on standby pending assessment of the proposed modification, prior to rehabilitation. The land behind the low wall is being rehabilitated in accordance with the MOP and the area is being managed to facilitate vegetation growth and establishment. As stated in Section 2.1, the final landform at Carrington Pit is planned to comprise a series of hills, ridges and minor valley systems designed to be consistent with the surrounding pre-mining landscape. It will have a mix of pasture and native habitat areas. The final void at Carrington Pit is designed to act as an evaporative sink to manage groundwater post-mining. *Proposed modification* The proposed modification uses fine reject rather than overburden to fill Carrington Pit, as per the current approved design options for the final void. The current planned long term rehabilitation outcome does not change as a result of the proposed modification.

Table 8.1 Other environmental considerations

Environmental aspect	Description
Surface water	*Existing environment* There are approximately 13,400km^2 of Hunter River catchment upstream of HVO. The Hunter River is a regulated river supplying water from Glenbawn Dam to a range of industrial and agricultural users as well as town water supplies. Glennies Creek and Wollombi Brook, drain into the Hunter River some 10km downstream of the mine. A local catchment of 13.75km^2 drains the south-western side of HVO North via an Unnamed Tributary to the Hunter River. The tributary is ephemeral. The upstream reach of the tributary has been constructed across previously mined areas and has been substantially realigned from pre-mining conditions. The realigned Unnamed Tributary consists of a small channel that is about 10m wide and 1m to 2m deep and is well grassed. Adjacent to the existing Carrington Pit, the tributary drains along the palaeochannel to the Hunter River. The tributary will be diverted during mining of the Carrington West Wing. Farrells Creek is a minor tributary of the Hunter River that drains the catchment north-east of Carrington Pit. Parnells Creek is a minor tributary of the Hunter River that drains the catchment to the west of West Pit. A flood assessment (WRM 2013) found that the two year Average Recurrence Interval (ARI) Hunter River design flood is generally confined to the main channel. The Hunter River flood flows exceed the capacity of the channel and inundate the floodplain in the vicinity of the proposed CIP FRE for the five year ARI design event. The Hunter River dominates flood levels in the vicinity of the proposed CIP FRE for floods greater than and equal to the ten year ARI event. Local catchment flows from the Unnamed Tributary dominate for the more frequent floods. The Hunter River has a consistent flow with average annual run-off volume between 1971 to 2011 about 419GL, with surface runoff increasing substantially once annual rainfall exceeded 400mm. Surface water upstream of the Hunter River has an annual average pH of 8.3, electrical conductivity (EC) of 730µS/cm and 28mg/L Total Suspended Solids (TSS). Downstream of the Hunter River has an annual average pH of 8.4, EC of 740µS/cm and 32mg/L TSS. Mean annual rainfall ranges from 644mm to 698mm and mean annual evaporation is approximately 1,641mm. *Proposed modification* The proposed modification is not expected to result in any surface water impacts, beyond those approved for the current operations.
Biodiversity	*Existing environment* Carrington Pit is highly disturbed, having been mined and partially backfilled in accordance with the conditions of the development consent. Biodiversity is limited in the pit itself, however, the area surrounding the pit comprises exotic pasture and extents of native vegetation communities, including extant and planted Eucalypt woodland. These areas may provide habitat and foraging opportunities for a number of native bird species, including the Regent Honeyeater and Swift Parrot, although presence of these species and others is unlikely given the current condition of the vegetation. Biodiversity is managed in accordance with HVO's existing environmental procedures. *Proposed modification* The proposed modification does not result in any additional ground disturbance and additional ecological impacts, beyond those approved for the current operations.
Aboriginal cultural heritage	*Existing environment* As noted above, Carrington Pit is highly disturbed, having been mined and partially backfilled in accordance with the conditions of the development consent. There are no extent Aboriginal cultural heritage items in the project area. Aboriginal cultural heritage is managed in accordance with the Rio Tinto Coal Australia Cultural Heritage Management System. *Proposed modification* The proposed modification is not expected to generate any Aboriginal cultural heritage impacts, beyond those approved for the current operations.

Table 8.1 Other environmental considerations

Environmental aspect	Description
Noise	*Existing environment* Mining within Carrington Pit is complete. The land use surrounding Carrington Pit is predominately large-scale open-cut coal mining operations. Hilly terrain characterises the topography to the north-east, north-west and south-west. To the south-east the terrain is generally open and gently undulating towards the lower Hunter Valley area. The closest privately owned residences to the proposed modification are at the village of Jerrys Plains and along Jerrys Plains Road (Golden Highway) approximately 4km to the south-west. The existing ambient noise environment at these properties is typical of rural residential locations in the Hunter Valley, with influence from agricultural activities, road traffic noise, existing mining noise and natural sounds. *Proposed modification* The proposed modification is not expected to generate any noise impacts, beyond those approved for the current operations.
Air quality	*Existing environment* As noted above, mining within Carrington Pit is complete. Existing air quality in the local area is influenced by particulate matter emissions from mining activities, power generation, agriculture, vehicle movements and other industrial activities. Meteorological data are collected at two automatic weather stations situated within the HVO mining complex; the HVO weather station and the Cheshunt weather station. Annual and seasonal windroses of meteorological data used in past assessments, show that in summer the wind is predominantly from the south/south-east and south-east, while in winter the wind is predominantly from the north-west. Autumn and spring experience a combination of these wind conditions. The HVO complex maintains a network of air quality monitoring equipment, including dust deposition gauges, High Volume Air Samplers (HVAS) and Tapered Element Oscillating Microbalances (TEOMs). In addition, OEH maintain two TEOMs in the area. Recorded PM_{10} levels are predominately higher during the summer and spring months. *Proposed modification* The proposed modification is not expected to generate any air quality impacts, beyond those approved for the current operations.

Table 8.1 Other environmental considerations

Environmental aspect	Description
Visual	*Existing environment* The Hunter Valley comprises a mixture of rural, built and natural landscapes, ranging from steep, forested mountain ranges to gently undulating farmland, mining pits and infrastructure and the river flats on the Hunter River floodplain. Dominant viewscape features are agricultural grazing lands, open cut coal mines and associated infrastructure and power stations, set against a backdrop of forested mountain ranges. Dominant industrial elements of the landscape immediately surrounding HVO North are the existing open cut pits, mine-related infrastructure, including CHPPs, water storages, rail load out and rail loop infrastructure, rehabilitated former mine areas and high voltage transmission lines. In addition to industrial characteristics of the local viewscapes, there are expanses of agricultural grazing land on the Hunter Valley floodplain to the south, and on the steeper slopes to the west, along with scattered rural residences, farm infrastructure and remnant tree stands. Dominant night-time visual elements surrounding HVO North are lighting for mine-related infrastructure and lights associated with mobile plant travelling on haul roads and lighting associated with active mining operations within mining areas. Areas of HVO North are visible from the surrounding road network, nearby industrial areas, rural properties and residences. *Proposed modification* The proposed modification will not generate any visual impacts, beyond those approved for the current operations and in the short term will delay the predicted minor visual impacts for users of Lemington Road from the construction of the COOP FRE (EMM 2013).
Socio-economic	*Existing environment* Coal & Allied operates two mines (HVO and Mount Thorley Warkworth (MTW)) in the Hunter Valley, NSW. The villages of Jerrys Plains, to the west, and Maison Dieu, to the south-east, are the two closest communities to the proposed modification. The Hunter Region is currently underpinned by the key industries of coal mining; agriculture (particularly dairy, beef cattle, vegetable growing and pasture production) and associated service industries; horse breeding; power generation; tourism; viticulture and wine making; and defence. Mining is the dominant industry of employment, representing up to 22 per cent of the workforce in Singleton LGA. Personal and business incomes in Singleton LGA increased between 2006 and 2011, at a greater rate than for NSW as a whole, in conjunction with mining investment. While not evident in these 2011 figures, the slowing of the coal mining sector is starting to impact the regional economy and the labour market. Recent job losses have also occurred in the wider industry, with approximately 2,200 direct mining jobs lost in the Hunter Valley since 2013, and the expected loss of approximately 1,000 jobs in the Hunter Valley and surrounding regions in 2016. HVO currently employs approximately 1,500 people as employees and contractors, 30 of whom are Indigenous and 25 of whom are apprentices and trainees. All employees reside within the Hunter Region, with the majority residing in the Singleton, Muswellbrook, Cessnock and Maitland LGAs. In 2015, HVO spent $229 million with 198 suppliers in the local region (comprising Singleton, Muswellbrook, Upper Hunter, Cessnock and Maitland LGAs), and $241 million with 283 suppliers in the rest of NSW. In addition, between 2015 and 2016 HVO's spend in the local region increased by $35 million. HVO, through Coal & Allied, is also a significant contributor to the local community through the Coal & Allied Community Development fund and site donations, which totalled over $1.6 million in 2015. *Proposed modification* The proposed modification will ensure that mining operations will have sufficient fine reject emplacement for the remainder of the development consent timeframe, allowing operations to continue, supporting the continued provision of HVO's economic benefits. The proposed modification is not anticipated to adversely affect the existing socio-economic benefits provided by HVO North.

9 Justification and conclusion

9.1 Introduction

This chapter considers the suitability of the site, and of the proposed modification against the objects of the EP&A Act, including ESD principles, and draws conclusions based on the EA.

9.2 Suitability of the site

HVO has successfully and responsibly operated for over 65 years. An overview of the site and surrounds is provided in Section 1.3.

The proposed modification will take place on land that has been mined previously and will operate in the future as an evaporative sink supporting the effective management of groundwater post-mining. The proposed modification does not increase the area of disturbance, it simply changes emplacement material within Carrington Pit final void from overburden to fine reject.

There is a significant volume of baseline environmental data that exists for HVO based on a well-established environmental management framework that includes an extensive groundwater monitoring programme. This supports the effective management of potential environmental impacts.

For the reasons given above, it is concluded that the site is highly suitable for the purposes of the proposed modification.

9.3 Objects of the Environmental Planning and Assessment Act 1979

Section 5 of the EP&A Act specifies its objectives. An assessment of the proposed modification against the objects is provided below.

(a)(i) *To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.*

HVO is a long standing operation that has demonstrated the ability to efficiently extract one of the State's valuable natural mineral resources for the benefit of a range of stakeholders. HVO contains a substantial coal resource supported by existing extensive physical and human infrastructure. The proposed modification will facilitate proper development and the orderly use of this resource, thus promoting social and economic welfare of the community. It will also not compromise the conservation of natural resources.

Furthermore, the proposed approach to fine reject management will utilise existing equipment, plant and workforce.

No significant environmental impacts are anticipated as a result of the proposed modification. Notwithstanding, there are a number of well-established environmental management measures and procedures regarding fine reject emplacement already in place at HVO to mitigate, manage and monitor any potential impacts that will continue to be implemented under the proposed modification.

Therefore, it is considered that the proposed modification is consistent with this objective.

(a)(ii) To encourage the promotion and co-ordination of the orderly and economic use and development of land.

The proposed modification encourages the proper management of a natural mineral resource within a State-approved disturbance footprint of an existing mine.

The proposed modification will utilise existing equipment, plant and workforce, and provide a lower cost solution for fine reject storage at HVO to defer capital for the construction of the COOP FRE in the current economic climate. It is considered that the proposed modification would constitute an orderly and economic use of the land and reserves, already approved for the purposes of mining and mining-related activities.

(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.

This objective is not applicable to the proposed modification.

(a)(iv) To encourage the provision of land for public purposes.

All the elements of the proposed modification will be developed on privately owned land within the State-approved disturbance footprint of an existing mine.

(a)(v) To encourage the provision and co-ordination of community services and facilities.

The proposed modification enables jobs to be maintained; it does not seek to increase HVO's workforce nor extend the development consent period. Accordingly, there will be no additional demand for community services as a result of the proposed modification. Ongoing operations will enable continued support of the community through initiatives such as the Coal & Allied Community Development Fund.

(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.

The project area is within the State-approved disturbance footprint of an existing mine. The proposed modification will not require clearing of additional land that would impact on the conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats. The existing environmental management measures will continue to be implemented for the proposed modification and the requirements of the existing development consent complied with.

(a)(vii) To encourage ecologically sustainable development.

The Commonwealth Government's (1992) *National Strategy for Ecologically Sustainable Development* defines ESD as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

The proposed modification will allow for the continuation of efficient fine reject emplacement management at HVO for the remainder of the development consent period. The proposed modification will not adversely affect community resources but will assist in the enabling continued provision of public revenues through royalties and taxes. In this way it will contribute to improvements in the local, State and National economies and contribute to an overall increase in quality of life.

Precautionary Principle: in practice this means that development should not cause serious or irreversible environmental impact. Such impacts can be avoided through the understanding of potential environmental impacts by undertaking a full environmental assessment, and incorporating effective mitigation or compensation measures into development proposals.

A number of design options were considered for the proposed modification, to ensure balance between potential environmental impacts and the need for fine reject storage capacity. Furthermore, the groundwater assessment is based on conservative assumptions ensuring that potential worst case impacts are captured. The environmental assessment of the proposed modification has identified and addressed the potential environmental impacts, which are generally indiscernible from currently approved operations.

For these reasons, the proposed modification is consistent with the precautionary principle.

Social equity including intergenerational equity: the suitability of the site for the proposed modification was established in Section 9.2. The proposed modification requires no property acquisition, no further impacts to amenity are envisaged and is not expected to disadvantage existing stakeholders. Once capacity of the CIP FRE has been reached, Coal & Allied will provide further detail regarding final void design and management as part of the FVMP in accordance with Condition 28 of DA 450-10-2003, or an EIS accompanying a future development application involving Carrington Pit, whichever is sooner.

Further, the proposed modification will result in minimal adverse environmental impacts.

Taking all the above matters into account, it is considered that the proposed modification will generally promote social equity including intergenerational equity.

Conservation of biological diversity and maintenance of ecological integrity: as previously discussed the proposed modification will have no impacts on biodiversity.

Improved valuation and pricing of environmental resources: the potential environmental impacts of the proposed modification have been addressed in this EA. The value of the proposed modification in terms of continued operations at HVO and the resultant enhanced security of employment were considered in the context of the potential environmental impacts. In this respect, it is considered that the proposed modification assists in the valuation and pricing of environmental resources.

(a)(viii) To encourage the provision and maintenance of affordable housing.

This object is not applicable to the proposed modification.

(b) To promote the sharing of the responsibility for environmental planning between the different levels of government in the State.

Consultation with relevant State and local government agencies has been undertaken, as necessary, during the preparation of the EA. Further consultation will occur during the response to submissions following exhibition and pre-determination phases.

(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.

As no Secretary's Environmental Assessment Requirements (SEARs) were issued for the proposed modification, the stakeholder engagement for this EA has been in accordance with existing Coal & Allied engagement programme, which provides for consistent proactive engagement with the community. Public involvement and participation will also be provided through the public exhibition process of this EA where the public will be invited to make submissions on the proposed modification.

9.4 Conclusions

It is considered that the proposed modification is justified, for the following reasons:

- effective fine reject management is critical to the ongoing viability of the mine;
- there are no other viable options for the management of fine reject at HVO North in the current economic environment;
- the site is suitable for the proposed modification given that it is an approved final void and there will be no change to the approved disturbance footprint and rehabilitation outcome;
- the method of proposed fine reject emplacement has consistently been successfully implemented at HVO;
- potential environmental and social impacts are largely indiscernible with those approved under the existing development consent (DA 450-10-2003) such that the existing management controls implemented by HVO North require only minor administrative amendments; and
- it is aligned with the principles of ecologically sustainable development, consistent with the contemporary legislative requirements and meets all relevant government policies.

Abbreviations

AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AIS	Agricultural Impact Statement
CCC	Community Consultative Committee
CHPP	Coal handling and preparation plants
CRD	Cumulative Rainfall Departure
DoEE	Department of the Environment and Energy
DP&I	Department and Planning and Infrastructure
EA	Environmental Assessment
EC	Electrical conductivity
EMM	EMM Consulting Pty Limited
EPBC Act	*Commonwealth Environment Protection and Biodiversity Conservation Act 1999*
EPL	Environment Protection Licence
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EP&A Regulation	NSW *Environmental Planning and Assessment Regulation 2000*
FRE	Fine Reject Emplacement project
GDE	Groundwater dependent ecosystems
ha	hectare
HCHPP	Howick Coal Handling and Preparation Plant
HITS	Hunter Integrated Telemetry System
HVCHPP	Hunter Valley Coal Handling and Preparation Plant
HVLP	Hunter Valley Load Point
HVO	Hunter Valley Operations
km	kilometres
LGA	Local Government Area
MER	Mackie Environmental Research
MNES	Matters of National Environmental Significance
MOP	Mining Operations Plan
Mt	Million tonnes
Mtpa	Million tonnes per annum

NLP	Newdell Load Point
NPW Act	NSW *National Parks and Wildlife Act 1974*
NSW	New South Wales
POEO Act	NSW *Protection of the Environment Operations Act 1997*
ROM	Run-of-mine
SEPP	State Environmental Planning Policy
tph	Tonnes per hour
TCS Act	NSW *Threatened Species Conservation Act 1995*
VWP	Vibrating wire piezometers
WM Act	NSW *Water Management Act 2000*
WMP	Water Management Plan
WMS	Water Management System

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HVO North Development Consent (DA 450-10-2003)

Appendix A

Appendix A — HVO North Development Consent (DA 450-10-2003)

A

Development Consent

Section 80 of the *Environmental Planning and Assessment Act 1979*

I, the Minister for Infrastructure, Planning and Natural Resources, approve the Development Application referred to in schedule 1, subject to the conditions in schedules 3 to 6.

These conditions are required to:
- prevent, minimise, and/or offset adverse environmental impacts;
- set standards and performance measures for acceptable environmental performance;
- require regular monitoring and reporting; and
- provide for the on-going environmental management of the development.

Craig Knowles MP
Minister for Infrastructure and Planning
Minister for Natural Resources

Sydney, 2004 File No: S02/02690

SCHEDULE 1

Development Application:	DA 450-10-2003.
Applicant:	Coal & Allied Operations Pty Ltd.
Consent Authority:	Minister for Infrastructure and Planning.
Land:	See Appendix 1.
Proposed Development:	The extension of open cut coal mine operations at the West Pit of Hunter Valley Operations in general accordance with the Environmental Impact Statement for the *Hunter Valley Operations - West Pit Extension and Minor Modifications*, which includes: • extending open cut mining operations to the east of currently approved development; • using existing mining methods and equipment; • using existing coal preparation facilities at the West Pit to process up to 6 million tonnes per annum (Mtpa) of coal and use of related coal reject disposal facilities; • continuing coal production at the rate of 12 Mtpa at West Pit; • increasing the approved production capacity of the Carrington Pit from 6 Mtpa to 10 Mtpa; • increasing approved coal haulage from mining areas south of the Hunter River to the Hunter Valley Coal Preparation Plant from 8 Mtpa to 16 Mtpa; • upgrading the capacity of the Hunter Valley Coal Preparation Plant from 13 Mtpa to 20 Mtpa; • upgrading the Belt Line Conveyor from the Hunter Valley Coal Preparation Plant to the Hunter Valley Loading Point; • constructing a conveyor between the Hunter Valley Loading Point and the Newdell Loading Point; • hauling coal, on an intermittent basis, between the Hunter Valley Loading Point and Newdell Loading Point and the Ravensworth Coal Terminal; • hauling coal, on an intermittent basis, between the Hunter Valley Coal Preparation Plant and the Hunter Valley Loading Point along a private haul road;

- moving coal and coal rejects between mining areas and facilities of the Hunter Valley Operations, including mining areas and facilities located south of the Hunter River;
- constructing temporary crossings of the Hunter River to allow the relocation of heavy mining equipment; and
- consolidating 15 existing development approvals, applying to Hunter Valley Operations north of the Hunter River, into a single consent.

State Significant Development: The proposal is classified as State significant development, under section 76A(7) of the *Environmental Planning and Assessment Act 1979*, because it involves coal-mining related development that requires a new mining lease under section 63 of the *Mining Act 1992*.

Integrated Development: The proposal is classified as integrated development, under section 91 of the *Environmental Planning and Assessment Act 1979*, because it requires additional approvals under the:

- *Protection of the Environment Operations Act 1997;*
- *National Parks and Wildlife Act 1974*;
- *Water Act 1912;*
- *Rivers and Foreshores Improvement Act 1948*;
- *Roads Act 1993*; and
- *Mine Subsidence Compensation Act 1961*.

Designated Development: The proposal is classified as designated development, under section 77A of the *Environmental Planning and Assessment Act 1979*, because it is for a coal mine that would "*produce or process more than 500 tonnes of coal a day*", and consequently meets the criteria for designated development in schedule 3 of the *Environmental Planning and Assessment Regulation 2000*.

BCA Classification: Class 10b: Coal conveyor

Note:

1) *To find out when this consent becomes effective, see section 83 of the Environmental Planning and Assessment Act 1979 (EP&A Act);*
2) *To find out when this consent is liable to lapse, see section 95 of the EP&A Act; and*
3) *To find out about appeal rights, see section 97 of the EP&A Act.*

Red type represents August 2005 modification
Blue type represents June 2006 modification
Green type represents March 2013 modification
Light blue type represents January 2014 modification

SCHEDULE 2
DEFINITIONS

AEMR	Annual Environmental Management Report
Applicant	Coal & Allied Operations Pty Ltd
ARTC	Australian Rail Track Corporation
BCA	Building Code of Australia
Bore	Any bore or well or excavation or other work connected or proposed to be connected with sources of sub-surface water, and used or proposed to be used or capable of being used to obtain supplies of such water whether the water flows naturally at all times or has to be raised whether wholly or at times by pumping or other artificial means
CCC	Community Consultative Committee
Council	Singleton Shire Council
DA	Development Application
Day	Day is defined as the period from 7am to 6pm on Monday to Saturday, and 8am to 6pm on Sundays and Public Holidays
Department	Department of Planning and Infrastructure
Director-General	Director-General of the Department, or nominee
DPI	Department of Primary Industries
DRE	Division of Resources and Energy within the Department of Trade, Investment, Regional Infrastructure and Services
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPL	Environment Protection Licence
EPL 640	Environment Protection Licence No. 640 issued for HVO's operations north of the Hunter River or any subsequent replacement for, or variation of, EPL 640
Evening	Evening is defined as the period from 6pm to 10pm
Executive Director Mineral Resources	Executive Director of Mineral Resources within DRE, or equivalent position
Feasible	Feasible relates to engineering considerations and what is practical to build or carry out
GTA	General Term of Approval
HVO	Hunter Valley Operations
Land	As defined in the EP&A Act, except for where the term is used in the noise and air quality conditions in schedules 3 and 4 of this consent where it is defined to mean the whole of a lot, or contiguous lots owned by the same landowner, in a current plan registered at Land and Property Information at the date of this consent
LPB	Low Permeability Barrier
Mining operations	Includes the removal of overburden and extraction, processing, handling, storage and transportation of coal on site
MOP	Mining Operations Plan
MSC	Muswellbrook Shire Council
MSB	Mine Subsidence Board
Negligible	Small and unimportant, such as to be not worth considering
Night	Night is defined as the period from 10pm to 7am on Monday to Saturday, and 10pm to 8am on Sundays and Public Holidays
NOW	NSW Office of Water within the Department of Primary Industries
NP&W Act	*National Parks and Wildlife Act 1974*
OEH	Office of Environment and Heritage
PCA	Principal Certifying Authority appointed under Section 109E of the Act
POEO Act	*Protection of the Environment Operations Act 1997*
Privately owned land	Land that is not owned by a public agency, or a mining company, or its subsidiary
Reasonable	Reasonable relates to the application of judgement in arriving at a decision, taking into account: mitigation benefits, cost of mitigation versus benefits provided, community views and the nature and extent of potential improvements
ROM coal	Run-of-mine coal
RMS	Roads and Maritime Services
Site	The land described in Appendix 1
Vacant land	Vacant land is defined as the whole of the lot in a current plan registered at the Land Titles Office that does not have a dwelling situated on the lot and is permitted to have a dwelling on that lot at the date of this consent.

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SCHEDULE 3
ADMINISTRATIVE CONDITIONS

Obligation to Minimise Harm to the Environment

1. The Applicant shall implement all practicable measures to prevent and/or minimise any harm to the environment that may result from the construction, operation, or rehabilitation of the development.

Terms of Approval

2. The Applicant shall carry out the development generally in accordance with the:
   (a) DA 450-10-2003;
   (b) EIS titled *Hunter Valley Operations – West Pit Extension and Minor Modifications*, volumes 1 – 4, dated October 2003, and prepared by Environmental Resources Management Australia;
   (c) the section 96(1A) modification application for the Hunter Valley Loading Point, dated 30 June 2005, and prepared by Matrix Consulting;
   (d) *Carrington Pit Extended Statement of Environmental Effects* volumes 1 & 2, dated October 2005, and prepared by Environmental Resources Management Australia;
   (e) *Carrington Pit Extension Response to Submissions Report*, dated May 2006, and prepared by Environmental Resources Management Australia;
   (f) Summary of Commitments for Carrington Pit as Extended, dated 28 May 2006 and prepared by the Applicant;
   (g) *Carrington West Wing Environmental* Assessment dated 1 October 2010, *Carrington West Wing Response to Submissions* dated 21 December 2010, *Carrington West Wing Agricultural Impact Assessment* dated 10 June 2011, *Carrington West Wing Statement of Commitments* dated 4 March 2013;
   (h) *HVO North – Fine Reject Emplacement Modification Environmental Assessment* dated June 2013 and *HVO North – Fine Reject Emplacement Modification Response to Submissions* dated August 2013; and
   (i) conditions of this consent.

3. If there is any inconsistency between the above documents, the most recent document shall prevail to the extent of the inconsistency. However, the conditions of this consent shall prevail over all other documents to the extent of any inconsistency.

4. The Applicant shall comply with any reasonable requirement/s of the Director-General arising from the Department's assessment of:
   (a) any reports, strategies, plans, programs, reviews, audits or correspondence that are submitted in accordance with this consent; and
   (b) the implementation of any actions or measures contained in these documents.

Surrender of Consents

5. Within 3 months of the submission of the revised West Pit extension MOP to the DRE, the Applicant shall surrender all existing development consents and existing use rights associated with Hunter Valley Operations' (HVO's) mining operations and related facilities north of the Hunter River in accordance with clause 97 of the *EP&A Regulation*.

Limits on Approval

6. The Applicant may carry out mining operations on the site until 12 June 2025.

   Note: Under this consent, the Applicant is required to rehabilitate the site and carry out additional undertakings to the satisfaction of both the Director-General and the Executive Director Mineral Resources. Consequently, this consent will continue to apply in all other respects other than the right to conduct mining operations until the rehabilitation of the site and those additional undertakings have been carried out satisfactorily.

7. The Applicant shall not extract more than 12 million tonnes per annum (Mtpa) of ROM coal from the West Pit and 10 Mtpa of ROM coal from the Carrington Pit.

8. The Applicant shall ensure that the Hunter Valley Coal Preparation Plant does not receive more than 16 Mtpa of coal from mining operations south of the Hunter River, and process more than 20 Mtpa of coal.

9. The Applicant shall ensure that the West Pit Coal Preparation Plant does not process more than 6 Mtpa of coal.

Structural Adequacy

10. The Applicant shall ensure that all new buildings and structures, and any alterations or additions to existing buildings and structures, are constructed in accordance with the relevant requirements of the BCA.

Notes:
1) Under Part 4A of the EP&A Act, the Applicant is required to obtain construction and occupation certificates for the proposed building works.
2) Part 8 of the EP&A Regulation sets out the requirements for the certification of development.
3) [1]The development is located in the Patrick Plains Mine Subsidence District. Under section 15 of the Mine Subsidence Compensation Act 1961, the Applicant is required to obtain the Mine Subsidence Board's approval before constructing or relocating any improvements on the site.

Demolition

11. The Applicant shall ensure that any demolition work is carried out in accordance with *AS 2601-2001: The Demolition of Structures*, or its latest version.

Operation of Plant and Equipment

12. The Applicant shall ensure that all plant and equipment used at the site, or to transport coal off-site, are:
(a) maintained in a proper and efficient condition; and
(b) operated in a proper and efficient manner.

Community Enhancement Contribution

13. Before carrying out any development, or as agreed otherwise by Council, the Applicant shall pay Council $15,000 for the provision of stream improvement works in the Hunter River or its tributaries. If Council has not carried out these enhancement works within 12 months of payment, the Applicant may retrieve the funds from Council.

Staged Submission of any Strategy, Plan and Program

14. With the approval of the Director-General, the Applicant may submit any strategy, plan or program required by this consent on a progressive basis.

Notes:
- *While any strategy, plan or program may be submitted on a progressive basis, the Applicant will need to ensure that the existing operations of the site are covered by suitable strategies, plans or programs at all times; and*
- *If the submission of any strategy, plan or program is to be staged, then the relevant strategy, plan or program must clearly describe the specific stage to which the strategy, plan or program applies, the relationship of this stage to any future stages, and the trigger for updating the strategy, plan or program.*

[1] Incorporates MSB GTA.

SCHEDULE 4
SPECIFIC ENVIRONMENTAL CONDITIONS

ACQUISITION UPON REQUEST

1. Upon receiving a written request for acquisition from any landowner of the land listed in Table 1, the Applicant shall acquire the land in accordance with the procedures in conditions 6-7 of schedule 5 and condition 5 of schedule 5 for property 8.

Table 1: Land subject to acquisition upon request

8 - Holz	10 - Moses
9 - Dallas	12 - Barry

Note: To identify the locations referred to in Table 1, see Appendix 2.

2. While the land listed in condition 1 is privately-owned, the Applicant shall implement all practicable measures to ensure that the impacts of the development comply with the predictions in the EIS, to the satisfaction of the Director-General.

AIR QUALITY & GREENHOUSE GAS

Odour

3. The Applicant shall ensure that no offensive odours are emitted from the site, as defined under the POEO Act.

Greenhouse Gas Emissions

4. The Applicant shall implement all reasonable and feasible measures to minimise the release of greenhouse gas emissions from the site to the satisfaction of the Director-General.

Air Quality Criteria

4A. Except for the air quality affected land in Table 1, the Applicant shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the development do not exceed the criteria listed in Tables 2, 3 or 4 at any residence on privately-owned land or on more than 25 percent of any privately-owned land.

In this condition 'reasonable and feasible avoidance and mitigation measures' includes, but is not limited to, the operational requirements in Condition 5 of Schedule 4 and the requirements in Conditions 5 and 6 of Schedule 4 to develop and implement a real-time air quality management system that ensures effective operational responses to the risks of exceedance of the criteria.

Table 2: Long term criteria for particulate matter

Pollutant	Averaging Period	[d] Criterion
Total suspended particulate (TSP) matter	Annual	[a] 90 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	[a] 30 µg/m^3

Table 3: Short term criterion for particulate matter

Pollutant	Averaging Period	[d] Criterion
Particulate matter < 10 µm (PM_{10})	24 hour	[a] 50 µg/m^3

Table 4: Long term criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a] 4 g/m^2/month

Notes to Tables 2–4:

- *[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources);*
- *[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own);*

- *[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.*
- *[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by the Director-General.*

Air Quality Acquisition Criteria

4B. If particulate matter emissions generated by the development exceed the criteria in Tables 5, 6 or 7 on a systemic basis at any residence on privately-owned land or on more than 25 percent of any privately-owned land, then upon receiving a written request for acquisition from the landowner the Applicant shall acquire the land in accordance with the procedures in Conditions 7 and 8 of Schedule 5.

Table 5: Long term acquisition criteria for particulate matter

Pollutant	Averaging Period	[d] Criterion
Total suspended particulate (TSP) matter	Annual	[a] 90 µg/m^3
Particulate matter < 10 µm (PM_{10})	Annual	[a] 30 µg/m^3

Table 6: Short term acquisition criteria for particulate matter

Pollutant	Averaging period	[d] Criterion
Particulate matter < 10 µm (PM_{10})	24 hour	[a] 150 µg/m^3
Particulate matter < 10 µm (PM_{10})	24 hour	[b] 50 µg/m^3

Table 7: Long term acquisition criteria for deposited dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
[c] Deposited dust	Annual	[b] 2 g/m^2/month	[a] 4 g/m^2/month

Notes to Tables 5-7:

- *[a] Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources);*
- *[b] Incremental impact (i.e. incremental increase in concentrations due to the development on its own);*
- *[c] Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.*
- *[d] Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents, illegal activities or any other activity agreed by the Director-General.*

Mine-owned Land

4C. The Applicant shall ensure that particulate matter emissions generated by the development do not exceed the criteria listed in Table 2, Table 3 and Table 4 at any occupied residence on any mine-owned land (including land owned by adjacent mines) unless:

(a) the tenant and landowner has been notified of health risks in accordance with the notification requirements under Schedule 5 of this consent;

(b) the tenant on land owned by the Applicant can terminate their tenancy agreement without penalty, subject to giving reasonable notice, and the Applicant uses its best endeavours to provide assistance with relocation and sourcing of alternative accommodation;

(c) air mitigation measures (such as air filters, a first flush roof water drainage system and/or air conditioning) are installed at the residence, if requested by the tenant and landowner (where owned by another mine other than the Applicant);

(d) particulate matter air quality monitoring is undertaken to inform the tenant and landowner of potential health risks; and

(e) monitoring data is presented to the tenant in an appropriate format, for a medical practitioner to assist the tenant in making an informed decision on the health risks associated with occupying the property,

to the satisfaction of the Director-General.

Air Quality Operating Conditions

5. The Applicant shall:
   (a) implement best management practice to minimise the off-site odour, fume and dust emissions of the development, including best practice coal loading and profiling and other measures to minimise dust emissions from coal transportation by rail;
   (b) operate a comprehensive air quality management system on site that uses a combination of predictive meteorological forecasting, predictive and real time air dispersion modelling and real-time air quality monitoring data to guide the day to day planning of mining operations and implementation of both proactive and reactive air quality mitigation measures to ensure compliance with the relevant conditions of this approval;
   (c) manage $PM_{2.5}$ levels in accordance with any requirements of any EPL;
   (d) minimise the air quality impacts of the development during adverse meteorological conditions and extraordinary events (see note d above under Table 5-7);
   (e) minimise any visible off-site air pollution;
   (f) minimise the surface disturbance of the site generated by the development; and
   (g) co-ordinate air quality management on site with the air quality management at nearby mines (Mount Thorley Warkworth, Wambo, Ravensworth and HVO South mines) to minimise the cumulative air quality impacts of these mines and the development,

   to the satisfaction of the Director-General.

Air Quality & Greenhouse Gas Management Plan

6. The Applicant shall prepare and implement a detailed Air Quality & Greenhouse Gas Management Plan for the development to the satisfaction of the Director-General. This plan must:
   (a) be prepared in consultation with the EPA, and submitted to the Director-General for approval by the end of June 2013;
   (b) describe the measures that would be implemented to ensure:
      - best management practice is being employed;
      - the air quality impacts of the development are minimised during adverse meteorological conditions and extraordinary events; and
      - compliance with the relevant conditions of this consent.
   (c) describe the proposed air quality management system;
   (d) include a risk/response matrix to codify mine operational responses to varying levels of risk resulting from weather conditions and specific mining activities;
   (e) include commitments to provide summary reports and specific briefings at CCC meetings on issues arising from air quality monitoring;
   (f) include an air quality monitoring program that:
      - uses a combination of real-time monitors and supplementary monitors to evaluate the performance of the development;
      - adequately supports the proactive and reactive air quality management system;
      - includes $PM_{2.5}$ monitoring;
      - includes monitoring of occupied development-related residences and residences on air quality-affected land listed in Table 1, subject to the agreement of the tenant;
      - evaluates and reports on the effectiveness of the air quality management system; and
      - includes a protocol for determining any exceedances of the relevant conditions in this approval; and
   (g) include a protocol that has been prepared in consultation with the owners of nearby mines (Mt Thorley Warkworth, Wambo, Ravensworth and HVO South mines) to minimise the cumulative air quality impacts of these mines and the development.

[2]NOISE

Noise Impact Assessment Criteria

7. The Applicant shall ensure that the noise generated by the development does not exceed the noise impact assessment criteria presented in Table 9 at any privately-owned land.

[2] Incorporates EPA GTAs

Table 9: Noise impact assessment criteria dB(A)

Day/Evening/Night $L_{Aeq(15\ minute)}$	***Night*** $L_{A1(1\ minute)}$	***Land Number***
40	*46*	*4 – Muller (from year 1 to year 7)* *7 – Stapleton* *Jerrys Plains Village – represented by residence locations 13 and 14 on Figure 24, volume 4 of the EIS (years 20 & 21).* *1 – Hayes (years 20 & 21)* *18 – Bennet (years 20 & 21)* *51 – Nicholls (years 20 & 21)* *52 – Old – (years 20 & 21)*
39	*46*	*2 – Skinner* *3 – Elisnore* *11 – Fisher* *19 – Biralee Feeds* *31 – Cooper* *36 – Garland* *54 – Skinner*
38	*46*	*1 – Hayes (from year 1 to year 19)* *18 – Bennet (from year 1 to year 19)* *51 – Nicholls (from year 1 to year 19)* *52 – Old (from year 1 to year 19)*
36	*46*	*4 – Muller (from year 8 to year 21)*
35	*46*	*All other residential or sensitive receptors, excluding the receptors listed in condition 1 above.*

Notes:

(a) *The years referenced in Table 9 are to be considered as the position of mining operations as set out in the EIS for that year. If mining operations are delayed or accelerated from the planned location as shown in the EIS for a particular year, then the noise assessment criteria will be adjusted in accordance with the location of actual mining operations. The location of actual mining operations in relation to locations predicted in the EIS, will be indicated in the AEMR (see schedule 6, condition 5).*

(b) *The noise limits in Table 9 are for the noise contribution of the West Pit extension and all Hunter Valley Operations north of the Hunter River and coal haulage identified in the EIS from the south side of the Hunter River.*

(c) *Noise from the development is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of a dwelling (rural situations) where the dwelling is more than 30 metres from the boundary, to determine compliance with the $L_{Aeq(15\ minute)}$ noise limits in the above table.*

(d) *To determine compliance with the $L_{Aeq(15\ minute)}$ noise limits in the above table. Where it can be demonstrated that direct measurement of noise from the development is impractical, the EPA may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy). The modification factors in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise levels where applicable.*

(e) *Noise from the development is to be measured at 1 metre from the dwelling façade to determine compliance with the* $L_{A1(1\ minute)}$ noise limits in the above table.

(f) *The noise limits in Table 9 are to be applied in accordance with the limitations and requirements set out in Appendix 3.*

Land Acquisition Criteria

8. If the noise generated by the development exceeds the criteria in Table 10, the Applicant shall, upon receiving a written request for acquisition from the landowner, acquire the land in accordance with the procedures in Conditions 6 and 7 of Schedule 5.

Table 10: Land acquisition criteria dB(A)

Day/Evening/Night $L_{Aeq(15\ minute)}$	***Property***
43	*11 – Fisher*
42	*7 - Stapleton*
41	*All residential or sensitive receptors, excluding the receptors listed in condition 1 above*

Note: See notes (c) to (f) to Table 9.

Noise Operating Conditions

9. The Applicant shall:
   (a) implement best management practice to minimise the operational, low frequency, road and rail traffic noise of the development;
   (a) operate a comprehensive noise management system on site that uses a combination of predictive meteorological forecasting and real-time noise monitoring data to guide the day to day planning of mining operations and the implementation of both proactive and reactive noise mitigation measures to ensure compliance with the relevant conditions of this approval;
   (b) maintain the effectiveness of any installed noise suppression equipment on plant at all times and ensure defective plant is not used operationally until fully repaired;
   (c) ensure that any noise attenuated plant on site is deployed preferentially in locations relevant to sensitive receivers;
   (d) minimise the noise impacts of the development during meteorological conditions when the noise limits in this approval do not apply;
   (e) ensure that the site is only accessed by locomotives that are approved to operate on the NSW rail network in accordance with the noise limits in ARTC's EPL (No. 3142);
   (f) use its best endeavours to ensure that the rolling stock supplied by service providers is designed, constructed and maintained to minimise noise;
   (g) co-ordinate the noise management on site with the noise management at nearby mines (Mt Thorley Warkworth, Wambo, Ravensworth and HVO South mines) to minimise the cumulative noise impacts of these mines and the development,

   to the satisfaction of the Director-General.

Noise Management Plan

10. The Applicant shall prepare and implement a Noise Management Plan for the development to the satisfaction of the Director-General. This plan must:
   (a) be prepared in consultation with the EPA, and submitted to the Director-General for approval by the end of June 2013;
   (b) describe the measures that would be implemented to ensure:
      - best management practice is being employed;
      - the noise impacts of the development are minimised during meteorological conditions when the noise criteria in this consent do not apply; and
      - compliance with the relevant conditions of this consent.
   (c) describe the proposed noise management system in detail, including:
      - nomination of the real-time noise monitoring locations and the noise levels that would trigger additional noise management actions;
      - a matrix of predetermined actions to be employed when trigger levels are exceeded; and
      - procedures for varying the rates and locations of attended monitoring should the real-time monitoring data suggest that the relevant noise limits are being exceeded;
   (d) include a risk/response matrix to codify mine operational responses to varying levels of risk resulting from weather conditions and specific mining activities;
   (e) include a noise monitoring program that:
      - uses attended monitoring to evaluate the performance of the development, including a minimum of four days attended monitoring per quarter at locations agreed to by the Director-General, or more regularly where required;
      - uses real-time monitoring to support the proactive and reactive noise management system on site;
      - evaluates and reports on the effectiveness of the noise management system on site;
      - provides for the annual validation of the noise model for the development; and
   (f) include a protocol that has been prepared in consultation with the owners of nearby mines (Mt Thorley Warkworth, Wambo, Ravensworth and HVO South mines) to minimise the cumulative noise impacts of these mines and the development.

METEOROLOGICAL MONITORING

11. The Applicant shall maintain a permanent meteorological station at a location approved by the EPA, and to the satisfaction of the Director-General, to monitor the parameters specified in Table 13, using the specified units of measure, averaging period, frequency, and sampling method in the table.

Table 11: Meteorological monitoring

Parameter	***Units of measure***	***Averaging period***	**Frequency**	***Sampling method*** [1]
Lapse rate	*°C/100m*	*1 hour*	Continuous	*Note* [2]
Rainfall	*mm/hr*	*1 hour*	Continuous	*AM-4*
Sigma Theta @ 10 m	*°*	*1 hour*	*Continuous*	*AM-2*
Siting	-	-	-	*AM-1*

Parameter	*Units of measure*	*Averaging period*	Frequency	*Sampling method*[1]
Temperature @ 10 m	*K*	*1 hour*	*Continuous*	*AM-4*
Temperature @ 2 m	*K*	*1 hour*	*Continuous*	*AM-4*
Total Solar Radiation @ 2m	*W/m*^{2}	*1 hour*	*Continuous*	*AM-4*
Wind Direction @ 10 m	°	*1 hour*	*Continuous*	*AM-2*
Wind Speed @ 10 m	*m/s*	*1 hour*	Continuous	*AM-2*

[1] NSW EPA, 2001, Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.
[2]The Applicant shall calculate lapse rate from measurements made at 2m and 10m or any improved system of the determination of inversions.

BLASTING & VIBRATION

Airblast Overpressure Limits

12. The Applicant shall ensure that the airblast overpressure level from blasting at the development does not exceed the criteria in Table 14 at any residence on privately-owned land.

Table 12: Airblast overpressure impact assessment criteria

Airblast overpressure level (dB(Lin Peak))	Allowable exceedance
115	5% of the total number of blasts in a 12 month period
120	0%

Ground Vibration Impact Assessment Criteria

13. The Applicant shall ensure that the ground vibration level from blasting at the development does not exceed the criteria in Table 15 at any residence on privately-owned land.

Table 13: Ground vibration impact assessment criteria

Peak particle velocity (mm/s)	Allowable exceedance
5	5% of the total number of blasts in a 12 month period
10	0%

Blasting Hours

14. The Applicant shall only carry out blasting at the development between 7 am and 6 pm Monday to Saturday inclusive. No blasting is allowed on Sundays, Public Holidays or any other time without the written approval of the EPA.

Blasting Frequency

14A. The Applicant may carry out a maximum of:
(a) 3 blasts a day, unless an additional blast is required following a blast misfire; and
(b) 12 blasts a week,
for all open cut mining operations at the HVO North mine.

This condition does not apply to blasts that generate ground vibration of 0.5 mm/s or less at any residence on privately-owned land, or to blasts required to ensure the safety of the mine or its workers.

Note: For the purposes of this condition, a blast refers to a single blast event, which may involve a number of individual blasts fired in quick succession in a discrete area of the mine.

Interactions With Adjoining Mines

15. Prior to carrying out any mining or associated development within 500 metres of active mining areas at Ravensworth Operations, the Applicant shall enter into an agreement with Ravensworth Operations Pty Ltd (or its assigns or successors in title) to address the potential interactions between the two mines. If during the course of entering into this agreement, or subsequently implementing this

agreement, there is a dispute between the parties about any aspect of the agreement, then either party may refer the matter to the Director-General for resolution.

16. Prior to carrying out any mining or associated development within 500 metres of active mining areas at Cumnock No. 1 Colliery, the Applicant shall enter into an agreement with Cumnock No. 1 Colliery Pty Ltd (or its assigns or successors in title) to address the potential interactions between the two mines. If during the course of entering into this agreement, or subsequently implementing this agreement, there is a dispute between the parties about any aspect of the agreement, then either party may refer the matter to the Director-General for resolution.

Property Inspections

16A. If the Applicant receives a written request from the owner of any privately-owned land within 2 kilometres of the approved open cut mining pit/s on site for a property inspection to establish the baseline condition of any buildings and/or structures on his/her land, or to have a previous property inspection updated, then within 2 months of receiving this request the Applicant shall:

(a) provide the Director-General with a report that:
- establishes the baseline condition of any buildings and other structures on the land, or updates the previous property inspection report; and
- identifies measures that should be implemented to minimise the potential blasting impacts of the development on these buildings and/or structures; and

(b) provide the landowner with a copy of the new or updated property inspection report.

The report is to be prepared by a suitably qualified, experienced and independent person, whose appointment is acceptable to both parties. If there is a dispute over the selection of the suitably qualified, experienced and independent person, or the Applicant or the landowner disagrees with the findings of the inspection report, either party may refer the matter to the Director-General for resolution.

If the Applicant considers that an extension of time is required to complete the report, the Applicant may apply in writing to the Director-General for an extension. The Applicant shall provide a copy of the request and of the Director-General's decision to the landowner.

Property Investigations

16B. If the owner of any privately-owned land claims that buildings and/or structures on his/her land have been damaged as a result of blasting on the site, then within 2 months of receiving this claim the Applicant shall:

(a) provide the Director-General with a report that:
- investigates the claim; and
- identifies measures or works that should be implemented to rectify any blasting impacts of the development on these buildings and/or structures; and

(b) provide the landowner with a copy of the claim inspection report and recommendations.

If this independent property investigation confirms the landowner's claim, and both parties agree with these findings, then the Applicant shall repair the damage to the satisfaction of the Director-General.

The report is to be prepared by a suitably qualified, experienced and independent person, whose appointment is acceptable to both parties. If there is a dispute over the selection of the suitably qualified, experienced and independent person, or the Applicant or the landowner disagrees with the findings of the claim inspection report, either party may refer the matter to the Director-General for resolution.

If the Applicant considers that an extension of time is required to complete the report, the Applicant may apply in writing to the Director-General for an extension. The Applicant shall provide a copy of the request and of the Director-General's decision to the landowner.

Blasting Operating Conditions

17. During mining operations on site, the Applicant shall:

(a) implement best management practice to:
- protect the safety of people and livestock in the surrounding area;
- protect public or private infrastructure/property in the surrounding area from any damage; and
- minimise the dust and fume emissions of any blasting;

(b) minimise the frequency and duration of any road closures, and avoid road closures during peak traffic periods;

(c) co-ordinate the timing of blasting on site with the timing of blasting at nearby mines (including the Mt Thorley Warkworth, Wambo, Ravensworth and HVO South mines) to minimise the cumulative blasting impacts of these mines and HVO North mine; and
(d) operate a suitable system to enable the public to get up-to-date information on the proposed blasting schedule on site,
to the satisfaction of the Director-General.

18. The Applicant shall not undertake blasting on site within 500 metres of:
(a) any public road without the approval of the appropriate road authority; or
(b) any land outside the site that is not owned by the Applicant; unless
- the Applicant has a written agreement with the relevant landowner to allow blasting to be carried out closer to the land, and the Applicant has advised the Department in writing of the terms of this agreement, or
- the Applicant has:
  - demonstrated to the satisfaction of the Director-General that the blasting can be carried out closer to the land without compromising the safety of the people or livestock on the land, or damaging the buildings and/or structures on the land; and
  - updated the Blast Management Plan to include the specific measures that would be implemented while blasting is being carried out within 500 metres of the land.

Blast Management Plan

19. The Applicant shall prepare and implement a Blast Management Plan for the development to the satisfaction of the Director-General. This plan must:
(a) be submitted to the Director-General for approval by the end of September 2013 unless otherwise agreed;
(b) propose and justify any alternative ground vibration limits for any public infrastructure in the vicinity of the site;
(c) describe the measures that would be implemented to ensure:
- best management practice is being employed;
- compliance with the relevant conditions of this consent;
- that blasting will not cause damage to the Carrington West Wing Groundwater Barrier (LPB) as described in Condition 23 of Schedule 4.

(d) include a road closure management plan for blasting within 500 metres of a public road, that has been prepared in consultation with the RMS and Council;
(e) include a specific blast fume management protocol to demonstrate how emissions will be minimised including risk management strategies if blast fumes are generated;
(f) include a monitoring program for evaluating the performance of the development, including:
- compliance with the applicable criteria;
- minimising the fume emissions from the site; and

(g) include a protocol that has been prepared in consultation with the owners of nearby mines (including the Mt Thorley Warkworth, Wambo, Ravensworth and HVO South mines) to minimise the cumulative blasting impacts of these mines and the HVO North mine.

[3]SURFACE & GROUND WATER

Note: Under the Water Act 1912 and/or Water Management Act 2000, the Applicant is required to obtain the necessary water licences and approvals for the development.

Pollution of Waters

20. Except as may be expressly provided by an EPA licence, the Applicant shall comply with section 120 of the *Protection of the Environment Operations Act 1997* during the carrying out of the development.

Water Supply

20A. The Applicant shall ensure that it has sufficient water for all stages of the development, and if necessary, adjust the scale of mining operations to match its available water supply, to the satisfaction of the Director-General.

Compensatory Water Supply

20B. The Applicant shall provide compensatory water supply to any landowner of privately-owned land whose water supply is adversely and directly impacted (other than an impact that is negligible) as a result of the development, in consultation with NOW, and to the satisfaction of the Director-General.

[3] Incorporates EPA GTA

The compensatory water supply measures must provide an alternative long-term supply of water that is equivalent to the loss attributed to the development. Equivalent water supply should be provided (at least on an interim basis) within 24 hours of the loss being identified, unless otherwise agreed with the landowner.

If the Applicant and the landowner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Director-General for resolution.

If the Applicant is unable to provide an alternative long-term supply of water, then the Applicant shall provide alternative compensation to the satisfaction of the Director-General.

Discharge Limits

21. Except as may be expressly provided by an EPA licence or the Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002 (or any subsequent version of the Regulation), the Applicant shall:
    (a) not discharge more than 237 ML/day from the licensed discharge points at HVO north of the Hunter River;
    (b) ensure that the discharges from licensed discharge points comply with the limits in Table 17:

Table 15: Discharge Limits

Pollutant	Units of measure	100 percentile concentration limit
pH	pH	6.5 ≤ pH ≤ 9.5
Non-filterable residue	mg/litre	NFR ≤ 120

Note: This condition does not authorise the pollution of waters by any other pollutants.

[4]Water Licensing

22. Prior to the renewal of a licence obtained under the *Water Act*, or 5 years after the issue date (whichever is first), the Applicant must undertake a comparison of predicted impacts, on water resources, in the EIS against actual impacts, to the satisfaction of the NOW.

Groundwater Barrier

22A. Within 2 years of commencing mining in the Carrington Pit Southern Extension, or as otherwise agreed with the Director-General, the Applicant shall construct a groundwater barrier wall across the eastern arm of the palaeochannel of the Hunter River, to the satisfaction of the Director-General and at a location no further south than shown in the figure "*Carrington River Red Gums, Billabong and Associated Infrastructure*" included in the *Carrington Pit Extension Response to Submissions Report*, dated May 2006.

22B. By 31 December 2006, or as otherwise agreed with the Director-General, the Applicant shall submit a report to the Department and the NOW that:
    (a) examines all reasonable and feasible options for the design and construction of the groundwater barrier wall (including matters such as materials, timing and method of construction, costs, projected initial and long-term effectiveness) to the satisfaction of the Director-General; and
    (b) recommends a preferred option for the approval of the Director-General.

Carrington West Wing Groundwater Barrier (LPB)

23. The Applicant shall design the Carrington West Wing LPB to the satisfaction of NOW and the Director-General. The detailed design must:
    (a) ensure that negligible movement of water can occur through the barrier in either direction over the long term;
    (b) be prepared by a suitably qualified and experienced expert/s;
    (c) be endorsed by NOW and approved by the Director-General, prior to construction of the LPB;
    (d) achieve the relevant performance measures including:
        - applicable permeability of 10^{-8} metres/second or less;
        - applicable Australian Standards (including AS 3798-2007); and

[4] Incorporates NOW GTAs

- hydraulic, geomorphologic and seismic stability which will withstand any blasting-related vibrations, mining operations, fluvial and weather events, decay corrosive and biological attack.

Note: The conceptual low permeability barrier is shown in Appendix 4.

24. Prior to undertaking any mining operations within 100 metres of the western arm of the Hunter River paleochannel, the Applicant shall:
    (a) install the LPB in the western arm of the paleochannel;
    (b) submit an as-executed report to the Director-General and NOW by a suitably qualified and experienced practising engineer, certifying that the LPB has been constructed to achieve the relevant performance measures set out in Condition 23(d) of Schedule 4; and
    (c) obtain endorsement on the installed LPB from NOW.

    If there is evidence after its installation that the LPB is not achieving the performance objective and performance measures in Condition 23 of Schedule 4, mining operations within 100 metres of the western arm of the Hunter River paleochannel must cease until approval to recommence is granted by the Director-General.

LPB Monitoring and Management Plan

25. The Applicant must prepare and implement a Low Permeability Barrier Monitoring and Management Plan to the satisfaction of NOW and the Director-General. The plan must:
    (a) address the monitoring and management of both the Carrington West Wing LPB and the Carrington Pit Southern Extension LPB;
    (b) be prepared by a suitably qualified and experienced expert;
    (c) be endorsed by NOW and approved by the Director-General, prior to construction of the Carrington West Wing LPB;
    (d) describe the monitoring and maintenance procedures to be implemented and the scheduling of these procedures;
    (e) demonstrate that the monitoring system is capable of timely detection of any failure or deficiency in either LPB; and
    (f) describe the contingency measures that will be implemented in the event of a failure or deficiency in either LPB.

Flood Design Works

26. The Applicant shall design and construct the flood levees and associated flood design works in the Carrington West Wing area at least 1.0 metres higher than the 1 in 100 year ARI flood event, to the satisfaction of NOW.

Water Management Plan

27. The Applicant shall prepare and implement a Water Management Plan for the HVO North mine to the satisfaction of the Director-General. This plan must be prepared in consultation with NOW and the EPA by suitably qualified and experienced persons whose appointment has been approved by the Director-General, and submitted to the Director-General by the end of September 2013 unless otherwise agreed. This plan must include:
    (a) a Site Water Balance that:
        - includes details of:
            - sources and security of water supply, including contingency planning for future reporting periods;
            - water use on site;
            - water management on site, including details of water sharing between neighbouring mining operations;
            - any off-site water transfers and discharges;
            - reporting procedures, including comparisons of the site water balance for each calendar year; and
        - describes the measures that would be implemented to minimise clean water use on site;
    (b) a Surface Water Management Plan, that includes:
        - detailed baseline data on surface water flows and quality in the waterbodies that could be affected by the development;
        - a detailed description of the water management system on site, including the:
            - clean water diversion systems and their final positioning;
            - erosion and sediment controls; and
            - water storages;
        - detailed plans, including design objectives and performance criteria, for:
            - design and management of the final voids;

- design and management of the evaporative sink;
- design and management of any tailings dams;
- ensuring the stability of high walls adjacent to low permeability barriers;
- establishment of drainage lines on the rehabilitated areas of the site; and
- control of any potential water pollution from the rehabilitated areas of the site;

- performance criteria for the following, including trigger levels for investigating any potentially adverse impacts associated with the development:
  - the water management system;
  - the stability of high walls adjacent to low permeability barriers;
  - surface water quality of the Hunter River; and
  - stream and riparian vegetation health of the Hunter River;
- a program to monitor:
  - the effectiveness of the water management system; and
  - surface water flows and quality, stream and riparian vegetation health in the Hunter River (in so far as it could potentially be affected by the development); and
- a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the development.

(c) a Groundwater Management Plan, which includes:

- detailed baseline data on groundwater levels, yield and quality in the region, and privately-owned groundwater bores, that could be affected by the development;
- groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts;
- a program to monitor:
  - groundwater inflows to the open cut mining operations;
  - the impacts of the development on:
    - the alluvial aquifers, including additional groundwater monitoring bores as required by NOW;
    - the effectiveness of the low permeability barrier;
    - base flows to the Hunter River;
    - any groundwater bores on privately-owned land that could be affected by the development; and
    - groundwater dependent ecosystems, including the River Red Gum Floodplain Woodland EEC located in the Hunter River alluvium;
  - the seepage/leachate from water storages, backfilled voids and the final void;
- a program to validate and recalibrate (if necessary) the groundwater model for the development, including an independent review of the model every 3 years, and comparison of monitoring results with modelled predictions; and
- a plan to respond to any exceedances of the groundwater assessment criteria.

Final Void Management Plan

28. At least 5 years before the cessation of open cut coal extraction that will result in the creation of a final void, or as otherwise agreed with the Director-General, the Applicant shall prepare and implement a Final Void Management Plan for each void, in consultation with DRE and NOW, and to the satisfaction of the Director-General. Each plan must:
    (a) assess locational, design and future use options;
    (b) be integrated with the Water Management Plan and the Rehabilitation Management Plan;
    (c) assess short term and long term groundwater and other impacts associated with each option; and
    (d) describe the measures to be would be implemented to avoid, minimise, manage and monitor potential adverse impacts of the final void over time.

Fine Reject Management Strategy

28A. The Applicant shall prepare and implement a life of mine fine reject management strategy to the satisfaction of the Director-General. The strategy must:
    (a) be prepared in consultation with DRE and NOW, and submitted to the Director-General for approval by 30 June 2015;
    (b) describe potential locations and design options for the emplacement of fine reject on site;
    (c) assess any material short term and long term impacts on surface and groundwater resources associated with each option;
    (d) describe the measures that would be implemented to avoid, minimise, manage and monitor any adverse impacts of the fine reject emplacements over time;
    (e) describe how the fine reject emplacements would be rehabilitated and describe potential options for future land uses; and
    (f) be integrated with the Rehabilitation Management Plan and Agricultural Land Reinstatement Management Plan for the mine.

[5]Temporary Crossing of the Hunter River

29. Prior to the commencement of any work within 40 metres of the Hunter River, a permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948* shall be obtained from the NOW. All works shall be:
    (a) undertaken in accordance with the permit application, except as otherwise provided by conditions of the permit;
    (c) designed and constructed such that the works do not cause sedimentation, erosion or permanent diversion of the Hunter River;
    (d) constructed in accordance with section 10.8 (Temporary Crossing of the Hunter River), volume 1 of the EIS, dated October 2003; and titled *"Hunter Valley Operations – West Pit Extension and Minor Modifications";* and
    (e) constructed in accordance with the Statement of Environmental Effects, prepared by Coal & Allied, dated August 2001, titled *"Proposed relocation of a dragline and electric rope shovel - Ravensworth and Hunter Valley Operations."*

    Notes:
    (a) Should Crown land, as defined under the Crown Lands Act 1989, be included in the temporary crossing, there is a requirement to seek approval from the Department of Lands under the Crown Lands Act; and
    (b) Any works on Crown public roads require the Department of Lands' approval and must satisfy the statutory requirements of the Roads Act 1993.

FAUNA & FLORA

Rehabilitation/Regeneration Strategy

30. The Applicant shall not destroy or disturb more than 1 mature river red gum in the river red gum population associated with the Carrington billabong, and ensure that the mining highwall is located at least 150 metres from the standing water line of the billabong.

31. By 30 June 2007, the Applicant shall prepare and implement a comprehensive Rehabilitation and Restoration Strategy for the Carrington billabong and river red gum population, in consultation with NOW, and to the satisfaction of the Director-General. This strategy must be prepared by suitably qualified expert/s, and must include:
    (a) the rehabilitation and restoration objectives for the billabong and associated river red gum population;
    (b) a description of the short, medium and long term measures that would be implemented to rehabilitate and restore the billabong and associated river red gum population (including measures to address matters which affect the long term health and sustainability of the billabong and river red gums such as surface and ground water supply, and controlling weeds, livestock and feral animals); and
    (c) detailed assessment and completion criteria for the rehabilitation and restoration of the billabong and associated river red gum population.

    Note. The billabong, standing water line and river red gum population referred to are the billabong, standing water line and endangered population of river red gums located on land owned by the Applicant between the Hunter River and Levee 5, as shown in the figure "Carrington River Red Gums, Billabong and Associated Infrastructure" included in the Carrington Pit Extension Response to Submissions Report, dated May 2006.

32. By 30 June 2007, the Applicant shall prepare and implement a conceptual Landscape and Rehabilitation Management Strategy, in consultation with affected agencies, to the satisfaction of the Director-General. The strategy must:
    (a) include objectives for landscape management and rehabilitation of the site and a justification for the proposed strategy;
    (b) present a conceptual plan for landscape management and rehabilitation of the site;
    (c) be integrated with the relevant requirements of the Mining Operations Plan;
    (d) describe the measures that would be implemented to achieve the objectives (including an indicative timetable for mine closure);
    (e) include proposals to offset the flora and fauna impacts of the development (including proposals resulting from condition 31 above), and an outline of how the strategy would integrate with existing and planned corridors of native vegetation in areas surrounding the development; and
    (f) outline how the proposed strategy would be integrated with the landscape management and rehabilitation of the other operations within Hunter Valley Operations (both north and south of the Hunter River) and other coal mines in the vicinity.

[5] Incorporates NOW GTAs

Strategic Study Contribution

33. If, during the development, the Department or the OEH commissions a strategic study into the regional vegetation corridor stretching from the Wollemi National Park to the Barrington Tops National Park, then the Applicant shall contribute a reasonable amount, up to $10,000, towards the completion of this study.

Operating Conditions

34. The Applicant shall salvage and reuse as much material as possible from the land that will be mined, such as soil, seeds, tree hollows, rocks and logs. Cleared vegetation must be reused or recycled to the greatest extent practicable. No burning of cleared vegetation shall be permitted. Reuse options including removing millable logs, recovering fence posts, mulching and chipping unusable vegetation waste for on-site use are to be implemented.

Flora and Fauna Management

35. The Applicant shall prepare and implement procedures for the management of flora and fauna for the development. These procedures shall:
    (a) provide details on:
        - delineating areas of disturbance;
        - protecting areas outside of the disturbance areas;
        - identifying when pre-clearance surveys are required for fauna;
        - determining the best time to clear vegetation to avoid nesting/breeding activities of threatened fauna;
        - capturing and releasing fauna;
        - relocating bat roosts;
        - salvaging habitat resources and collecting seed;
        - controlling weeds in regeneration/rehabilitation areas; and
        - controlling access to the regeneration/rehabilitation areas;
    (b) describe how the land in regeneration areas would be revegetated;
    (c) describe how the mined areas would be rehabilitated for grazing and biodiversity values;
    (d) identify actions to minimise the potential impacts of the development on threatened fauna;
    (e) describe how the performance of the revegetation/rehabilitation strategies would be monitored over time including, as a minimum, the parameters in Table 18; and
    (f) identify who is responsible for monitoring, reviewing, and implementing the procedures.

    The Applicant shall submit a copy of these procedures to the Director-General for approval within 6 months of the date of this consent.

Table 16: Parameters and Units of Measure for Fauna and Flora Monitoring

Parameter	***Units of measure***
Density of vegetation	*Plants/m^2*
	Understorey
	Ground cover
Diversity of flora	*Species/m^2*
Age/maturity of flora	*Vegetation height/diameter/form*
Vegetation health	-
Disturbance	*Weeds/m^2*
	Erosion
	Feral animals
	Stock
Density of fauna	*Fauna (Avian/Mammals/Reptiles-Amphibians)/m^2*
Diversity of fauna	*Species/m^2*
Density of fauna habitat	*Hollow-bearing trees/nesting sites/ logs/dams, etc.* *Habitat Complexity Score*
Ecosystem Function	*Landscape Function Analysis*

Note: The requirements of condition 35 may be satisfied within the Rehabilitation Management Plan required under Condition 62C of Schedule 4.

Annual Review

36. The Applicant shall
    (a) review the performance of the flora & fauna management procedures annually, and, if necessary,
    (b) revise these documents to take into account any recommendations from the annual review.

[6]ABORIGINAL CULTURAL HERITAGE

Note: The Applicant is required to obtain consent from the OEH under the National Parks and Wildlife Act 1974 to destroy Aboriginal sites and objects on the site. The OEH has issued General Terms of Approval for the sites listed in condition 37.

West Pit Extension - Consents to Destroy

37. The Applicant shall obtain consent from OEH to destroy the following sites:

- WPE 1
- WPE 2
- WPE 3
- WPE 4
- WPE 5
- WPE 6
- WPE 7
- WPE 8
- WPE 9
- WPE 10
- WPE 11
- 37-2-1964
- 37-2-1965
- 37-2-1966
- 37-2-1967
- 37-2-0038
- 37-2-0144
- 37-2-0894
- 37-2-0896
- 37-2-0805

West Pit Extension - Salvage

38. Before making application for section 90 consents under NP&W Act, the Applicant shall prepare a salvage program for the sites listed in condition 37 in consultation with the OEH and Aboriginal communities, and to the satisfaction of the OEH.

39. The Applicant shall obtain consent under the *National Parks and Wildlife Act 1974* to destroy the following sites:

- 37-2-0145
- 37-2-0147
- 37-2-0148
- 37-2-0523
- 37-2-0524
- 37-2-0525
- 37-2-0526
- 37-2-0527
- 37-2-0528
- 37-2-0562
- 37-2-0777
- 37-2-0778
- 37-2-0779
- 37-2-0780
- 37-2-0781
- 37-2-0782
- 37-2-0783
- 37-2-0784
- 37-2-0785
- 37-2-0786
- 37-2-2078 (C1)
- 37-2-2079 (C2)
- 37-2-2080 (C3)
- 37-5-0494 (C4)
- 37-2-2083 (C8)
- 37-2-2084 (C9)
- 37-2-0787
- 37-2-0788
- 37-2-0789
- 37-2-0790
- 37-2-0791
- 37-2-0792
- 37-2-0793
- 37-2-0794
- 37-2-0795
- 37-2-0796
- 37-2-0895
- 37-2-1865
- 37-2-1866
- 37-2-1867
- 37-2-1868
- 37-2-1869
- 37-2-1870
- 37-2-1871
- 37-2-1872
- IF1
- 37-2-2085 (C10)
- 37-2-1962 (CM45)
- 37-2-1963 (CM46)
- 37-2-1504 (CM1)
- 37-2-1505 (CM2)
- 37-2-1522 (CM19)
- TD
- TG
- 37-2-1504
- 37-2-1522
- 37-2-1535
- 37-2-1864
- 37-2-1874
- 37-2-1875
- 37-2-1876
- 37-2-1962
- 37-2-1963
- 37-5-0061
- 37-2-1861
- 37-2-1862
- 37-2-1873
- 37-2-1860
- 37-5-0131
- 37-3-0286
- 37-5-0061
- 37-1-0399
- 37-2-1535 (CM32)
- 37-2-2754
- 37-2-2755
- 37-2-2756
- 37-2-2757

Aboriginal Heritage Site 37-2-1877 (CM-CD1)

40. Mining operations and associated activities in the Carrington West Wing area are not permitted to be carried out within 20 metres of Aboriginal heritage site 37-2-1877 (CM-CD1) and the Older Stratum as shown on the plan in Appendix 5.

    Note: for clarification purposes, Condition 40 of Schedule 4 does not prohibit heritage surveys and studies to be undertaken within CM-CD1 or within 20 metres of CM-CD1 and the Older Stratum.

40A. The Applicant must ensure that mining operations (including blasting) and associated activities do not cause any impact to Aboriginal heritage site 37-2-1877 (CM-CD1) and the Older Stratum.

[6] Incorporates OEH GTAs.

Heritage Management Plan

41. The Applicant shall prepare and implement a Heritage Management Plan for the development to the satisfaction of the Director-General. This plan must:
    (a) be prepared by suitably qualified and experienced persons whose appointment has been endorsed by the Director-General;
    (b) be prepared in consultation with OEH and the Aboriginal stakeholders (in relation to the management of Aboriginal heritage values);
    (c) be submitted to the Director-General for approval by the end of June 2013, unless the Director-General agrees otherwise;
    (d) include the following for the management of Aboriginal Heritage:
        - a detailed plan of management for Aboriginal heritage site 37-2-1877 (CM-CD1) including a description of the measures that would be implemented to protect, monitor and manage the site from mining operations and associated activities;
        - a description of the measures that would be implemented for:
            - managing heritage items on the site, including any proposed archaeological investigations and/or salvage measures;
            - managing the discovery of any human remains or previously unidentified Aboriginal objects on site;
            - maintaining and managing reasonable access for Aboriginal stakeholders to heritage items on site;
            - ongoing consultation with the Aboriginal stakeholders on the conservation and management of Aboriginal cultural heritage both on-site and within any Aboriginal heritage conservation areas; and
            - ensuring any workers on site receive suitable heritage inductions prior to carrying out any development on site, and that suitable records are kept of these inductions; and
        - a strategy for the storage of any heritage items salvaged on site, both during the development and in the long term.

41A. Prior to disturbance by mining, the Applicant shall ensure that the scarred tree 37-2-2080 (C3) is removed and relocated to a site where it will be protected from future development, in consultation with the Wonnarua Tribal Council, and to the satisfaction of the Director-General.

Note: In conditions 37 – 41A, all seven-figure numbers refer to Aboriginal site listings in OEH's Aboriginal Heritage Information Management System (AHIMS). All other numbers are site numbers used by the Applicant in on-site Aboriginal heritage studies. Site numbers beginning with C or CM are associated with the Carrington Pit, as shown in Fig 5.1 of Annex G of the Carrington Pit Extended Statement of Environmental Effects.

Trust Fund Contribution

42. Before carrying out the development, or as agreed otherwise by the Director-General, the Applicant shall contribute $20,000 to the Hunter Aboriginal Cultural Heritage Trust Fund for further investigations into Aboriginal cultural heritage, as defined by the Trust Deed.

TRAFFIC & TRANSPORT

New Access Intersection to Hunter Valley Loading Point

Note: The Applicant requires Council approval under the Roads Act 1993 for the new road entry from Liddell Station Road to the Hunter Valley Loading Point.

43. [7]The Applicant shall design, construct and maintain for the duration of this consent, the proposed new access intersection from Liddell Station Road to the Hunter Valley Loading Point to the satisfaction of the Council.

Road Closure

Note: The Applicant requires MSC approval under the Roads Act 1993 prior to closing a section of Pikes Gully Road.

44. Within 12 months of the date of this consent, unless otherwise agreed by the Director-General, the Applicant is to complete the relevant requirements to enable the section of Pikes Gully Road situated in the Muswellbrook local government area to be closed as a public road.

[7] Incorporates Council GTA

45. The Applicant shall not blast within 500 metres of a public road while the road is open to the public. Any road closures with respect of blasting shall be subject to a plan of management approved by Council.

Lemington Road

46. The Applicant shall reimburse Council for any road upgrading works undertaken on Lemington Road, to a maximum amount of $30,000.

47. The Applicant shall alter or cease mining operations if driver visibility or traffic safety on Lemington Road is adversely affected by dust, in accordance with the requirements of Council.

48. The Applicant shall be responsible for the full cost of the maintenance of the Lemington Road deviation undertaken for the Carrington Pit until March 2011, in accordance with the standards and requirements of Council.

Intersection of Lemington Road and the Golden Highway

49. Within 2 years of the date of this consent, the Applicant shall upgrade the intersection of the Golden Highway (SH 27) and Lemington Road to a type "BAR" intersection with a sealed shoulder to the satisfaction of the RMS.

Road Safety Audit

49A.

(a) By 31 December 2006, the Applicant shall prepare and submit a road safety audit to the RMS and Council for all public roads used by mine employees and service vehicles in the vicinity of the development, including an audit of the existing intersections of all mine access roads with public roads;

(b) any improvement to meet accepted road safety standards required by the relevant road manager (ie the RMS or Council) for public roads as a result of impacts related to the development as identified by the audit shall be undertaken at the Applicant's cost and to the satisfaction of the road manager;

(c) any dispute between the Applicant and the relevant road manager in relation to the audit findings and the requirements of the road manager for improvements of public roads is to be determined by the Director-General; and

(d) any maintenance of line marking and sign posting required by the relevant road manager at existing intersections of mine access roads with public roads shall be undertaken at the Applicant's cost and to the satisfaction of the road manager.

Coal Haulage

50. [8]The Applicant shall ensure that spillage of coal from coal haulage vehicles is minimised and that sediment-laden runoff from roads is effectively managed, to the satisfaction of the Director-General. Measures that shall be implemented include:
(a) covering all loads where loaded coal trucks leave the site and enter public roads;
(b) ensuring the gunwhales of all loaded trucks are clean of coal;
(c) providing effective wheel wash facilities at all coal load and unload facilities prior to vehicles entering public roads; and
(d) sweeping, at regular intervals and at the completion of campaign hauls, public roads used for the transportation of coal.

51. The Applicant shall enter into an agreement with Council for the maintenance of the sections of Pikes Gully Road and Liddell Station Road whilst used by the Applicant for the haulage of coal, and during the period the roads are owned by Council.

Monitoring

52. The Applicant shall maintain and include in each AEMR records of the:
(a) amount of coal transported from the site each year;
(b) amount of coal received from Hunter Valley Operations south of the Hunter River;
(c) amount of coal hauled by road to the Hunter Valley Loading Point;
(d) amount of coal hauled by road to the Newdell Loading Point;
(e) amount of coal hauled by road from the Newdell Loading Point to the Ravensworth coal Terminal;

[8] This may include the use of sediment dams or the incorporation of runoff into the mine water management system.

(f) amount of coal hauled by road from the Hunter Valley Loading Point to the Ravensworth Coal Terminal; and
(g) number of coal haulage truck movements generated by the development.

VISUAL IMPACT

Visual Amenity

53. The Applicant shall implement measures to mitigate visual impacts including:
(a) design and construction of development infrastructure in a manner that minimises visual contrasts; and
(b) progressive rehabilitation of mine waste rock emplacements (particularly outer batters), including partial rehabilitation of temporarily inactive areas.

54. The Applicant shall plant trees to provide an effective visual screen from Lemington Road in the vicinity of the Belt Line Road and adjacent to the Mitchell pit area. The plan for this tree planting is to:
(a) provide for tree planting within 2 years of the date of this consent;
(b) achieve an 80% survival rate by the 5th year;
(c) be submitted to DRE and Director-General for review and approval; and
(d) provide an assessment of whether visual bunds are required to supplement the vegetative visual screen.

Lighting Emissions

55. The Applicant shall take all practicable measures to mitigate off-site lighting impacts from the development.

56. All external lighting associated with the development shall comply with *Australian Standard AS4282 (INT) 1995 – Control of Obtrusive Effects of Outdoor Lighting*.

WASTE MINIMISATION

57. The Applicant shall minimise the amount of waste generated by the development to the satisfaction of the Director-General.

HAZARDS MANAGEMENT

Spontaneous Combustion

58. The Applicant shall:
(a) take the necessary measures to prevent, as far as is practical, spontaneous combustion on the site; and
(b) manage any spontaneous combustion on-site to the satisfaction of DRE.

Dangerous Goods

59. The Applicant shall ensure that the storage, handling, and transport of:
(a) dangerous goods is done in accordance with the relevant *Australian Standards*, particularly *AS1940* and *AS1596*, and the *Dangerous Goods Code*; and
(b) explosives are managed in accordance with the requirements of DRE.

BUSHFIRE MANAGEMENT

60. The Applicant shall:
(a) ensure that the development is suitably equipped to respond to any fires on-site; and
(b) assist the Rural Fire Service and emergency services as much as possible if there is a fire on-site during the development.

61. The Applicant shall ensure that the Bushfire Management Plan for the site, is to the satisfaction of Council and the Rural Fire Service.

REHABILITATION

Rehabilitation Objectives

62. The Applicant shall rehabilitate the site to the satisfaction of the Executive Director Mineral Resources. The rehabilitation must be generally in accordance with the proposed rehabilitation

strategy described by the documents listed in Condition 2 of Schedule 3 (and depicted conceptually in the final landform plans in Appendices 6 and 7) and the objectives in Table 17.

Table 17: Rehabilitation Objectives

Area/Domain	Rehabilitation Objectives
Mine site (as a whole), including the final void	Safe, stable & non-polluting
Carrington West Wing revised proposed extension area	Reinstatement of Rural Land Capability agricultural land values to be measured as: 65.0 hectares of Class II and 65.0 hectares of Class III
Surface infrastructure	To be decommissioned and removed, unless the Executive Director Mineral Resources agrees otherwise
Community	Ensure public safety Minimise the adverse socio-economic effects associated with mine closure

Note: The Carrington West Wing revised proposed extension area is shown in Appendix 5.

Operating Conditions

62A. The Applicant shall:

(a) develop a detailed soil management protocol that identifies procedures for
- comprehensive soil surveys prior to soil stripping;
- assessment of top-soil and sub-soil suitability for mine rehabilitation; and
- annual soil balances to manage soil handling including direct respreading and stockpiling;

(b) maximise the salvage of suitable top-soils and sub-soils and biodiversity habitat components such as bush rocks, tree hollows and fallen timber for rehabilitation of disturbed areas within the site and for enhancement of biodiversity offset areas;

(c) ensure that coal reject or any potentially acid forming interburden materials must not be emplaced at elevations within the pit shell or out of pit emplacement areas where they may promote acid or sulphate species generation and migration beyond the pit shell or out of pit emplacement areas; and

(d) ensure that no dirty water can drain from an out of pit emplacement area to any offsite watercourse or to any land beyond the lease boundary.

Progressive Rehabilitation

62B. The Applicant shall carry out rehabilitation of the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable and feasible measures must be taken to minimise the total area exposed for dust generation at any time. Interim rehabilitation strategies shall be employed when areas prone to dust generation cannot yet be permanently rehabilitated.

Note: It is accepted that some parts of the site that are progressively rehabilitated may be subject to further disturbance at some later stage in the development.

Rehabilitation Management Plan

62C. The Applicant shall prepare and implement a Rehabilitation Management Plan for the HVO North mine to the satisfaction of the Executive Director Mineral Resources. This plan must:

(a) be prepared in consultation with the Department, NOW, OEH, Council and the CCC;

(b) be submitted to the Executive Director Mineral Resources by the end of September 2013;

(c) be prepared in accordance with any relevant DRE guideline;

(d) include an Agricultural Land Reinstatement Management Plan;

(e) include detailed performance and completion criteria for evaluating the achievement of the rehabilitation objectives in Table 17 and the overall rehabilitation of the site, and triggering remedial action (if necessary);

(f) include proposals to offset the flora and fauna impacts of the development (including proposals resulting from condition 31 above), and an outline of how the plan would integrate with existing and planned corridors of native vegetation in areas surrounding the development;

(g) describe the measures that would be implemented to ensure compliance with the relevant conditions of this consent, and address all aspects of rehabilitation including mine closure, final landform and final land use;

(h) outline how the proposed plan would be integrated with the landscape management and rehabilitation of the other operations within Hunter Valley Operations (both north and south of the Hunter River) and other coal mines in the vicinity;

(i) include interim rehabilitation where necessary to minimise the area exposed for dust generation;

(j) include a program to monitor, independently audit and report on the effectiveness of the measures, and progress against the detailed performance and completion criteria; and

(k) build to the maximum extent practicable on the other management plans required under this consent.

Agricultural Land Reinstatement Management Plan

62D. The Agricultural Land Reinstatement Management Plan required under Condition 62C of Schedule 4 is intended to ensure that the alluvial lands are restored to a productive capacity at least equivalent to their pre-mining state and are able to be managed using techniques and equipment common to management of equivalent lands in the district. The plan must:

(a) be prepared in consultation with DPI and to the satisfaction of the Director-General;

(b) be prepared in accordance with any relevant DPI guideline;

(c) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the Carrington West Wing revised proposed extension area, and triggering remedial action (if necessary);

(d) include a long-term monitoring programme on the success of reinstating alluvial lands, which must:

- assess a comprehensive suite of indicators of productivity and environmental sustainability (such as soil settling, soil profile development, other soil characteristics, water transmissivity and soil water availability, agricultural productivity, fertilizer needs, weeds and pests) over an extended period (a minimum of 20 years);
- compare the performance of the reinstated alluvial lands with a reference site; and
- make monitoring results publicly available.

(e) in accordance with Condition 4(h) of Schedule 6 provide for reviews of progress against the plan every 3 years (unless otherwise agreed by the Director-General after completion of the second review) and for a final review by the end of 2033.

Note: The Carrington West Wing revised proposed extension area is shown in Appendix 5.

MINE EXIT STRATEGY

63. Within 5 years of the date of this consent, the Applicant shall work with the Council and MSC to investigate the minimisation of adverse socio-economic effects of a significant reduction in local employment levels and closure of the development at the end of its life.

SCHEDULE 5
ADDITIONAL PROCEDURES FOR AIR QUALITY AND NOISE MANAGEMENT

Notification of Landowners/Tenants

1. By the end of September 2013, the Applicant shall:
   (a) notify in writing any remaining private owners of:
      - the land listed in Table 1 of schedule 4 that they have the right to require the Applicant to acquire their land at any stage during the development;
      - any residence on the land listed in Table 1 of schedule 4 that they have the right to request the Applicant to ask for additional noise and/or air quality mitigation measures to be installed at their residence at any stage during the development; and
      - any privately-owned land within 2 kilometres of the approved open cut mining pit/s that they are entitled to ask for an inspection to establish the baseline condition of any buildings or structures on their land, or to have a previous property inspection report updated;
   (b) notify the tenants of any mine-owned land of their rights under this approval; and
   (c) send a copy of the NSW Health fact sheet entitled "Mine Dust and You" (as may be updated from time to time) to the owners and/or existing tenants of any land (including mine-owned land) where the predictions in the documents listed in condition 2 of schedule 3 identify that dust emissions generated by the development are likely to be greater than any air quality criteria in schedule 4 at any time during the life of the development.

2. Prior to entering into any tenancy agreement for any land owned by the Applicant that is predicted to experience exceedances of the recommended dust and/or noise criteria, or for any of the land listed in Table 1 purchased by the Applicant, the Applicant shall:
   (a) advise the prospective tenants of the potential health and amenity impacts associated with living on the land, and give them a copy of the NSW Health fact sheet entitled "Mine Dust and You" (as may be updated from time to time);
   (b) advise the prospective tenants of the rights they would have under this approval; and
   (c) request the prospective tenants consult their medical practitioner to discuss the air quality monitoring data and prediction and health impacts arising from this information,

   to the satisfaction of the Director-General.

3. As soon as practicable after obtaining monitoring results showing:
   (a) an exceedance of any criteria in schedule 4, the Applicant shall:
      - notify each affected landowner and/or tenant of the land (including the tenants of any mine-owned land) in writing of the exceedance; and
      - provide each affected party with regular monitoring results until the development is again complying with the relevant criteria; and
   (b) an exceedance of the air quality criteria in schedule 4, the Applicant shall additionally provide each affected party with:
      - a copy of the NSW Health fact sheet entitled "Mine Dust and You" (as may be updated from time to time), if not recently provided; and
      - monitoring data in an appropriate format such that the party's medical practitioner can assist them in making an informed decision on the health risks associated with continued occupation of the property,

   to the satisfaction of the Director-General.

Independent Review

4. If an owner of privately-owned land considers the development to be exceeding the criteria in Schedule 4, then he/she may ask the Director-General in writing for an independent review of the impacts of the development on his/her land.

   If the Director-General is satisfied that an independent review is warranted, then within 2 months of the Director-General's decision, the Applicant shall:
   (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Director-General, to:
      - consult with the landowner to determine his/her concerns;
      - conduct monitoring to determine whether the development is complying with the relevant impact assessment criteria in Schedule 4; and
      - if the development is not complying with these criteria then:
         - determine if more than one mine is responsible for the exceedance, and if so the relative share of each mine regarding the impact on the land;
         - identify the measures that could be implemented to ensure compliance with the relevant criteria; and
   (b) give the Director-General and landowner a copy of the independent review.

5. If the independent review determines that the development is complying with the criteria in Schedule 4, then the Applicant may discontinue the independent review with the approval of the Director-General.

If the independent review determines that the development is not complying with the criteria in Schedule 4, and that the development is primarily responsible for this non-compliance, then the Applicant shall:

(a) implement all reasonable and feasible mitigation measures, in consultation with the landowner and appointed independent person, and conduct further monitoring until the development complies with the relevant criteria; or

(b) secure a written agreement with the landowner to allow exceedances of the relevant impact assessment criteria,

to the satisfaction of the Director-General.

If the independent review determines that the development is not complying with the relevant acquisition criteria in Schedule 4, and that the development is primarily response for this non-compliance, then upon receiving a written request from the landowner, the Applicant shall acquire all or part of the landowner's land in accordance with the procedures in Conditions 7 and 8 below.

6. If the independent review determines that the relevant criteria are being exceeded, but that more than one mine is responsible for this exceedance, then together with the relevant mine/s the Applicant shall:

(a) implement all reasonable and feasible mitigation measures, in consultation with the landowner and appointed independent person, and conduct further monitoring until there is compliance with the relevant criteria; or

(b) secure a written agreement with the landowner and other relevant mine/s to allow exceedances of the relevant impact assessment criteria,

to the satisfaction of the Director-General.

If the independent review determines that the development is not complying with the relevant acquisition criteria in Schedule 4, but that more than one mine is responsible for the exceedance, then upon receiving a written request from the landowner, the Applicant shall acquire all or part of the landowner's land on as equitable a basis as possible with the relevant mine/s in accordance with the procedures in Conditions 7 and 8 below.

Land Acquisition

7. Within 3 months of receiving a written request from a landowner with acquisition rights, the Applicant shall make a binding written offer to the landowner based on:

(a) the current market value of the landowner's interest in the land at the date of this written request, as if the land was unaffected by the development, having regard to the:
- existing and permissible use of the land, in accordance with the applicable planning instruments at the date of the written request; and
- presence of improvements on the land and/or any approved building or structure which has been physically commenced on the land at the date of the landowner's written request, and is due to be completed subsequent to that date;

(b) the reasonable costs associated with:
- relocating within the Singleton or Muswellbrook local government areas, or to any other local government area determined by the Director-General; and
- obtaining legal advice and expert advice for determining the acquisition price of the land, and the terms upon which it is to be acquired; and

(c) reasonable compensation for any disturbance caused by the land acquisition process.

However, if at the end of this period, the Applicant and landowner cannot agree on the acquisition price of the land and/or the terms upon which the land is to be acquired, then either party may refer the matter to the Director-General for resolution.

Upon receiving such a request, the Director-General will request the President of the NSW Division of the Australian Property Institute (the API) to appoint a qualified independent valuer to:
- consider submissions from both parties;
- determine a fair and reasonable acquisition price for the land and/or the terms upon which the land is to be acquired, having regard to the matters referred to in paragraphs (a)-(c) above;
- prepare a detailed report setting out the reasons for any determination; and
- provide a copy of the report to both parties.

Within 14 days of receiving the independent valuer's report, the Applicant shall make a binding written offer to the landowner to purchase the land at a price not less than the independent valuer's determination.

However, if either party disputes the independent valuer's determination, then within 14 days of receiving the independent valuer's report, they may refer the matter to the Director-General for review. Any request for a review must be accompanied by a detailed report setting out the reasons why the party disputes the independent valuer's determination. Following consultation with the independent valuer and both parties, the Director-General will determine a fair and reasonable acquisition price for the land, having regard to the matters referred to in paragraphs (a)-(c) above, the independent valuer's report, the detailed report disputing the independent valuer's determination, and any other relevant submissions.

Within 14 days of this determination, the Applicant shall make a binding written offer to the landowner to purchase the land at a price not less than the Director-General's determination.

If the landowner refuses to accept the Applicant's binding written offer under this condition within 6 months of the offer being made, then the Applicant's obligations to acquire the land shall cease, unless the Director-General determines otherwise.

8. The Applicant shall pay all reasonable costs associated with the land acquisition process described in Condition 7 above, including the costs associated with obtaining Council approval for any plan of subdivision (where permissible), and registration of this plan at the Office of the Registrar-General.

SCHEDULE 6
ENVIRONMENTAL MANAGEMENT, MONITORING, AUDITING & REPORTING

ENVIRONMENTAL MANAGEMENT STRATEGY

1. Within 6 months of the date of this consent, the Applicant shall prepare and implement an Environmental Management Strategy for the development to the satisfaction of the Director-General. This strategy must:
   (a) provide the strategic context for environmental management of the development;
   (b) identify the statutory requirements that apply to the development;
   (c) describe in general how the environmental performance of the development would be monitored and managed during the development;
   (d) describe the procedures that would be implemented to:
      - keep the local community and relevant agencies informed about the operation and environmental performance of the development;
      - receive, handle, respond to, and record complaints;
      - resolve any disputes that may arise during the course of the development;
      - respond to any non-compliance;
      - manage cumulative impacts; and
      - respond to emergencies; and
   (e) describe the role, responsibility, authority, and accountability of all the key personnel involved in environmental management of the development.

2. Within 14 days of the Director-General's approval, the Applicant shall:
   (a) send copies of the approved strategy to the relevant agencies, Council, and the CCC; and
   (b) ensure the approved strategy is publicly available during the development.

2A. Within 6 months of the completion of the Independent Environmental Audit, the Applicant shall review, and if necessary revise, the Environmental Management Strategy to the satisfaction of the Director-General.

ENVIRONMENTAL MONITORING PROGRAM

3. Within 6 months of the date of this consent, the Applicant shall prepare an Environmental Monitoring Program for the development in consultation with the relevant agencies, and to the satisfaction of the Director-General. This program must consolidate the various monitoring requirements in schedule 4 of this consent into a single document.

3A. Within 6 months of the completion of the Independent Environmental Audit, the Applicant shall review, and if necessary revise, the Environmental Management Strategy to the satisfaction of the Director-General.

MANAGEMENT PLAN REQUIREMENTS

4. The Applicant shall ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include:
   (a) detailed baseline data;
   (b) a description of:
      - the relevant statutory requirements (including any relevant consent, licence or lease conditions);
      - any relevant limits or performance measures/criteria;
      - the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures/criteria;
   (c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;
   (d) a program to monitor and report on the:
      - impacts and environmental performance of the development;
      - effectiveness of any management measures (see c above);
   (e) a contingency plan to manage any unpredicted impacts and their consequences;
   (f) a program to investigate and implement ways to improve the environmental performance of the development over time;
   (g) a protocol for managing and reporting any:
      - incidents;
      - complaints;
      - non-compliances with statutory requirements; and
      - exceedances of the impact assessment criteria and/or performance criteria; and

(h) a protocol for periodic review of the plan and for a final review. Any final review must be submitted for the approval of the Director-General and include an assessment as to whether the objectives of the plan have been met and any requirements for further action(s) to ensure objectives are met. The Director-General may require the Applicant to carry out the further actions to the satisfaction of the Director-General, or require the Applicant to provide an annuity or other funding arrangement to enable the actions to be carried out to the satisfaction of the Director-General.

ANNUAL REVIEW

5. By the end of March 2014, and annually thereafter, unless otherwise agreed, the Applicant shall review the environmental performance of the development to the satisfaction of the Director-General. This review must:
   (a) describe the development (including any rehabilitation) that was carried out in the past calendar year, and the development that is proposed to be carried out over the next calendar year;
   (b) include a comprehensive review of the monitoring results and complaints records of the development over the past calendar year, which includes a comparison of these results against the:
      - the relevant statutory requirements, limits or performance measures/criteria;
      - the monitoring results of previous years; and
      - the relevant predictions in the EA;
   (c) identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to ensure compliance;
   (d) identify any trends in the monitoring data over the life of the development;
   (e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and
   (f) describe what measures will be implemented over the next year to improve the environmental performance of the development.

REVISION OF STRATEGIES, PLANS AND PROGRAMS

5A. Within 3 months of:
   (a) the submission of an annual review under Condition 5 above;
   (b) the submission of an incident report under Condition 5B below;
   (c) the submission of an audit under Condition 6 below; and
   (d) any modification to the conditions of this consent (unless the conditions require otherwise),

   the Applicant shall review, and if necessary revise, the strategies, plans, and programs required under this consent to the satisfaction of the Director-General.

   Note: This is to ensure the strategies, plans and programs are updated on a regular basis, and incorporate any recommended measures to improve the environmental performance of the development.

INCIDENT REPORTING

5B. The Applicant shall notify, at the earliest opportunity, the Director-General and any other relevant agencies of any incident that has caused, or threatens to cause, material harm to the environment. For any other incident associated with the development, the Applicant shall notify the Director-General and any other relevant agencies as soon as practicable after the Applicant becomes aware of the incident. Within 7 days of the date of the incident, the Applicant shall provide the Director-General and any relevant agencies with a detailed report on the incident, and such further reports as may be requested.

REGULAR REPORTING

5C. The Applicant shall provide regular reporting on the environmental performance of the development on its website in accordance with:
   (a) the reporting arrangements in any plans or programs approved under the conditions of this approval;
   (b) the requirements of condition 9; and
   (c) the requirements of an approved on-line communication plan to be submitted to the Director-General by the end of September 2013 containing a description of the content and frequency of posting for information that could reasonably be expected to be provided on the website concerning:
      - incidents of the type included in condition 5B;
      - any other non-compliance by the development;
      - responses to operational requirements imposed by real-time management systems for air and noise;
      - data from real-time management systems for air and noise.

INDEPENDENT ENVIRONMENTAL AUDIT

6. Within 3 years of the date of this consent, and every 3 years thereafter, unless the Director-General directs otherwise, the Applicant shall commission and pay the full cost of an Independent Environmental Audit of the development. This audit must:
   (a) be conducted by suitably qualified, experienced, and independent expert/s whose appointment has been endorsed by the Director-General;
   (b) assess the various aspects of the environmental performance of the development, and its effects on the surrounding environment;
   (c) assess whether the development is complying with the relevant standards, performance measures, and statutory requirements;
   (d) review the adequacy of any strategy/plan/program required under this consent; and, if necessary,
   (e) recommend measures or actions to improve the environmental performance of the development, and/or any strategy/plan/program required under this consent.

7. Within 3 months of completion of this audit, the Applicant shall submit a copy of the audit report to the Director-General, with a response to any of the recommendations contained in the audit report.

COMMUNITY CONSULTATIVE COMMITTEE

8. The Applicant shall establish and operate a new Community Consultative Committee (CCC) for the development to the satisfaction of the Director-General. This CCC must be operated in general accordance with the *Guidelines for Establishing and Operating Community Consultative Committees for Mining Projects* (Department of Planning, 2007, or its latest version, and be operating by the end of September 2013.

   Notes:
   - *The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Applicant complies with this approval; and*
   - *The CCC should have an independent chair and include appropriate representation from the Proponent, Council, recognised environmental groups and the local community.*

9. The Applicant shall:
   (a) by the end of September 2013, make the following information publicly available on its website:
      - all documents referred to in Condition 2 of Schedule 3;
      - all current statutory approval for the development;
      - approved strategies, plans and programs required under the conditions of this consent;
      - a comprehensive summary of the monitoring results of the development, which have been reported in accordance with the various plans and programs approved under the conditions of this consent;
      - a complaints register, which is to be updated on a monthly basis;
      - minutes of CCC meetings;
      - the last five AEMRs or Annual Reviews;
      - any independent environmental audit, and the Applicant's response to the recommendations in any audit;
      - any other material required by the Director-General; and

   (b) keep this information up to date,

   to the satisfaction of the Director-General.

APPENDIX 1
SCHEDULE OF LAND

Development Application Area - Lot and DP Schedule						
Hunter Valley Operations, West Pit Extension and Minor Modifications						
DP	**Lot**	**Portion**	**Part**	**Volume**	**Folio**	**Property Owner**
752468	128					Coal & Allied Operations Pty Limited
1018576	1					Coal & Allied Operations Pty Limited
1017998	100					Novacoal Australia Pty Limited
705454	161					Novacoal Australia Pty Limited and Mitsubishi Development Pty Ltd
727718	165					Coal & Allied Operations Pty Limited
191982	1					Coal & Allied Operations Pty Limited
752481			20	3269	568	Coal & Allied Operations Pty Limited
752481		170				Coal & Allied Operations Pty Limited
808301	2					Coal & Allied Operations Pty Limited
90727	1			7716	156	Coal & Allied Operations Pty Limited
752481						Coal & Allied Operations Pty Limited
544091	201					Coal & Allied Operations Pty Limited
752481	98					Coal & Allied Operations Pty Limited
752481	21					J. & A. Brown and Abermain Seaham Collieries Limited
752481	18					Coal & Allied Operations Pty Limited
752481	17					Coal & Allied Operations Pty Limited
752481	22					J. & A. Brown and Abermain Seaham Collieries Limited
752481	124					Coal & Allied Operations Pty Limited
752481	125					Coal & Allied Operations Pty Limited
752481	126					Coal & Allied Operations Pty Limited
752481	127					Coal & Allied Operations Pty Limited
752481	123					Coal & Allied Operations Pty Limited
752481	122					Coal & Allied Operations Pty Limited
752481	121					Coal & Allied Operations Pty Limited
752481	120					Coal & Allied Operations Pty Limited
752481	119					Coal & Allied Operations Pty Limited
752481	118					Coal & Allied Operations Pty Limited
752481	117					Coal & Allied Operations Pty Limited
7542481		89				J. & A. Brown and Abermain Seaham Collieries Limited
740183	10					Coal & Allied Operations Pty Limited
752481	171			6353	145	J. & A. Brown and Abermain Seaham Collieries Limited
110662	1			13933	249	J. & A. Brown and Abermain Seaham Collieries Limited
737796	1					Coal & Allied Operations Pty Limited
110656	1			11057	141	J. & A. Brown and Abermain Seaham Collieries Limited
752468	126					Novacoal Australia Pty Limited
779625	1					Novacoal Australia Pty Limited
779626	1					Novacoal Australia Pty Limited
625507	1					Novacoal Australia Pty Limited and Mitsubishi Development Pty Ltd
48165						Lemington Road
786904	22					Coal & Allied Operations Pty Limited
786904	21					Novacoal Australia Pty Limited
48555	4					Novacoal Australia Pty Limited

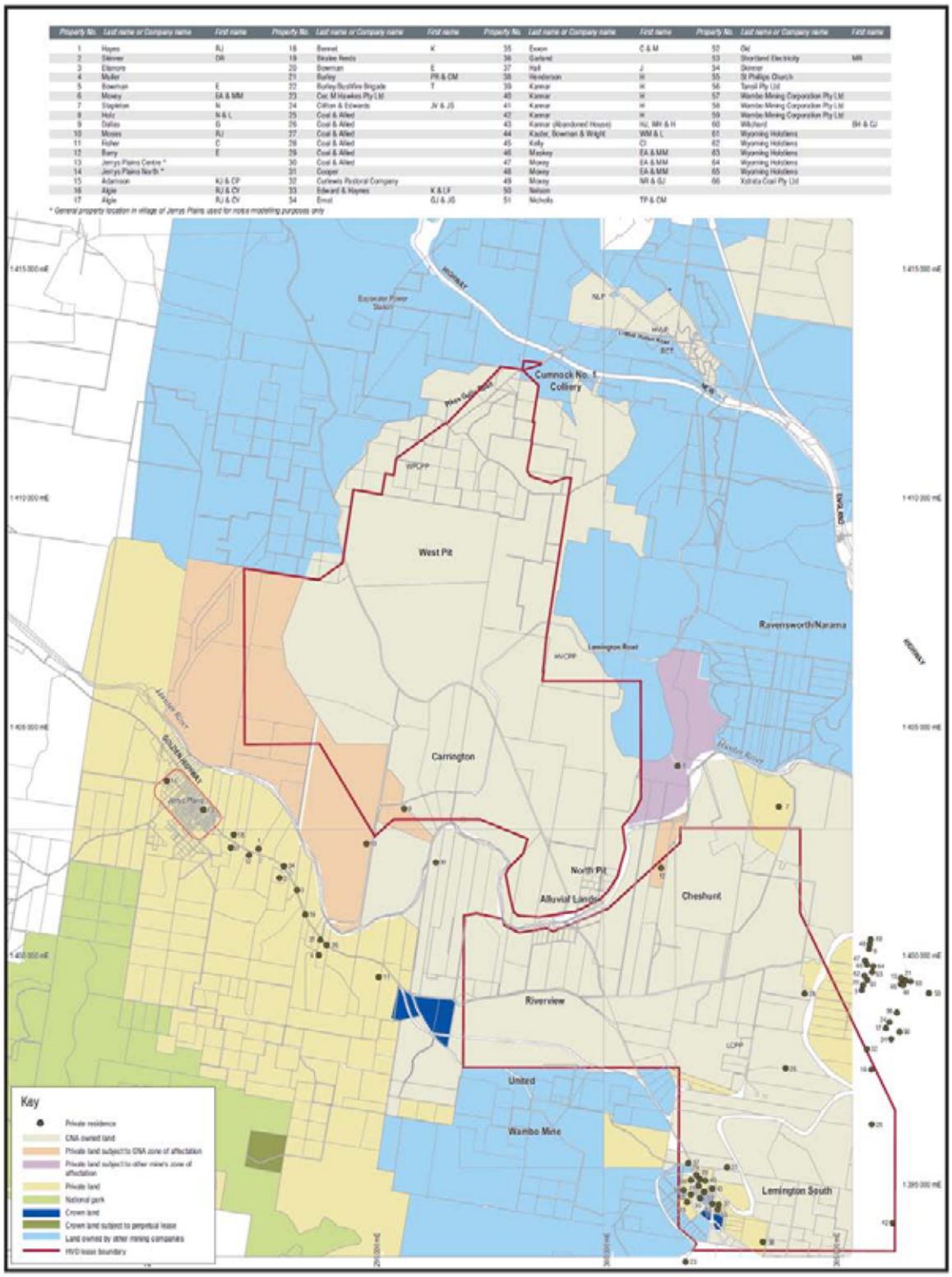
1037665	101			Coal & Allied Operations Pty Limited
752468	80	1782	37	Novacoal Australia Pty Limited
752468	81			Novacoal Australia Pty Limited
752468	53	7834	45	Novacoal Australia Pty Limited
752468	83	7834	45	Novacoal Australia Pty Limited
752468	157			Novacoal Australia Pty Limited
752481	83	6408	207	Novacoal Australia Pty Limited
752481	82	6408	207	Novacoal Australia Pty Limited
596670	3	13659	69	J. & A. Brown and Abermain Seaham Collieries Limited
868175	305			Novacoal Australia Pty Limited
752481	200	6408	207	Novacoal Australia Pty Limited
752468	158	6408	206	Novacoal Australia Pty Limited
752468	84	6408	206	Novacoal Australia Pty Limited
752468	54	6408	206	Novacoal Australia Pty Limited
752468	65			Novacoal Australia Pty Limited
752468	70	1782	37	Novacoal Australia Pty Limited
752468	71			Novacoal Australia Pty Limited
752468	68	1782	37	Novacoal Australia Pty Limited
752468	66	6408	206	Novacoal Australia Pty Limited
752468	159	6408	206	Novacoal Australia Pty Limited
252530	8	8625	137	Novacoal Australia Pty Limited
752468	94	6408	206	Novacoal Australia Pty Limited
752468	156	6408	206	Novacoal Australia Pty Limited
752468	102	6408	206	Novacoal Australia Pty Limited
700554	12	8625	137	Novacoal Australia Pty Limited
130831	1	10547	67	Novacoal Australia Pty Limited
252530	2	8625	137	Novacoal Australia Pty Limited
252530	4	8625	137	Novacoal Australia Pty Limited
48555	7			Novacoal Australia Pty Limited
252530	5	8625	137	Novacoal Australia Pty Limited
130831	2			Novacoal Australia Pty Limited
252530	3	8625	137	Novacoal Australia Pty Limited
393657	1			Novacoal Australia Pty Limited
780177	1	8625	137	Novacoal Australia Pty Limited
868175	304			Novacoal Australia Pty Limited
860535	319			Coal & Allied Operations Pty Limited
48555	3			Novacoal Australia Pty Limited
48555	2			Novacoal Australia Pty Limited
48555	5			Novacoal Australia Pty Limited
752481	58	8625	137	Novacoal Australia Pty Limited
256503	2			J. & A. Brown and Abermain Seaham Collieries Limited
130831	4	10547	67	Novacoal Australia Pty Limited
130831	3	10547	67	Novacoal Australia Pty Limited
752468	82	1782	37	Novacoal Australia Pty Limited
752481	38	8625	137	Novacoal Australia Pty Limited
48537	1			Novacoal Australia Pty Limited
727260	1			Novacoal Australia Pty Limited and Mitsubishi Development Pty Ltd
574166	1			Macquarie Generation
211043	1			Cumnock No 1 Colliery Pty Limited
574166	2			Novacoal Australia Pty Ltd and Mitsubishi Development Pty Ltd

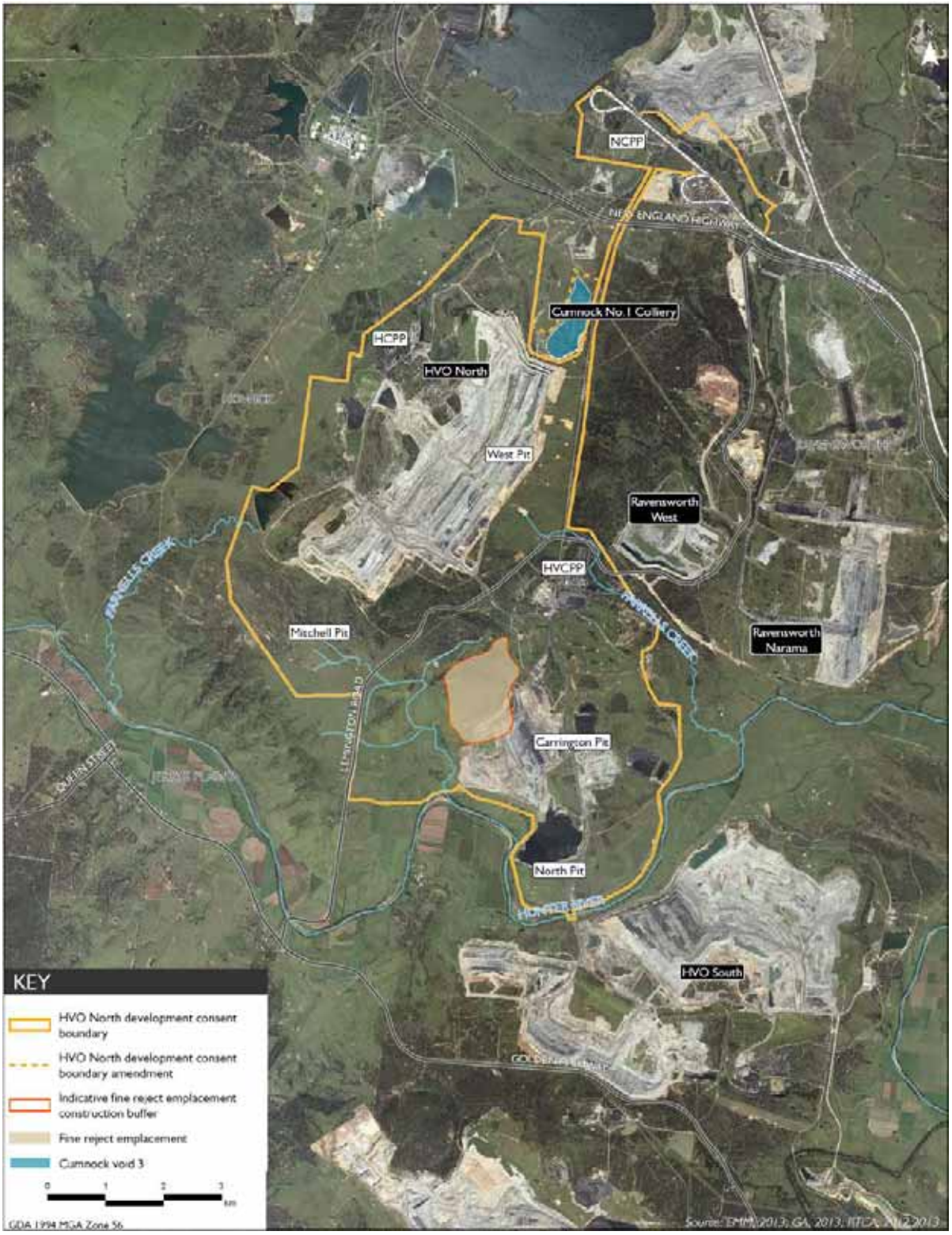
700429	100					The Shortland County Council
979456						J. & A. Brown & Abermain Seaham Collieries Ltd
869839	380					Novacoal Australia Pty Limited and Mitsubishi Development Pty Ltd
808431	2					Novacoal Australia Pty Limited
1019325	601					Macquarie Generation
808431	1					Coal & Allied Operations Pty Limited
201214	1					Novacoal Australia Pty Limited
869399	22					Coal Operations Australia Limited, Cumnock No.1 Colliery Pty Limited, Muswellbrook Coal Company Limited, BCA No. 11 Pty Limited
858172	11					Coal & Allied Operations Pty Limited
752470						Coal & Allied Operations Pty Limited
659810	1					J. & A. Brown and Abermain Seaham Collieries Limited
114966	2			12915	20	J & A Brown & Abermain Seaham Collieries Limited
700429	101					Coal & Allied Operations Pty Limited
729048	1					Coal & Allied Operations Pty Limited
752470	148					Crown Land Reserve 144
93617						Crown land Reserve 68816

Carrington West Wing Extension Area						
DP	**Lot**	**Portion**	**Part**	**Volume**	**Folio**	**Property Owner**
808301	2					Coal & Allied Operations Pty Limited
1078618	1					Coal & Allied Operations Pty Limited
1113789	7					Novacoal Australia and Coal & Allied Operations Pty Limited
597726	300					Coal & Allied Operations Pty Limited
752468	127					Coal & Allied Operations Pty Limited

Cumnock Void 3 Boundary Amendment						
DP	**Lot**	**Portion**	**Part**	**Volume**	**Folio**	**Property Owner**
1132357	3000					Cumnock No 1 Colliery Pty Limited, ICRA CUMNOCK PTY LIMITED
1153575	1000					Coal & Allied Operations Pty Limited & Novacoal Australia PTY
48555	5 (part lot)					Novacoal Australia Pty Limited

APPENDIX 2
LANDOWNERSHIP PLAN & RESIDENTIAL RECEIVERS




NCPP
NEW ENGLAND HIGHWAY
Cumnock No 1 Colliery
HCPP
HVO North
West Pit
Ravensworth West
HVCPP
Mitchell Pit
Ravensworth Narama
Carrington Pit
North Pit
HVO South
KEY
HVO North development consent boundary
HVO North development consent boundary amendment
Indicative fine reject emplacement construction buffer
Fine reject emplacement
Cumnock void 3
0 1 2 3 km
GDA 1994 MGA Zone 56

APPENDIX 3
NOISE COMPLIANCE ASSESSMENT

Applicable Meteorological Conditions

1. The criteria in Table 9 and 10 apply under all meteorological conditions except:

   a) during periods of rain or hail;

   b) when average wind speed at microphone height exceeds 5 m/s;

   c) when wind speeds greater than 3 m/s are measured at 10 m above ground level; or

   d) during temperature inversion conditions greater than 3°C/100 m.

Determination of Meteorological Conditions

2. Except for wind speed at microphone height, the data to be used for determining meteorological conditions shall be those recorded by the meteorological station located on the site.

Compliance Monitoring

3. Attended monitoring is to be used to evaluate compliance with the relevant conditions of this approval.

4. Unless otherwise agreed with the Director-General, this monitoring is to be carried out in accordance with the relevant requirements for reviewing performance set out in the NSW *Industrial Noise Policy* (as amended or replaced from time to time), including the requirements relating to:

   a) monitoring locations for collection of representative noise data;

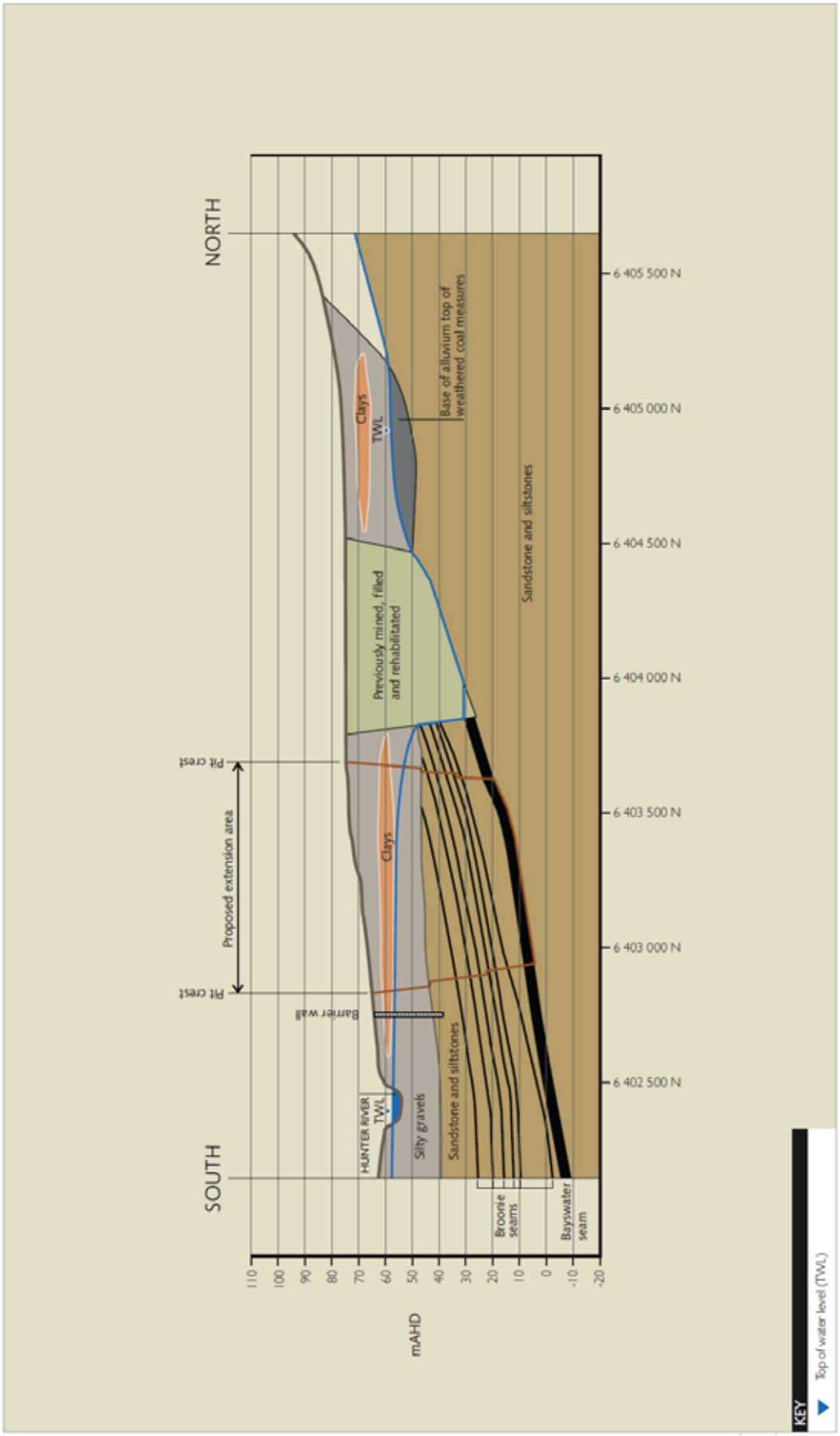
   b) meteorological conditions during which collection of noise data is not appropriate;

   c) equipment used to collect noise data, and conformation with relevant Australian Standards for such equipment; and

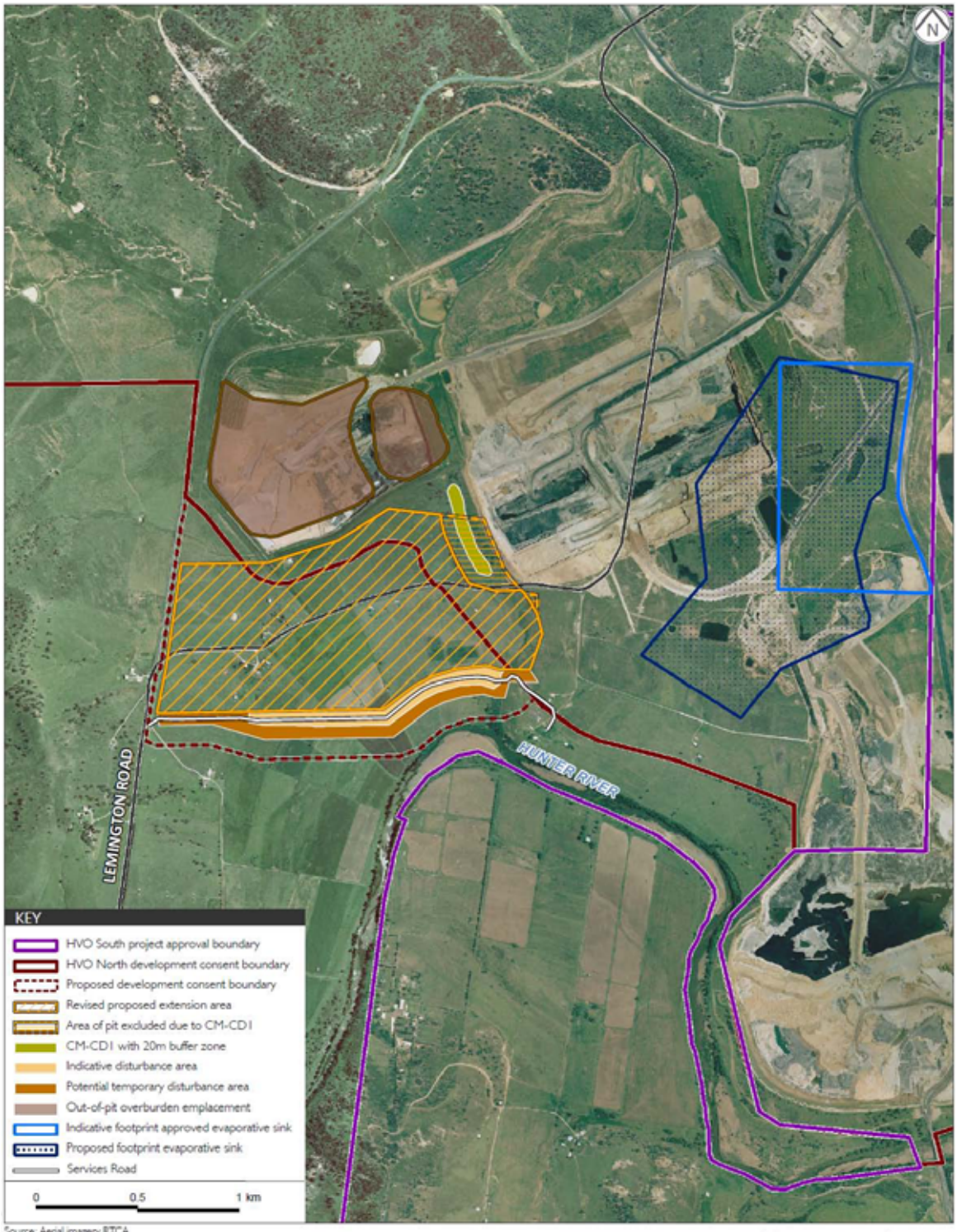
   d) modifications to noise data collected, including the exclusion of extraneous noise and/or penalties for modifying factors apart from adjustments for duration.

APPENDIX 4

CONCEPTUAL GROUNDWATER BARRIER WALL



APPENDIX 5
REVISED MINE PLAN AVOIDING SITE CM-CD1



Source: Aerial imagery RTCA

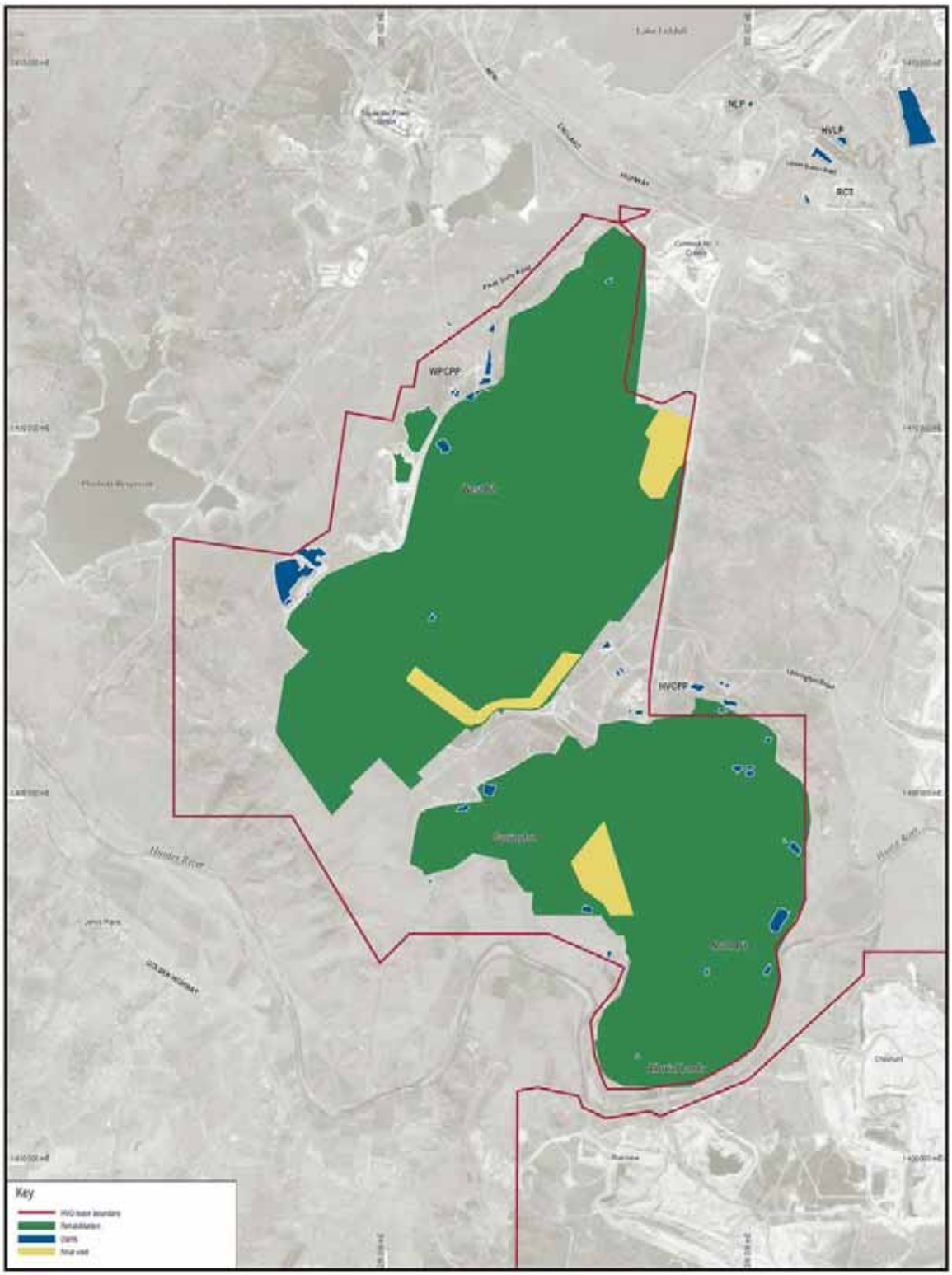
EMM

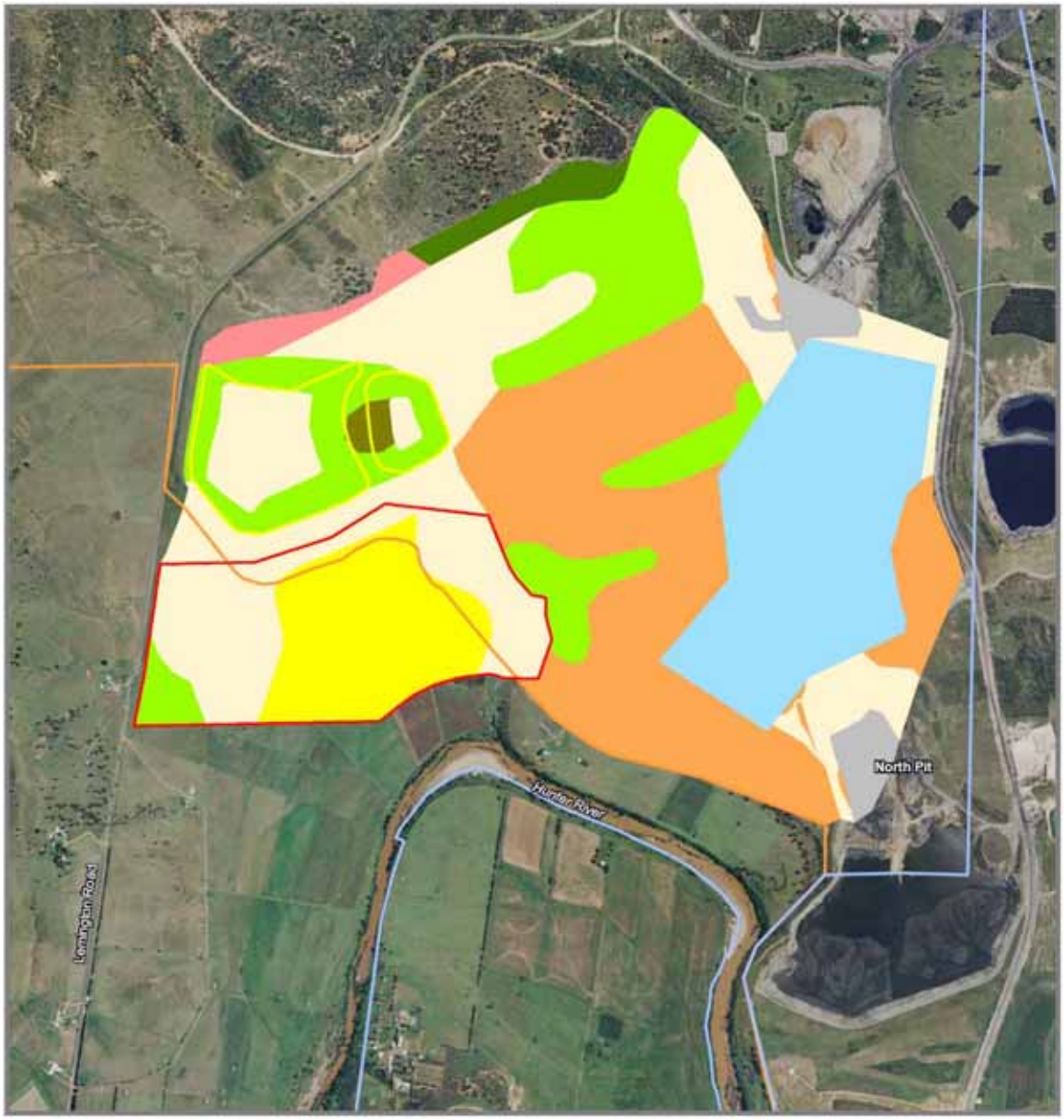
Revised key project elements

Carrington West Wing

FIGURE 1

APPENDIX 6
CONCEPTUAL FINAL LANDFORM PLANS

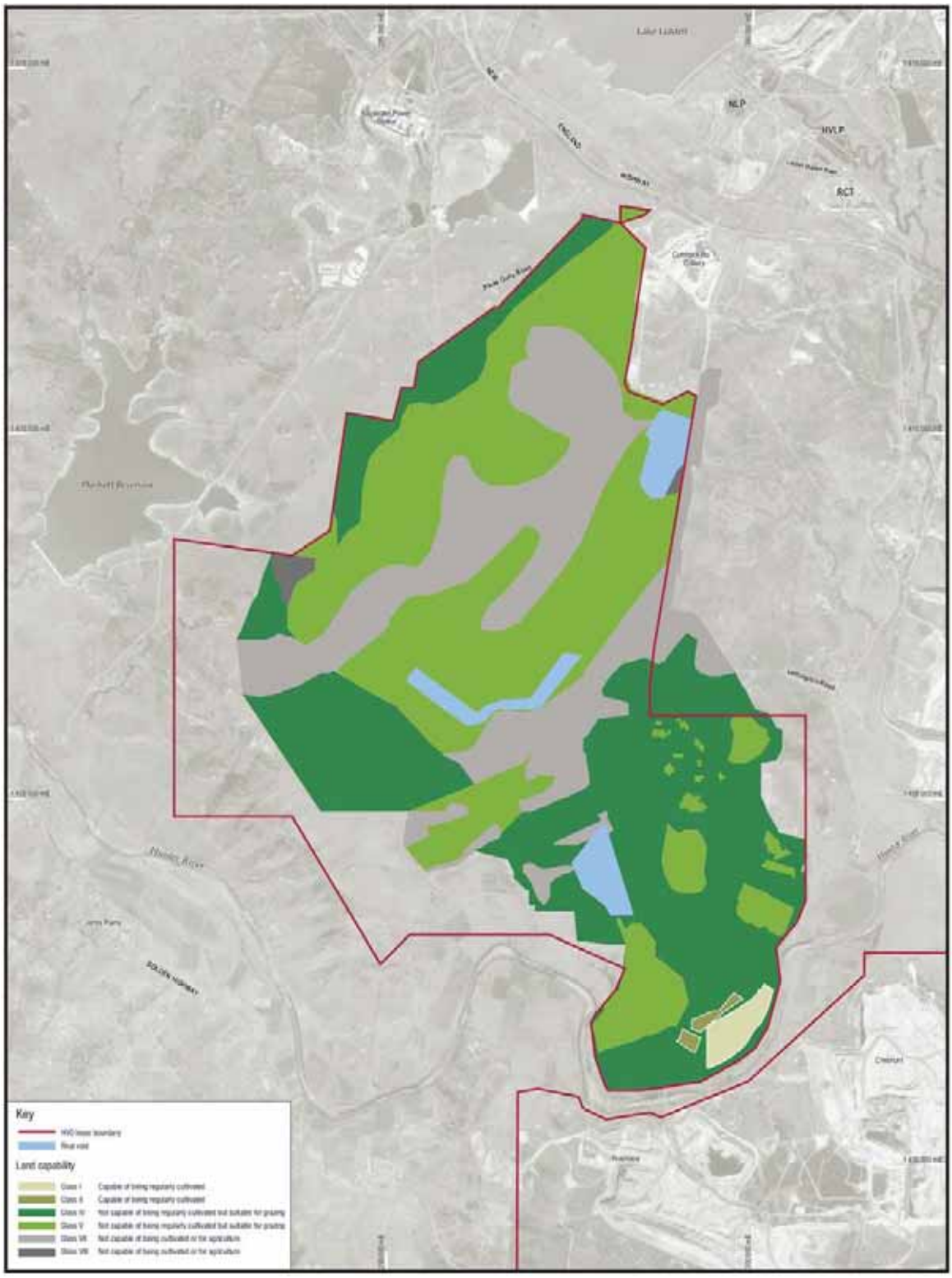


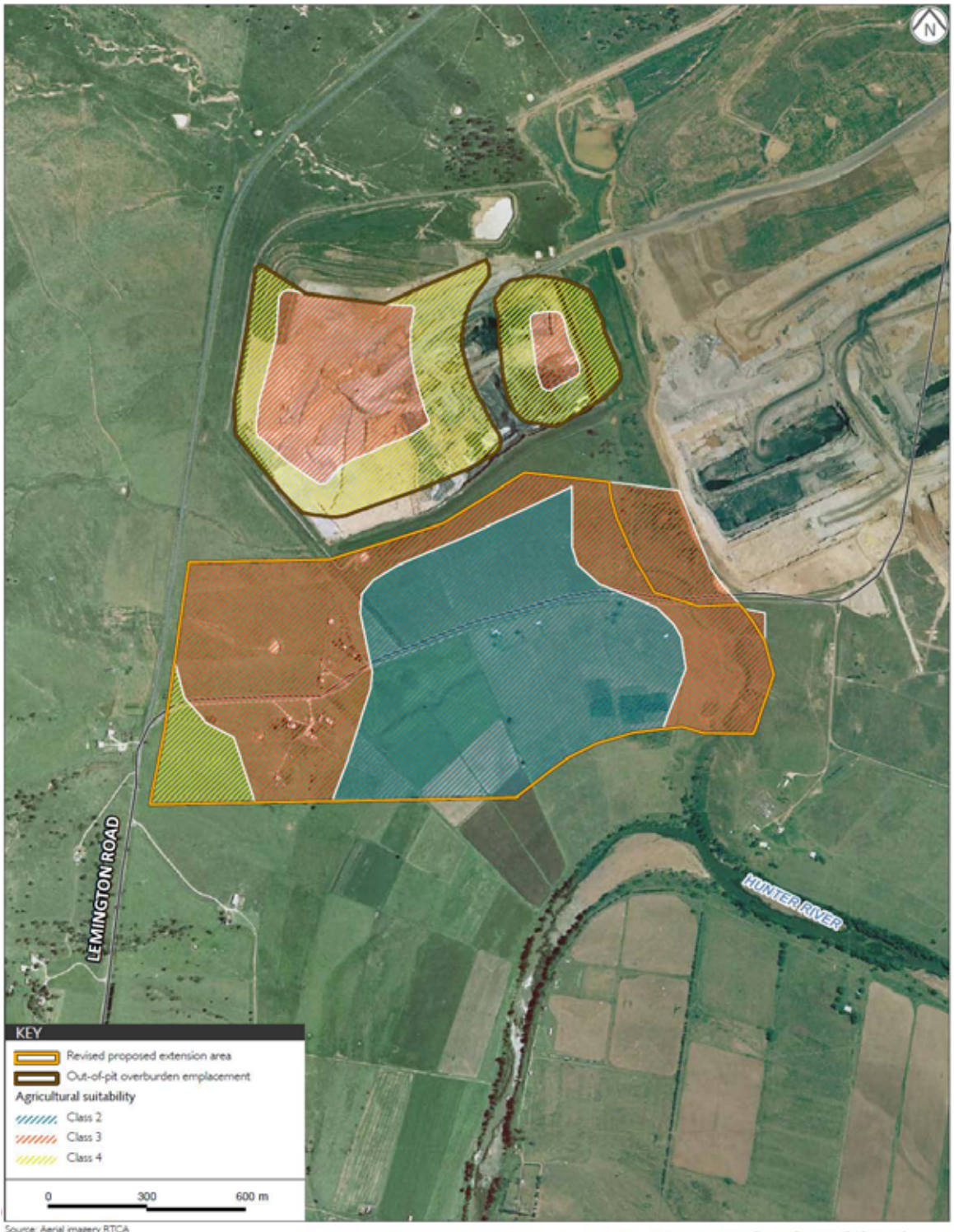


- Regenerated Grassland (grazing)
- Regenerated Woodland (biodiversity)
- Rehabilitated Grassland (grazing/cropping)
- Rehabilitated Woodland (biodiversity)
- Rehabilitated Woodland (grazing)
- Void / dam / mining area
- Rehabilitated Woodland (Central Hunter Box - Ironbark Woodland) - indicative location
- Rehabilitated Grassland (grazing/ cropping) - Class II land capability

- HVO North current development consent boundary
- HVO South project approval boundary
- Proposed footprint of evaporative sink
- Out-of-pit overburden emplacement
- Proposed extension area

APPENDIX 7
CONCEPTUAL FINAL LANDUSE PLANS





Source: Aerial imagery RTCA

EMM

Post-mining agricultural suitability classes

Carrington West Wing

FIGURE 2

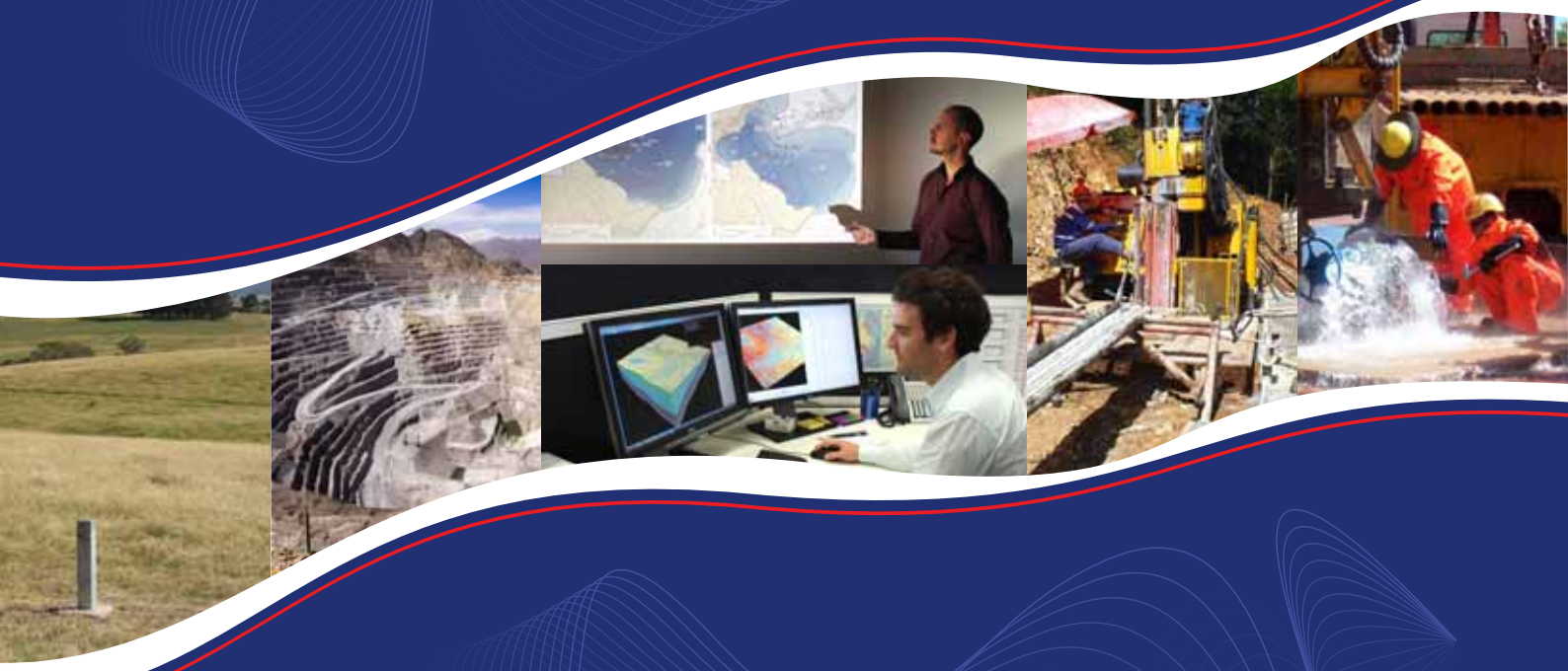
Groundwater Assessment

Appendix B

Appendix B — Groundwater Assessment

B

Australasian
Groundwater
and Environmental
Consultants Pty Ltd
(AGE)



Report on

HVO North - Modification 6

Groundwater Study

Prepared for

EMM Consulting Pty Limited

Project No. G1737C November 2016
www.ageconsultants.com.au ABN 64 080 238 642

Document details and history

Document details

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Report on

HVO North - Modification 6
Groundwater Study

1 Introduction

Coal & Allied Operations Pty Limited and HVO Resources Pty Limited own the Hunter Valley Operations (HVO) mining complex, which is managed by HV Operations Pty Ltd (Coal & Allied). HVO mining complex is located 24km north-west of Singleton in NSW (Figure 1-1). Mining activities at HVO are geographically divided by the Hunter River into HVO North and HVO South, but are integrated at an operational level. This enables movement of material and associated equipment around HVO, including run-of-mine (ROM) coal, product coal, coal rejects, overburden and water systems.

While HVO is managed as one operation, HVO North and HVO South each have separate planning approvals. HVO North operates under DA 450-10-2003 (the development consent), under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The mine is within the Singleton local government area (LGA). HVO North comprises mining activities and infrastructure, such as overburden and fine reject emplacement areas. Mine areas at HVO North include Carrington West Wing, West Pit and historical operations at Carrington Pit, North Pit and Alluvial Lands.

Modification to the Hunter Valley Operations North (HVO North) development consent is required to emplace fine rejects within the currently approved void in Carrington Pit, which is proposed to be known as the 'HVO North – Carrington in-pit fine reject emplacement' (CIP fine reject emplacement). No other changes to the existing operations are contemplated within this modification. Existing mining and the proposed modification are described in more detail within Section 1.1. The components described above collectively form the 'HVO North CIP fine reject emplacement Modification', which is referred to herein as the 'proposed modification'.

EMM Consulting Pty Limited (EMM) was engaged by Coal & Allied as the lead consultant for the preparation of an environmental assessment (EA) to accompany the application to modify the development consent. Australasian Groundwater and Environmental Consultants Pty Ltd (AGE) were engaged by EMM to assess potential groundwater related impacts as a result of the proposed modification.

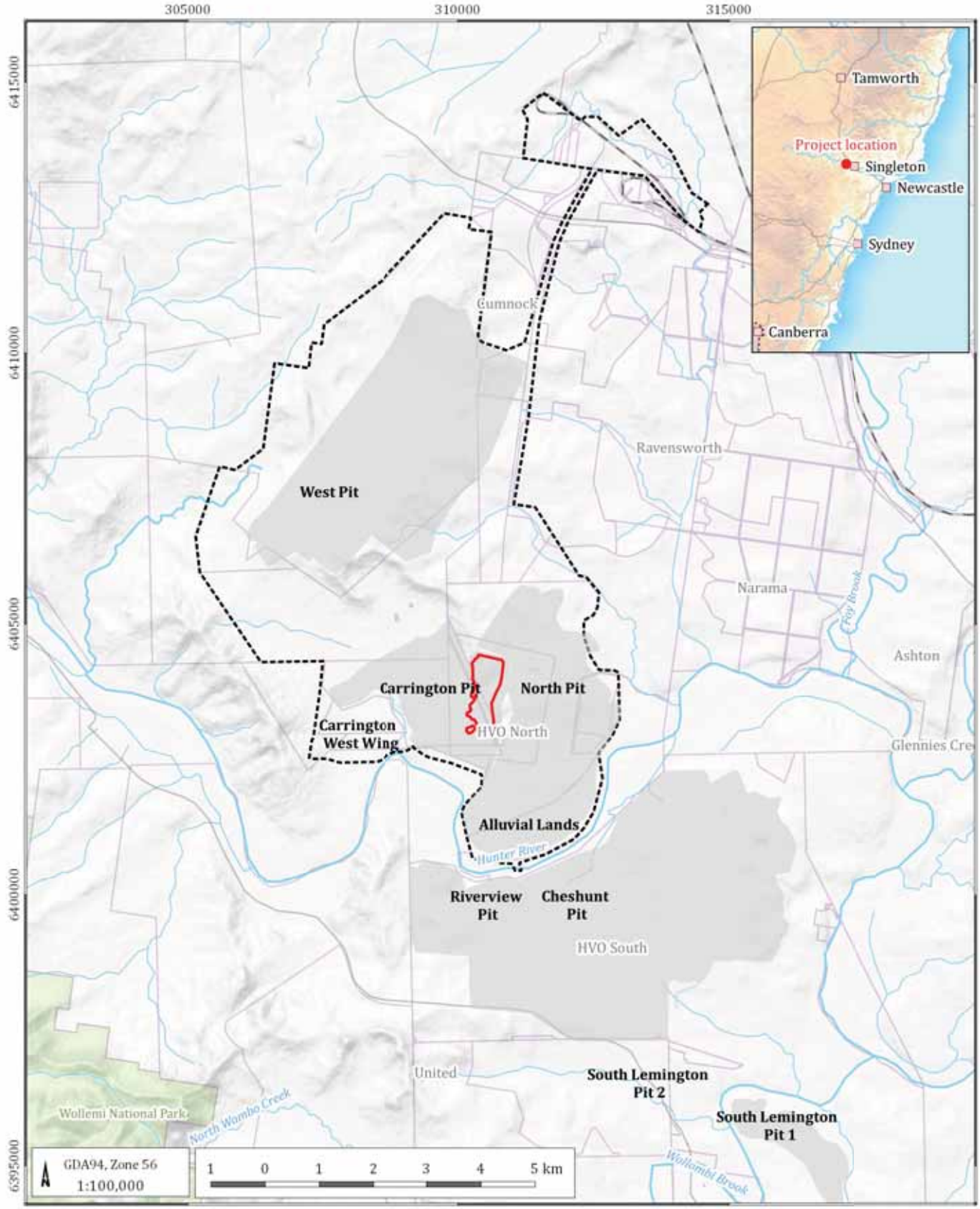
1.1 Project description

Coal & Allied is proposing to modify DA 450-10-2003 under section 75W of the EP&A Act, to allow for the emplacement of fine rejects within the Carrington Pit void. The current approval requires the void within Carrington Pit be backfilled with spoil upon completion of mining to a level of 40m Australian Height Datum (mAHD) and be shaped to have a nominal surface area of 100 hectares (ha) to promote evaporation and a long term void lake water level of around 40mAHD. This final void landform has been referred to in previous documentation as an 'evaporative sink'. As shown in Table 1-1, there are no other changes to DA 450-10-2003 under the proposed modification.

The proposed CIP fine reject emplacement will fill the approved void within Carrington Pit with fine rejects, rather than spoil. The fine reject will be supplied predominantly from the Hunter Valley Coal Handling and Preparation Plant (HVCHPP) via existing and available infrastructure, with additional fine reject supplied by the Howick Coal Preparation Plant (HCPP), should the integrated HVO fine rejects management system require it. The proposed emplacement will hold approximately 12.6 million bulk cubic metres (BCM) of fine rejects, up to a maximum elevation of 38mAHD where it will be capped and rehabilitated. The proposed CIP fines emplacement has been designed to enable the operation of the evaporative sink, as approved.

Table 1-1 Overview of the proposed modification

Project element	Current approval	Proposed modification
ROM coal extraction limit	22Mtpa ROM coal	No change
Project approval period	Up to June 2025	No change
Operating hours	Seven days per week, 24 hours per day	No change
Number of employees	Approximately 1,500	No change
Mining methods	Dragline; and truck and shovel	No change
Mining areas	As per approved disturbance boundary	No change
Infrastructure	As detailed in original EIS and subsequent modifications	No change
Coarse reject	Ability to emplace coarse rejects within overburden emplacement areas across HVO	No change
Fine reject	Approved and integrated fine reject management with HVO South	No change to integrated management with HVO South. Emplacement of fine rejects within approved void within Carrington Pit.
Water	Approved and integrated water management with HVO South. Approved water transfers with other mining operations.	No change
External coal transport	Transport of coal via rail	No change



LEGEND

- CIP fine reject emplacement
- HVO North development consent boundary
- Previously mined area
- Rail
- Major road
- Major drainage
- Minor drainage
- Coal titles
- Reserve

HVO North - Modification 6 Groundwater Study (G1737C)

General location plan

DATE 01/11/2016

FIGURE No **1-1**

G:/Groundwater Jobs/G1737C_HVO North Mod/3_GIS/Workspaces/002_HVO North Mod Qualitative/01-01_G1737C_General location plan.qgs

1.2 Existing and approved operations

HVO North is an active open-cut mining operation that generates thermal and semi-soft coking coal for the local and export market. Open cut mining at HVO North is conducted using a dragline and truck and shovel method. ROM coal is crushed at the on-site coal handling facilities and product coal is transported by rail to domestic customers and the Port of Newcastle for export. HVO North is approved to continue operations until 2025. Operations include active mining at West Pit and approved future mining at Carrington West Wing. Mining also historically occured at Carrington Pit (currently an open void) as well as at North Pit and Alluvial Lands (fully backfilled and rehabilitated). Ongoing mining is also approved at HVO South (i.e. Cheshunt Pit and Riverview Pit) until 2028, as well as at other surrounding mine operations (i.e. Ravensworth and Ashton). The location of the various mine areas is shown on Figure 1-2.

The approved mine infrastructure at HVO includes active fine reject emplacement facilities, North Pit Void (Dam 29N), Dam 6W and Cumnock Void. There are also three inactive fine reject emplacement facilities (Dam 27N, Dam 28N and Dam 20W/Bobs Dump). Active and inactive facilities are managed in accordance with environmental procedures described within the approved HVO Water Management Plan (WMP) prepared by RTCA (2016) in accordance with Condition 29 of Schedule 4 under DA 450-10-2003. The Cumnock Void is operated under a Joint Facility Agreement with Glencore. A list of the approved fine reject emplacement facilities is included in Table 1-2 and the locations of approved North facilities are shown on Figure 1-2.

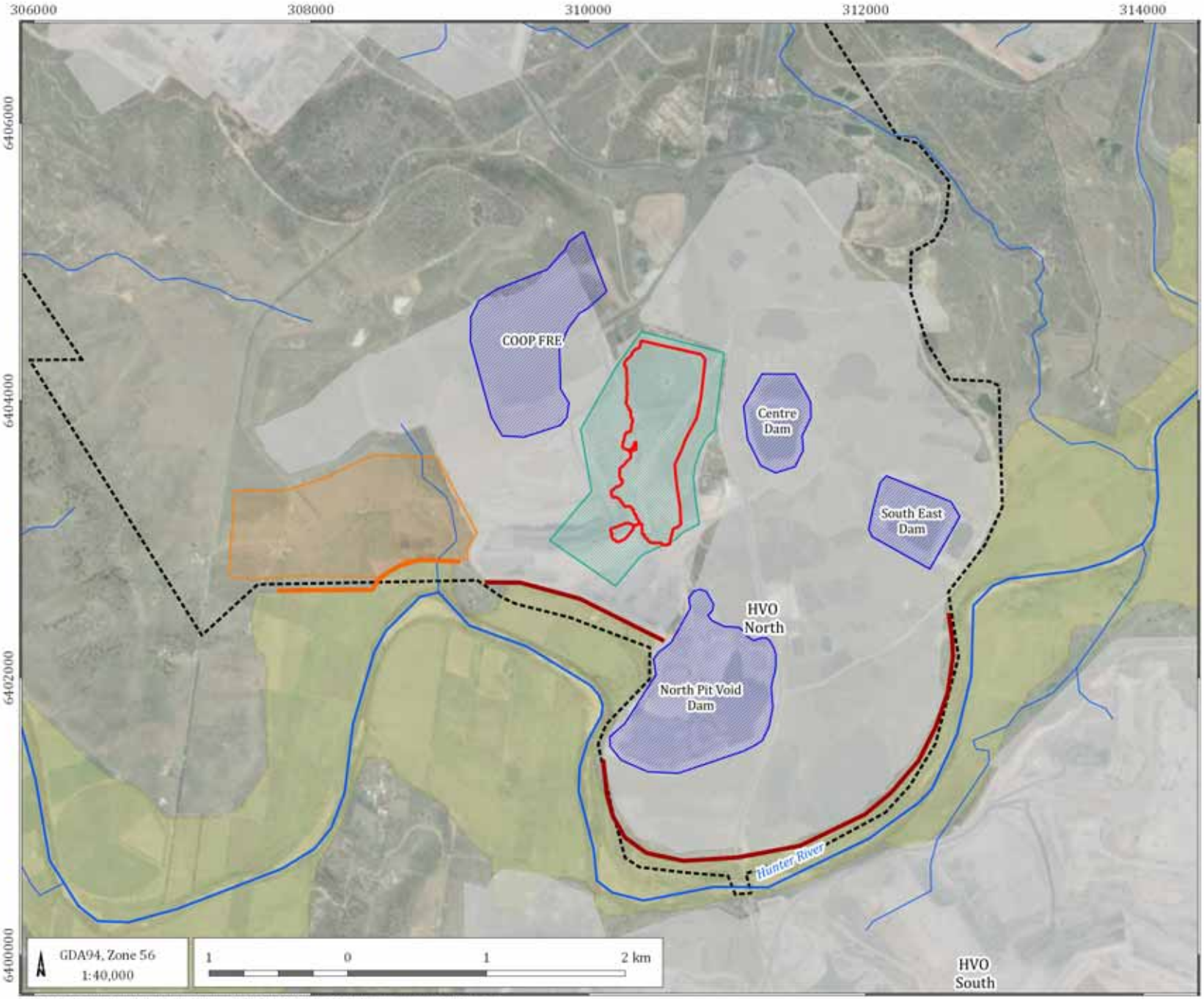
Table 1-2 Approved fine reject emplacement facilities – HVO North

Storage	Location	Status	Proposed rehabilitation
North Pit Void (29N)	North Pit	Active	2022
Dam 6W	West Pit	Active	2025
Cumnock Void	Cumnock	Active	-
Centre (28N)	North Pit	Decommissioned	2018
South East (27N)	North Pit	Decommissioned	2016
Bobs Dump (20W)	West Pit	Decommissioned	2017
Carrington Out of Pit Fine Reject Emplacement (COOP FRE)	North Pit/ Carrington Pit	Approved but not yet constructed	-

As shown in Figure 1-2, Dam 6W and Bobs Dump are located at the northern end of West Pit. West Pit is a separate pit to the north of the proposed CIP fine reject emplacement, which targets deeper coal seams than those mined at Carrington.

There is one active facility at Carrington (North Pit Void) that is positioned on rehabilitated spoil within North Pit, which was mined down to the Vaux Seam. Mining ceased at North Pit and Alluvial Lands in 2003. Following mining the North Pit Void landform was rehabilitated to approximately 47mAHD, which is approximately 15m below natural surface levels. Since 2007, rejects have been placed in North Pit Void, with current sediment levels at around 61mAHD. North Pit Void has capacity to be filled to 69mAHD, and is planned to be decommissioned by 2022.

An out of pit Fine Reject Emplacement (COOP FRE) north-west of Carrington Pit was approved in January 2014 but has not been constructed. The COOP FRE has capacity to hold 14.1 BCM of fine rejects, with embankment walls designed up to 120mAHD and rejects fill approved to a maximum elevation of 119mAHD. It should be noted that as planning for the COOP FRE has not commenced, Condition 28a of Schedule 4 under DA 450-10-2003 (Fine Reject Management Strategy) has not been triggered and is therefore not included under the current WMP (RTCA 2016).



LEGEND
- CIP fine reject emplacement
- HVO North development consent boundary
- Previously mined area
- Approved future barrier wall
- Existing barrier wall
- Major drainage
- Approved tailings facility
- Approved final void
- Approved Carrington West Wing
- Quaternary alluvium (1:25K AGE)

HVO North - Modification 6 Groundwater Study (G1737C)

Approved fine reject emplacement facilities and proposed modification

DATE
01/11/2016

FIGURE No:
1-2

G:/Groundwater Jobs/G1737C_HVO North Mod/3_GIS/Workspaces/002_HVO North Mod Qualitative/01-02_G1737C_Approved fine reject emplacement facilities and proposed modification.qgs

In addition to reject emplacements, a final void is approved within Carrington Pit upon completion of mining. The approved final void has two design options, the first is a 100ha void, partially backfilled with spoils to an elevation of 40mAHD, that facilitates the formation of an open water lake with the water level ranging from 40mAHD to 45mAHD. The second option is to backfill the 100ha void to an elevation of over 40mAHD above the permanent lake level and plant trees on the surface to facilitate evapotranspiration. The backfilled level of 40mAHD is approximately 25m below the elevation of the crests of the barrier walls, and 20m below the median water level within the Hunter River. Stylised schematics depicting the two final void options are included in Figure 1-3.

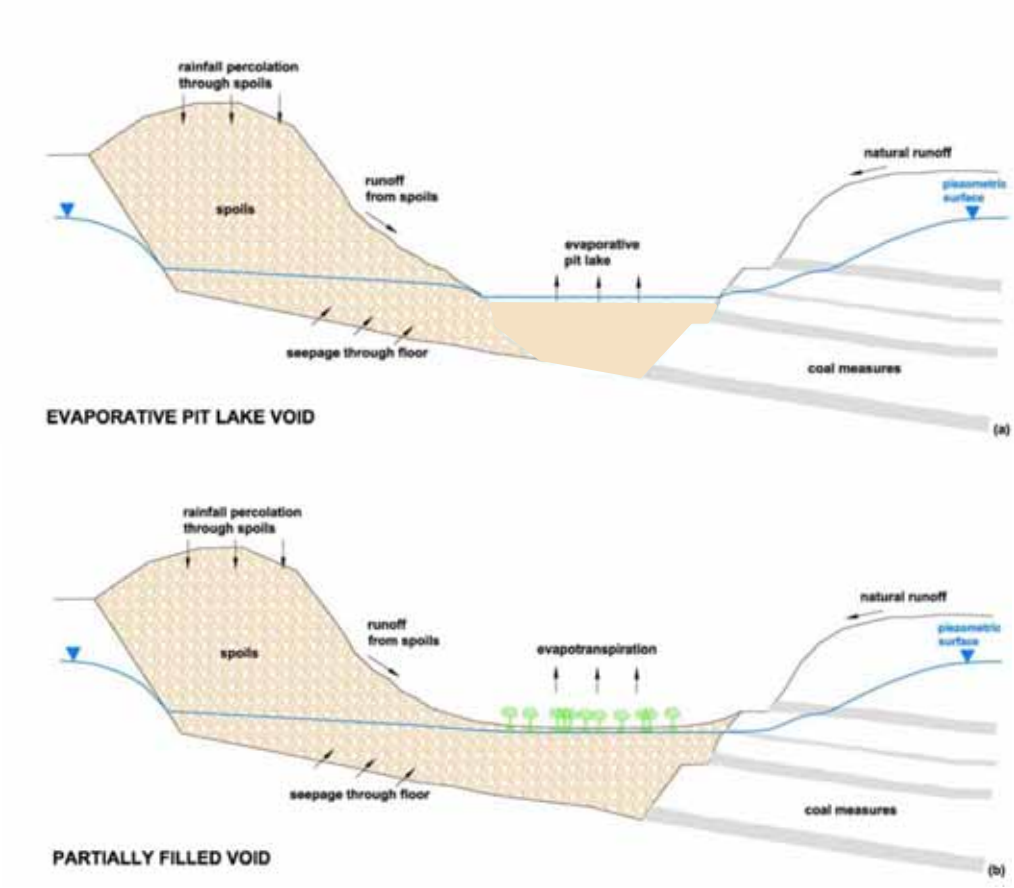


Figure 1-3 Mine closure groundwater control options (adapted from Figure 50, Mackie 2009)

Numerical modelling by MER (2005) determined a 60ha final void could maintain water levels within the void at around 45mAHD to 50mAHD. Updated modelling by MER (2010) for the Carrington West Wing modification included expansion of the final void to cover 100ha. At this size, MER (2010) predicted that the final void would maintain water levels at around 40mAHD, forming a permanent zone of drawdown around the void. This ensures groundwater within the mine spoils, would be drawn towards the final void and removed by evaporation.

1.3 Proposed modification

The proposed modification does not entail any changes to excavation of insitu-rock, groundwater interception or the final landform. The modification instead proposes to fill the Carrington Pit void to the approved final landform level with fine rejects instead of spoil material. The proposed CIP fine reject emplacement could hold approximately 12.6 BCM of fine rejects, up to a level of 38mAHD, where it will be capped and rehabilitated to promote evaporation.

The commissioning and operation of the proposed emplacement would commence as soon as it is available and cease operation within the existing development consent period. The proposed emplacement would increase fine reject storage capacity for approximately eight years. The fine rejects will be supplied predominantly from HVCHPP via existing and available infrastructure, with additional fine rejects supplied by HCPP, should the integrated HVO management system require it.

The proposed CIP FRE will operate as a settling pond, primarily under the principle of gravity settlement. A slurry mixture of fine reject and water will be fed from HVCHPP to the emplacement via a pipeline. As is currently operated at approved emplacement facilities at HVO, the pipeline's discharge location will vary to promote beaching and fine reject settlement, whilst minimising the extent of water pooling against the void wall. The water will then be decanted from the proposed CIP fine reject emplacement and re-used in the coal handling and preparation plants.

Over the life of the CIP fine reject emplacement the volume of coal fines will accumulate until a level of 38mAHD is reached. After this time the remaining water will be decanted from the emplacement leaving the coal fines to air dry.

Ongoing monitoring will determine when the emplacement is dry and stable. Following this, the proposed CIP FRE will have at least 2m of capping material at the northern end (near the deposition points) and up to 6m at the southern extent; to create the approved final landform. The capping material will be drawn from either surrounding dumps or the Carrington out-of-pit emplacement area (which currently stockpiles capping material for the surrounding dams). Following capping of the proposed CIP fine reject emplacement, the area will be rehabilitated to promote evaporation, as approved. Rehabilitation will be consistent with that proposed within the Carrington Pit Extended Project (ERM 2005) and the development consent.

1.4 Scope of work and assessment objectives

As detailed within Section 1.3, the proposed modification does not include any excavation of insitu material and has been designed to maintain the final landform as currently approved within Carrington Pit. The key difference of the proposed modification is the change in properties of the material used to fill the void to the approved final landform. The proposed modification therefore represents a change of backfill material from spoil to fine rejects.

The proposed modification does not involve any additional penetration or interference with an aquifer and there is no obstruction of flow that would affect the functioning of aquifers (i.e. alluvial aquifer and Permian coal measures). There is also expected to be no long term change in groundwater take or disposal of groundwater taken from an aquifer. As a result, the proposed modification is not considered to meet the definition of an aquifer interference activity, as defined within the *Water Management Act 2000* Aquifer Interference Policy (AIP).

While the proposed modification does not clearly meet the definition of an aquifer interference activity, a groundwater assessment was conducted as a matter of due diligence. As the proposed modification does not involve any changes to mine plans or to the final landform, the take of groundwater and predicted impact on groundwater receptors is already presented within numerical groundwater modelling conducted for Carrington West Wing (MER 2010).

The groundwater assessment presented in this report involved review of the predicted groundwater conditions for the approved HVO North operations against recent site data. This was done to ensure the modelled predictions (i.e. function of the final void to act as a sink) fit with current groundwater conditions. In addition, the hydraulic properties and quality of the fine rejects, spoil and surrounding strata were characterised based on recent data, in order to identify any changes the use of different fill material might make.

The current understanding of the existing groundwater regime was based on a review of extensive site data, previous studies conducted at site and surrounding areas, as well as relevant literature from academic sources. The review included:

- extensive water level and water quality data from Coal & Allied's surface water monitoring system, as well as the integrated groundwater monitoring network that comprises 282 monitoring points with data dating back to 2000;
- routine groundwater monitoring reports and annual groundwater reviews for HVO North and HVO South;
- previous groundwater assessments conducted at site and in the region, including (but not limited to):
    - *Hydrogeological Characterisation of coal measures and overview of impacts of coal mining on groundwater systems in the Upper Hunter Valley*, PhD thesis by Mackie (2009) that includes extensive field data and analysis specific to HVO North;
    - Alluvial Lands Project Environmental Assessment (1992), which includes a groundwater assessment conducted by MMA (1992);
    - Carrington Pit Environmental Assessments (1999), which includes a groundwater impact assessment with numerical groundwater modelling conducted by MER (1999);
    - Carrington Pit Extended Environmental Assessments (2005), which includes a groundwater impact assessment with numerical groundwater modelling conducted by MER (2005);
    - Carrington West Wing Environmental Assessment (2010), which includes a groundwater impact assessment with numerical groundwater modelling conducted by MER (2010);
    - Fine Reject Emplacement Environmental Assessment (2013), which includes a groundwater impact assessment with numerical groundwater modelling conducted by AGE (2013); and
    - HVO South Environmental Assessment (2008), which include groundwater impact assessments with numerical groundwater modelling conducted by ERM (2008).
- scholarly articles relevant to the groundwater assessment (i.e. articles on the properties of fine rejects).

2 Background data

As part of the groundwater assessment, site data was reviewed in order to understand the current groundwater conditions and develop a conceptual groundwater model (Section 3) that reflects current conditions. Review of data was also undertaken in order to compare current conditions against predicted groundwater conditions for the approved HVO North operations. This was done to ensure the modelled predictions (i.e. function of the final void to act as a sink) fit with current groundwater conditions and to identify any other possible impacts. Comparison of the background data to previous predictions and potential impacts is presented in Section 4.

This section of the report provides a summary of site data reviewed as part of the groundwater assessment. This includes climatic conditions, terrain and drainage, existing monitoring network, local geology, hydraulic parameters of key stratigraphic units, water levels, water quality and groundwater use.

2.1 Climate

The climate in the region is temperate and is characterised by hot summers and mild dry winters. Long term daily rainfall and evaporation data was obtained for the area from a SILO data drill for the period 01/01/1889 to 01/02/2016 (Queensland Government 2016). SILO provides estimates of daily rainfall and evaporation interpolated from surrounding rainfall recording stations. The location selected for the SILO data drill was at longitude 151.00^0, latitude -32.5^0 decimal and elevation 128mAHD. A summary of SILO rainfall and evaporation data is shown in Table 2-1.

Table 2-1 Rainfall and evaporation averages

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Mean rainfall (mm)	73.7	69.6	59.9	46.0	39.8	47.3	40.4	35.6	37.7	49.0	59.0	65.9	623.9
Mean evaporation (mm)	207.9	164.1	146.1	106.2	73.0	55.0	63.8	87.8	118.5	156.3	180.1	211.9	1570.7
Evap minus rainfall (mm)	134.1	94.5	86.1	60.2	33.3	7.7	23.4	52.3	80.8	107.3	121.1	146.0	946.8

Table 2-1 shows the long term average annual rainfall in the area is 624mm, with January being the wettest month (74mm). Evaporation exceeds mean rainfall throughout the year, with the highest moisture deficit occurring during summer.

Monthly records from the SILO dataset were used to calculate the Cumulative Rainfall Departure (CRD), also referred to as the rainfall residual mass. The CRD is a summation of the monthly departure of rainfall from the long term average monthly rainfall and provides a historical record of relatively wet and dry periods. A rising trend in slope in the CRD plot indicates periods of above average rainfall, whilst a declining slope indicates periods when rainfall is below average. The CRD in Figure 2-1 indicates that from mid-2007 to 2012 the region recorded above average rainfall events, followed by generally average rainfall since 2012.

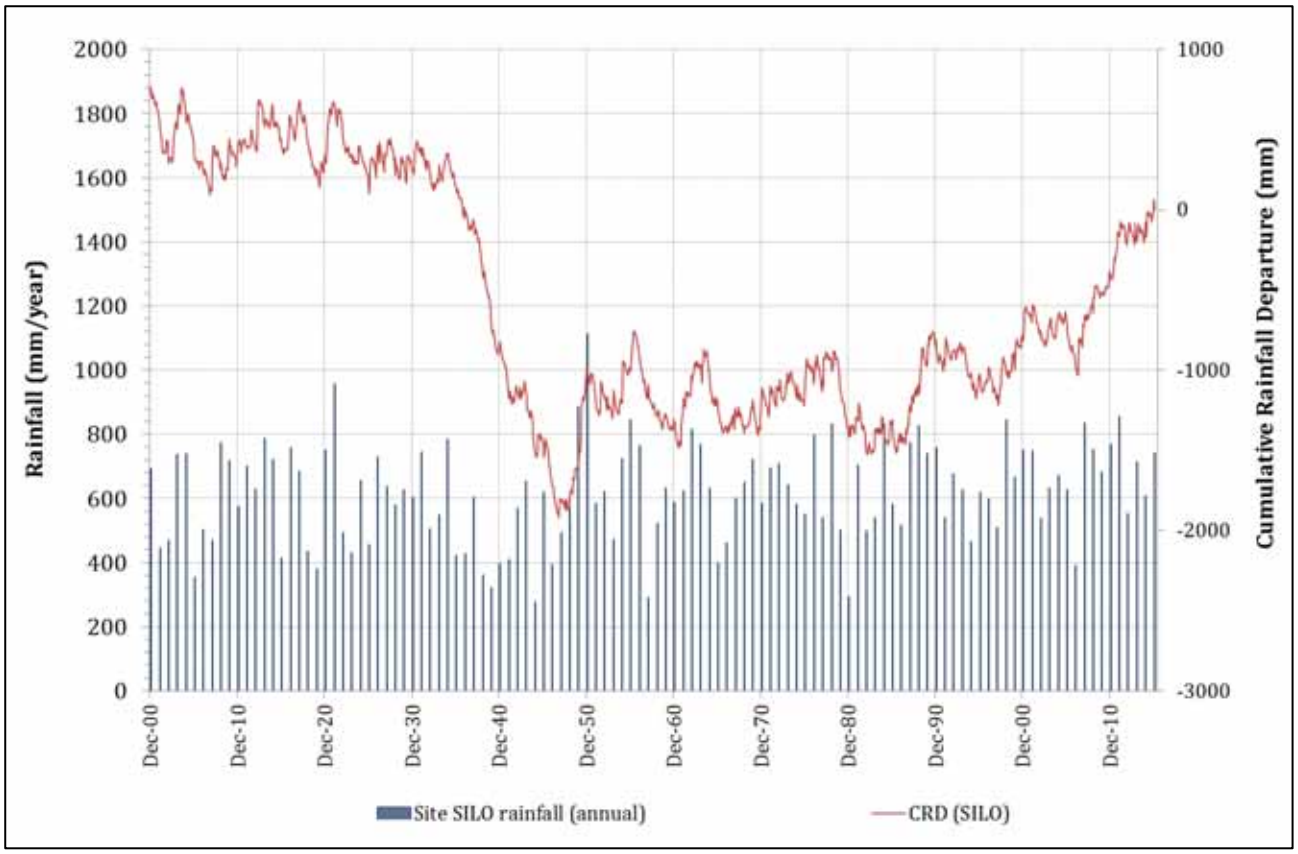


Figure 2-1 Cumulative Rainfall Departure and monthly rainfall

The SILO dataset also provides monthly pan evaporation and calculated plant evapotranspiration rates using the Penman-Monteith formulation as shown in Figure 2-2. The bimodal plot indicates higher rainfall, evaporation and evapotranspiration during the summer months. During the mid-year winter months evaporation and evapotranspiration is lowest.

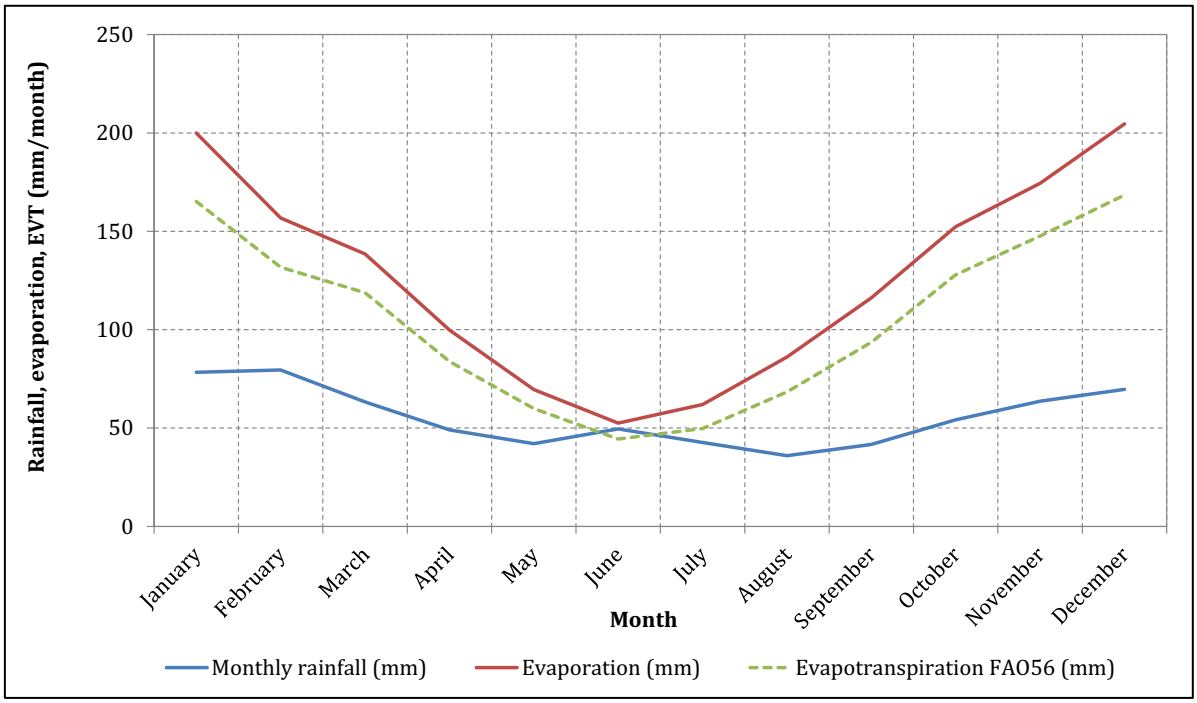


Figure 2-2 SILO average monthly rainfall, evaporation and evapotranspiration

2.2 Terrain and drainage

The proposed modification surroundings are gently undulating, with elevation ranging between 180mAHD along the eastern extent of West Pit, down to around 60mAHD along the Hunter River alluvial plains to the south. The proposed modification is within a previously mined out pit (Carrington Pit). As a result, no vegetation is present at the site. Riparian vegetation is present along the Hunter River, including tree species such as the River Red Gum. The alluvium where this vegetation is present is separated from the mine area by a barrier wall that was installed as a hydraulic barrier through the unconsolidated sediments and up to a height of 65mAHD (Figure 1-2).

The Hunter River flows in an easterly direction immediately south of HVO North. Minor drainage lines are also present around HVO North (ie Parnells Creek, Farrells Creek and Bayswater Creek) that are ephemeral in nature. Figure 2-4 shows the local surface water drainage setting.

Real time stream flow data is monitored along the Hunter River at DPI Water gauging stations via the Hunter Integrated Telemetry System (HITS). The closest upstream gauging station along the Hunter River is located 4km south-west of the project area at the Liddell station (210083). Figure 2-3 shows the stream flow and estimated baseflow at the gauging station.

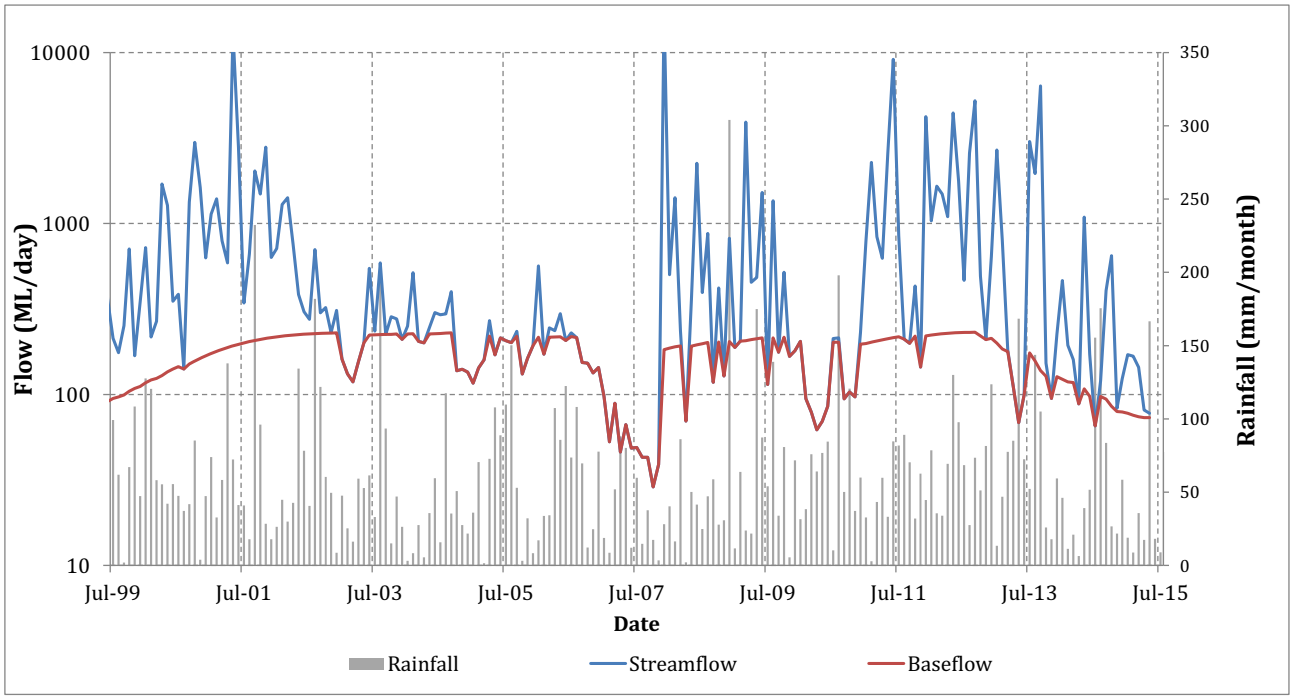
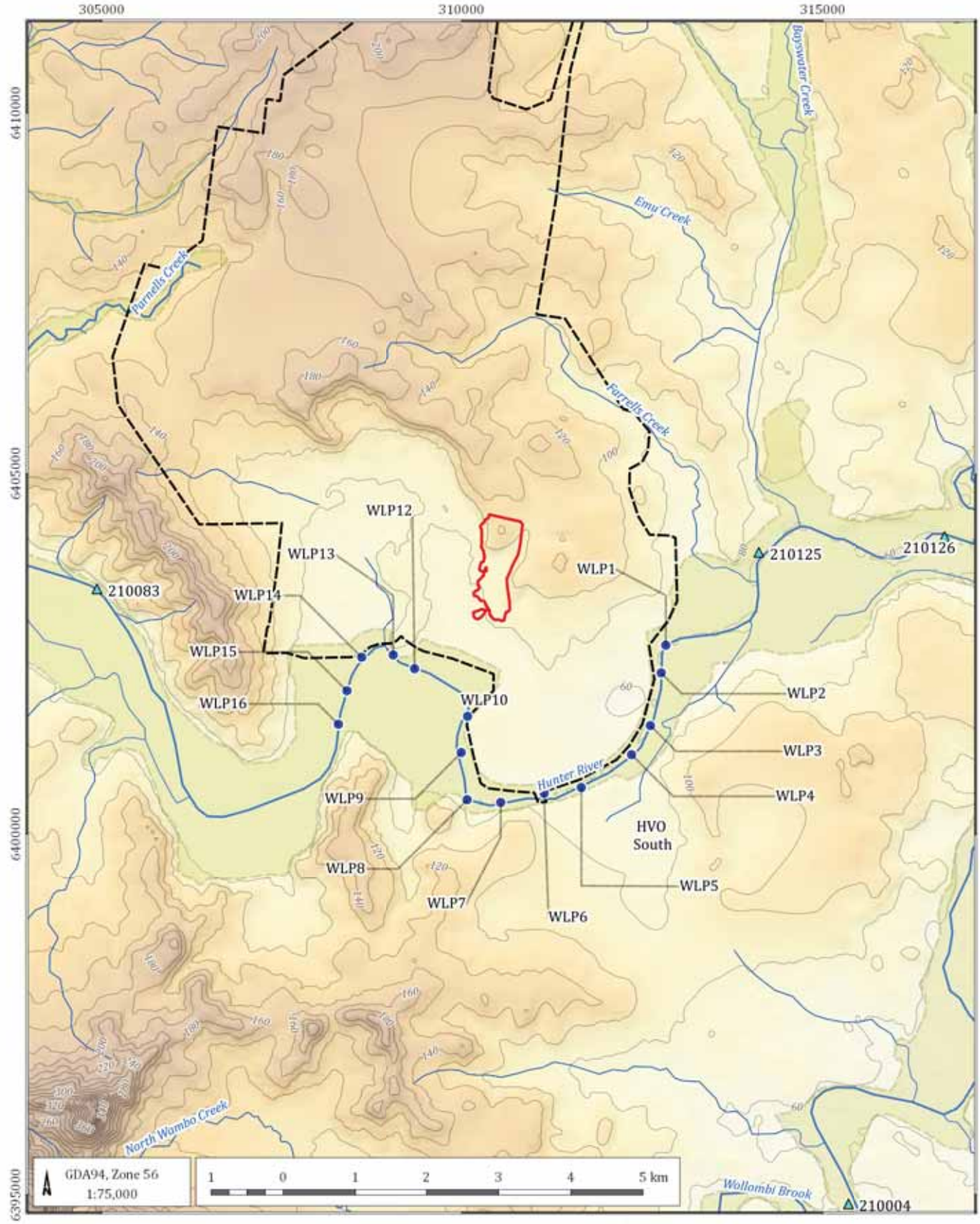


Figure 2-3 Baseflow in Hunter River at Liddell (210083)

The baseflow was estimated by comparing the monthly rainfall with total monthly stream flow. The results show that surface water flow is largely a function of rainfall and dam releases. Based on averaged monthly flow data from 1997 to 2015 (station 2100083), the Hunter River flows at a rate of 940ML/day (343,137ML/year), of which a proportion is derived from Glenbawn Dam releases. Figure 2-3 shows that the Hunter River also has a high baseflow contribution of up to 200ML/day. However, the baseflow contribution is likely to be less than estimated due to the releases from Glenbawn Dam, which maintains a permanent flow for downstream users.

The Hunter River is predominantly gaining water from the surrounding alluvium. However, there are also areas where the river recharges the underlying alluvium (losing), particularly around areas of active mining. As with the rivers, alluvium is also largely gaining groundwater from the underlying Permian coal measures, particularly away from active mining that depressurises the Permian coal measures.



LEGEND

- CIP fine reject emplacement
- HVO North Development consent boundary
- Major drainage
- Minor drainage
- DPI Water stream gauge
- HVO stream gauge
- Contour (mAHD, 20m interval)
- Quaternary alluvium (1:25K AGE)

Elevation (mAHD)

40

603

HVO North - Modification 6 Groundwater Study (G1737C)

Terrain and drainage

DATE 01/11/2016

FIGURE No: **2-4**

2.3 Existing monitoring

Coal & Allied has an integrated groundwater monitoring network spanning HVO North and HVO South that has evolved and gradually expanded since establishment of the mines. The groundwater monitoring network comprises 251 bores and 17 vibrating wire piezometers (VWP) with 31 sensors (282 monitoring points in total). The network was established from the year 2000, and extends across HVO North and HVO South. Over time, several of the bores have been abandoned and destroyed due to mine progression and deterioration. The proponent currently monitor 155 bores and two VWP sensors, with an additional 126 monitoring points that are no longer monitored but have available historical data, as summarised in Table 2-2.

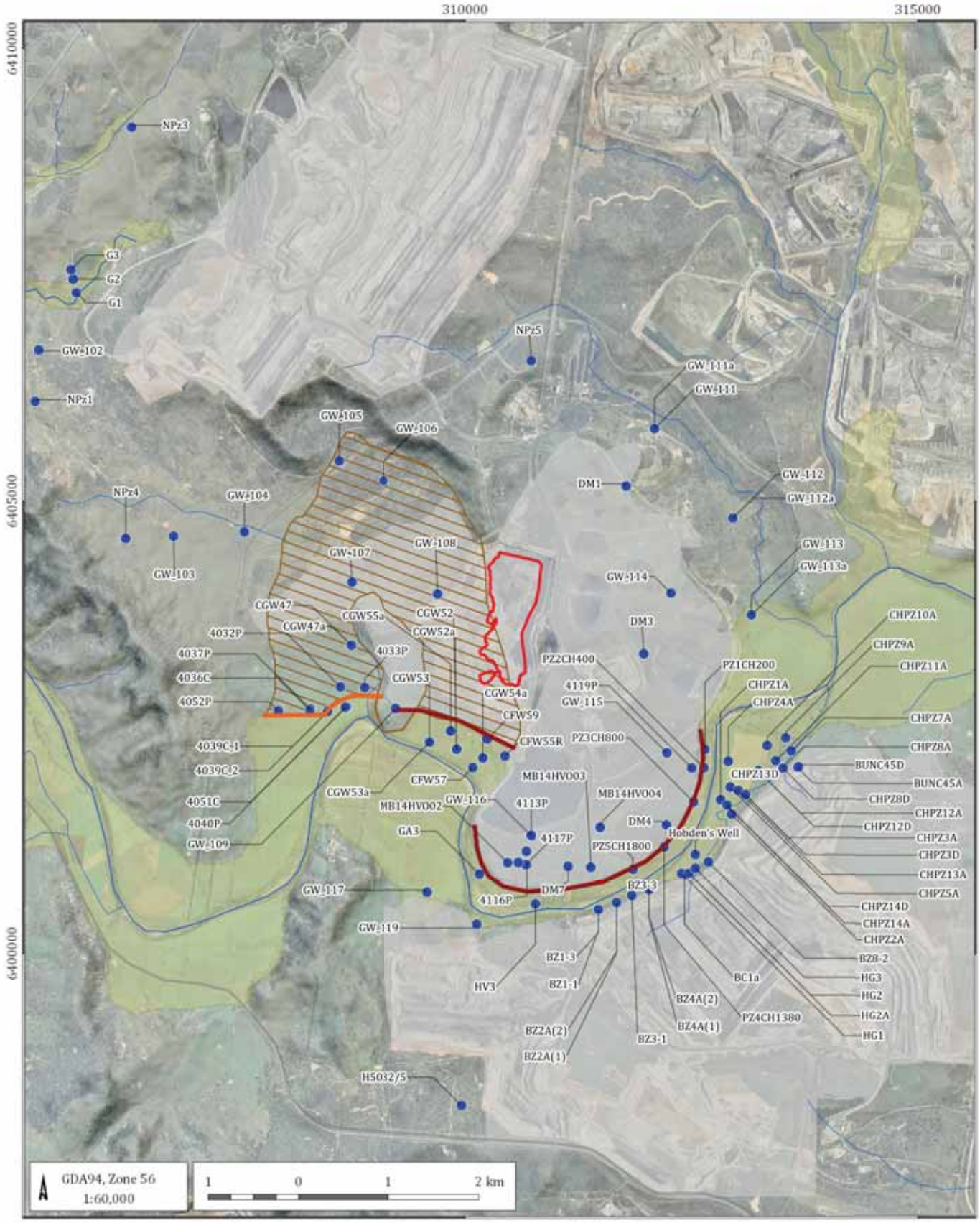
Table 2-2 Site monitoring network summary

Bore status	Number of bores				
	Total	Alluvium	Coal measures – sandstone/ siltstone	Coal measures - coal	Spoil
Existing	156	52	21	71	12
Abandoned but usable	29	5	7	5	12
Historical bore (abandoned and destroyed)	97	20	24	44	9

The location of the full monitoring network across HVO North is shown in Figure 2-5. As shown in Figure 2-5, there are 18 monitoring points within spoil (previously mined area) surrounding the proposed CIP fine reject emplacement. Within around 2km of the proposed CIP fine reject emplacement there are also over 10 bores within the coal measures and over 20 bores within the alluvium along the barrier walls and palaeochannel.

Coal & Allied monitor groundwater levels within the site monitoring network on a quarterly to annual basis. Bores equipped with dataloggers and the VWPs also record data approximately four times a day.

Since 2001 water quality data has also been collected by Coal & Allied, which is collected as part of the existing surface water and groundwater monitoring program. The extensive historic groundwater quality data includes over 4,000 readings for field EC and pH (each), and generally over 600 readings for major ions and metals.



LEGEND

- CIP fine reject emplacement
- Previously mined area
- Quaternary alluvium (1:25K AGE)
- Paleochannel (MER, 2005)
- Approved future barrier wall
- Existing barrier wall
- Monitoring point
- Major drainage
- Minor drainage

HVO North - Modification 6 Groundwater Study (G1737C)

Groundwater monitoring network

DATE 01/11/2016

FIGURE No. **2-5**

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2.4 Geology

HVO North is within the Sydney Basin which formed in the Late Carboniferous – Early Permian due to igneous rifting and crustal thinning, which resulted in the deposition of Permian and Triassic aged sedimentary sequences. HVO North extracts coal seams within the Permian Jerrys Plains Subgroup of the Hunter Coalfields. The Jerrys Plains Subgroup comprise economic coal seams, along with overburden and interburden consisting of sandstone, siltstone, tuffaceous mudstone and conglomerate. The Permian coal measures are stratified (layered) sequences that have undergone deformation resulting in strata dipping at a shallow angle of 2^0 to 5^0 to the south-west at HVO North. Regionally, the structure of the coal measures is influenced by large fold structures (ie Camberwell Anticline and the Bayswater Syncline), resulting in the stratigraphy dipping in a general south-westerly direction.

Along the Hunter River thin Quaternary alluvial deposits (alluvium) unconformably overlie the Permian sediments and comprise silt, sand and gravel. Further details about the main lithological units are provided within Section 2.4.1 to Section 2.4.3.

Figure 2-6 shows the regional surface geology across the site and surrounds, based on the 1:100,000 scale regional Coalfields geological map, published by Department of Mineral Resources (Glen & Beckett 1993). The Quaternary alluvium in Figure 2-6 has been digitised based on the 1:25,000 Geology Map of Singleton (McIlveen 1984), Muswellbrook (Summerhayes 1983), Jerrys Plains (Sniffin & Summerhayes 1987) and Doyles Creek (Sniffin *et al* 1988), which are not available in digital format.

Figure 2-7 to Figure 2-9 present geological cross sections based on site geological models and lithological logs from monitoring and exploration holes. The cross sections show the relative distribution of key stratigraphic units across the proposed modification, as well as surface water features and mining.

2.4.1 Alluvium and palaeochannel

The alluvium along the Hunter River flood plain comprises two distinct depositional units, a surficial fine grained sediment and coarser basal material. The surficial alluvium comprises shallow sequences of clay, silty sand and sands. Along the minor drainage lines the surficial alluvium is typically constrained within 400m of the creeks and is between 7m to 19m thick. Alluvium is absent from the footprint of the proposed modification, with the closest alluvium separated from the mine area by a barrier wall.

Within the Hunter River flood plain the surficial alluvium is underlain by basal sands and gravels that form a productive groundwater aquifer ('highly productive alluvium'). Along the Hunter River flood plain the productive basal sands are typically between 7m and 20m thick. The basal sands and gravels of the 'highly productive alluvium' do not occur within the approved footprint of the proposed modification, but are present approximately 750m south of the proposed CIP fine reject emplacement.

A palaeochannel infilled with alluvium occurs north of the Hunter River (Figure 2-6) and south of the CIP fine reject emplacement. The alluvial palaeochannel is generally 12m to 20m thick and is filled with unconsolidated gravels, silts and clays. Prior to mining, groundwater flow within the alluvium deviated north from the Hunter River into the western limb of the palaeochannel. This groundwater then flowed back toward the Hunter River, along the eastern limb of the palaeochannel.

The depositional environment of the palaeochannel was dominated by flood surge events, resulting in deposition of gravels contiguously with silts and clays. Despite the variability in stratigraphy caused by the depositional environment, the alluvial palaeochannel is comprised of three main layers as reported by MER (2010):

- upper layer, comprised of thin bands of sand, silt and clay;
- middle layer, which is approximately 3m to 8m thick and is comprised of stiff clays; and
- basal layer, which is approximately 3m to 8m thick and is comprised of fine to coarse-grained silty clay gravels and cobbles or in some areas, sandy gravels.

Previous mining of Carrington Pit intersected the palaeochannel sediments to the west of the proposed CIP fine reject emplacement. Palaeochannel sediments remain to the north of the backfilled Carrington Pit, but are isolated from the palaeochannel sediments to the south by the spoils backfilled within the Carrington Pit. In addition, construction of the Carrington West Wing barrier wall prior to mining commencing in this area will add a further physical barrier between the palaeochannel alluvium and the Hunter River alluvium.

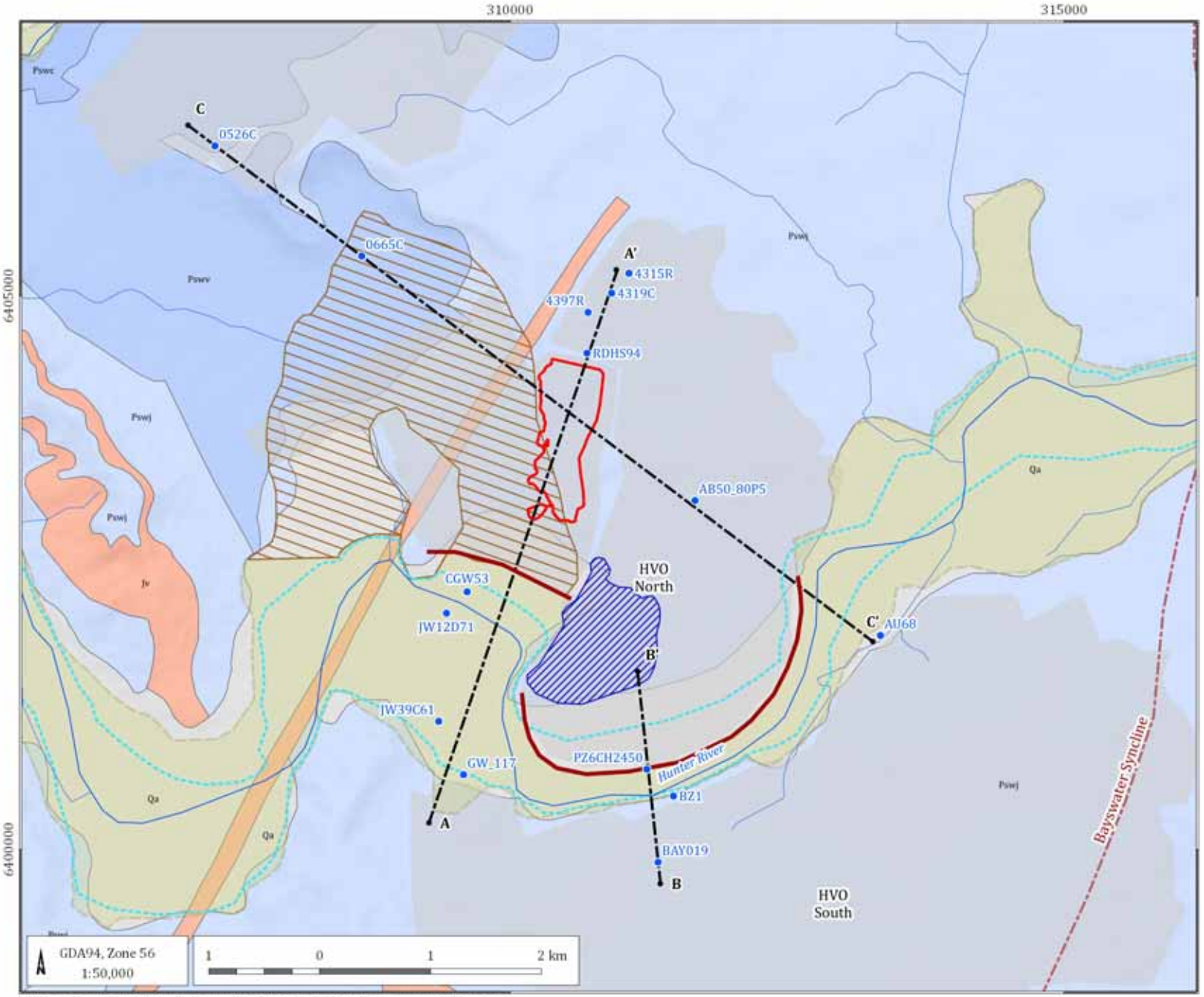
2.4.2 Permian coal measures

The Permian aged coal measures of the Jerry's Plains Subgroup occur at outcrop across HVO North, and can occur at sub crop beneath alluvial sediments. The Jerry's Plains Subgroup comprise coal seams interbedded with siltstone, sandstone, shales and conglomerates. The non-coal portions of the sequence are referred to collectively as 'interburden' in the mining context. Within the Jerrys Plains Subgroup there are 15 main coal seams that are mined across the Hunter Valley. In stratigraphic order (youngest to oldest), they are the Whybrow, Redbank Creek, Wambo, Whynot, Blakefield, Glen Munro, Woodlands Hill, Arrowfield, Bowfield, Warkworth, Mt Arthur, Piercefield, Vaux, Broonie and Bayswater seams. The Bayswater Seam is underlain by the Archerfield Sandstone, which is a marker bed between the Jerrys Plains Subgroup and the underlying Vane Subgroup of the Wittingham Coal Measures.

Each coal seam occurs with various splits and plies, with an average coal thickness of 3m, and a total coal thickness of up to 5.5m for most seams. The coal seams are interbedded with units of siltstone, sandstone and shale. The interburden has an average thickness of 25m, and a maximum thickness of up to 90m for each interburden sequence. The Jerrys Plains Subgroup is up to 150m thick at HVO North, but regionally can be up to 600m thick.

2.4.3 Spoil

Historically mined out areas at HVO North have been backfilled with spoils and largely rehabilitated. North Pit and Alluvial Lands have been fully backfilled with spoil, while Carrington Pit has been partially backfilled. The spoil comprises a mix of Permian interburden and overburden material that is generated as waste in the open cut coal mining process (Figure 2-6).



LEGEND

- CIP fine reject emplacement
- Previously mined area
- Paleochannel (MER, 2005)
- North Pit Void Dam
- Selected drillholes within sections
- Fold
- Geological section
- Existing barrier wall
- Drainage

Geology - Hunter Coalfield Regional 100k

- Qa - Quaternary Alluvium
- Jv - Jurassic Volcanics
- Psl - Wollombi Coal Measures
- Pswj - Jerrys Plains Subgroup
- Pswv - Archerfield sandstone, Vane Subgroup
- Pswc - Saltwater Creek Formation
- Quaternary alluvium (1:25K AGE)

HVO North - Modification 6 Groundwater Study (G1737C)

Geology

DATE
01/11/2016

FIGURE No:
2-6

Quaternary alluvium (1:25k AGE): 1:25,000 Singleton - AGE digitised and adjusted based on site data
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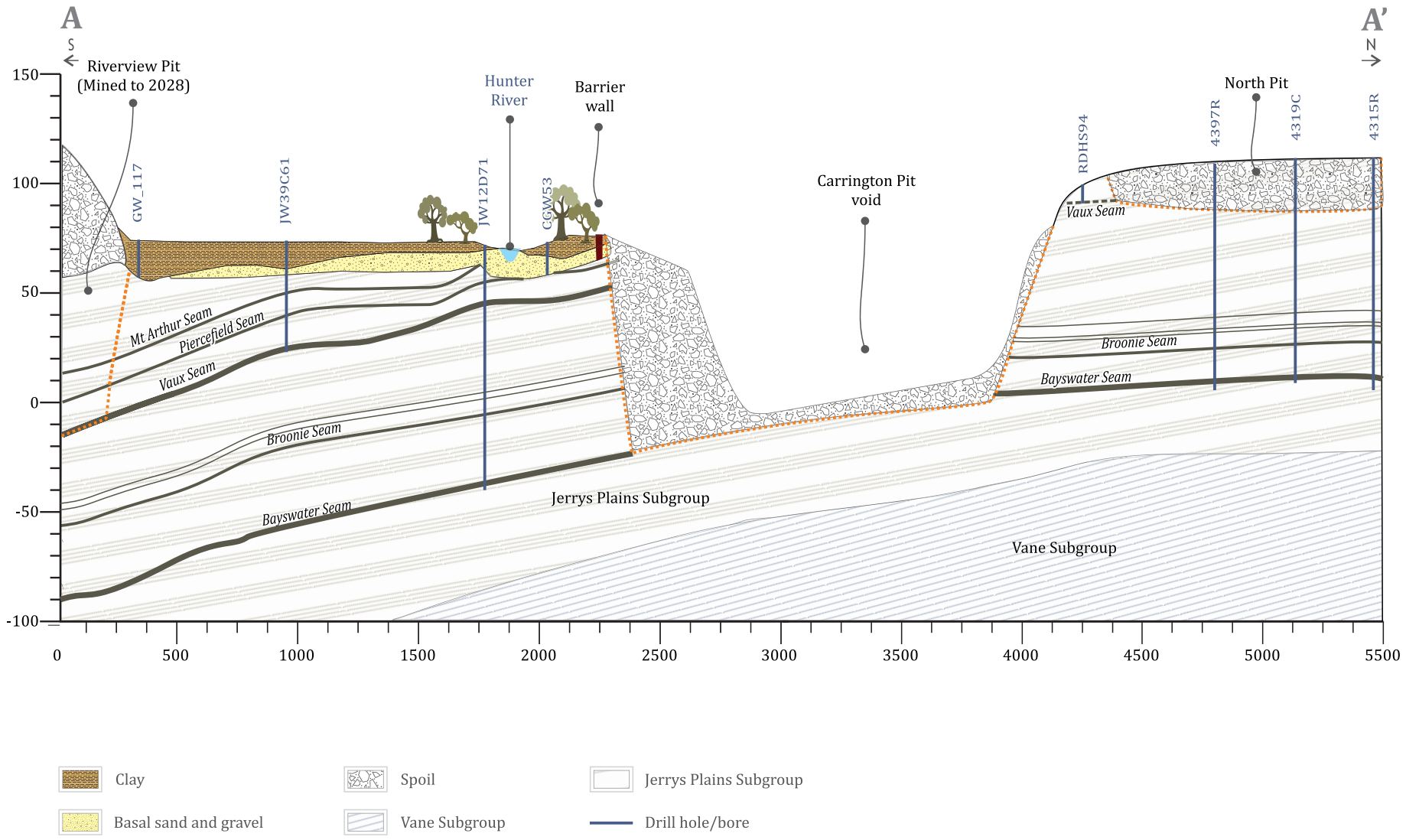
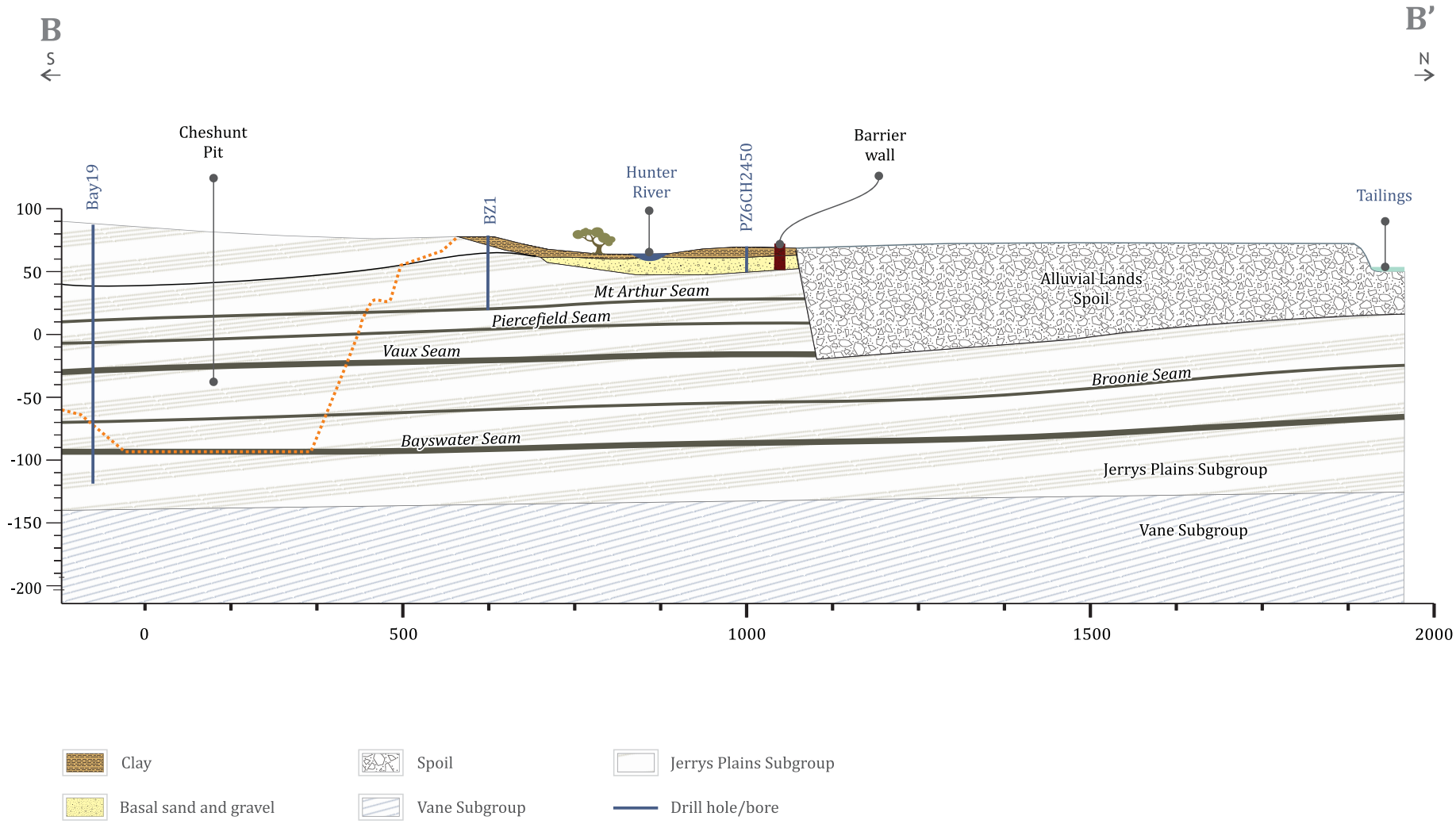


Geological cross section - Carrington Pit south to north

Figure 2-7

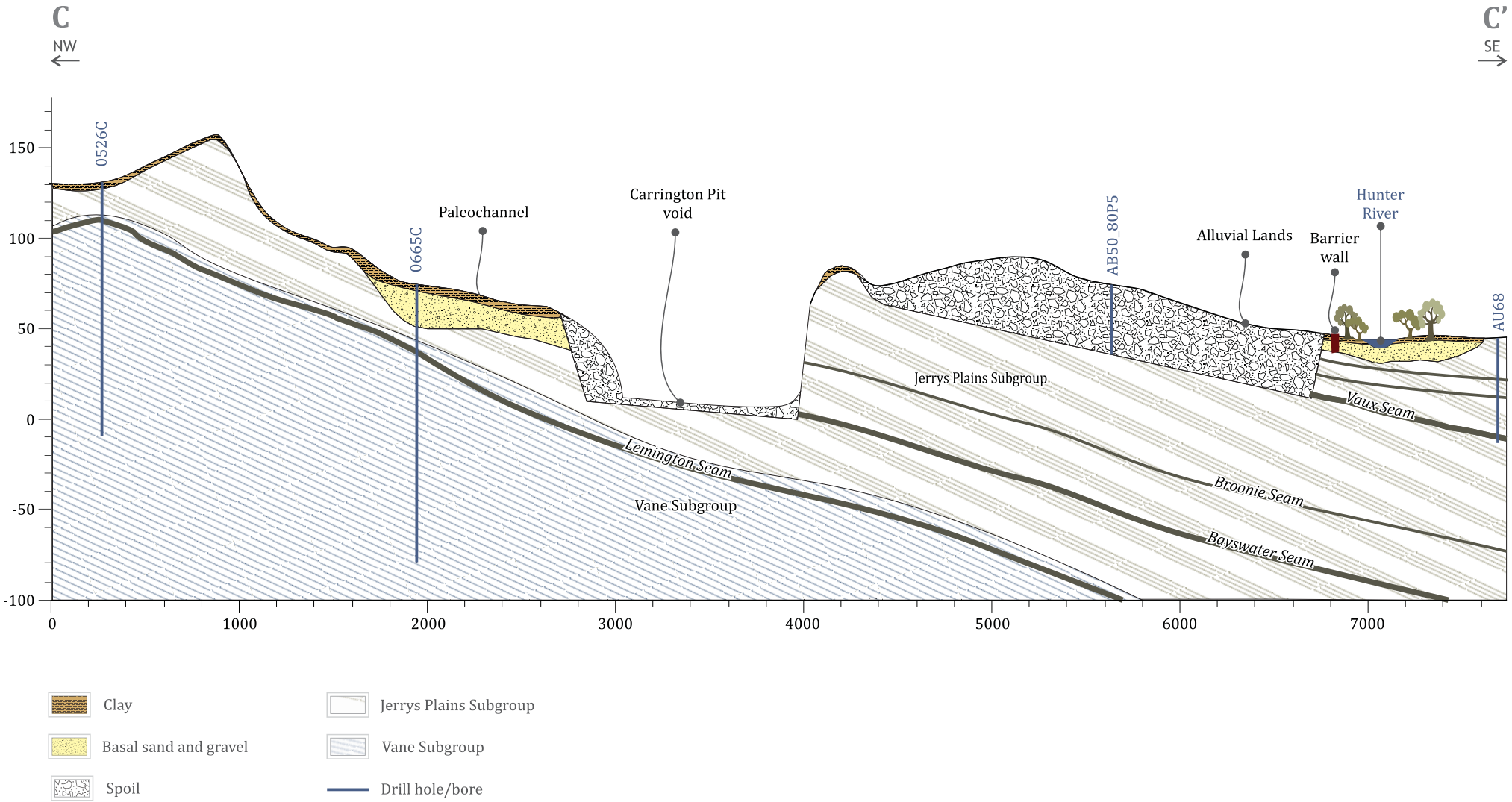
HVO North - Modification 6 Groundwater Study (G1737C)



Geological cross section - Alluvial Lands south to north

Figure 2-8

HVO North - Modification 6 Groundwater Study (G1737C)



Geological cross section - northwest to southeast

Figure 2-9

HVO North - Modification 6 Groundwater Study (G1737C)

2.5 Hydraulic parameters

As the proposed modification aims to replace spoil material within Carrington Pit void with fine rejects, the difference in hydraulic properties between the two units was reviewed, and presented in Figure 2-10. Hydraulic conductivity values for fine rejects and spoil were derived from ranges reported by various authors, discussed further below.

In addition, in order to understand the behaviour of groundwater flow within the insitu strata, the range in hydraulic conductivity for the alluvium and Permian coal measures (interburden and coal) is also presented in Figure 2-10. The available data includes 59 measurements for alluvium, 303 measurements of coal, and 151 measurements of interburden material.

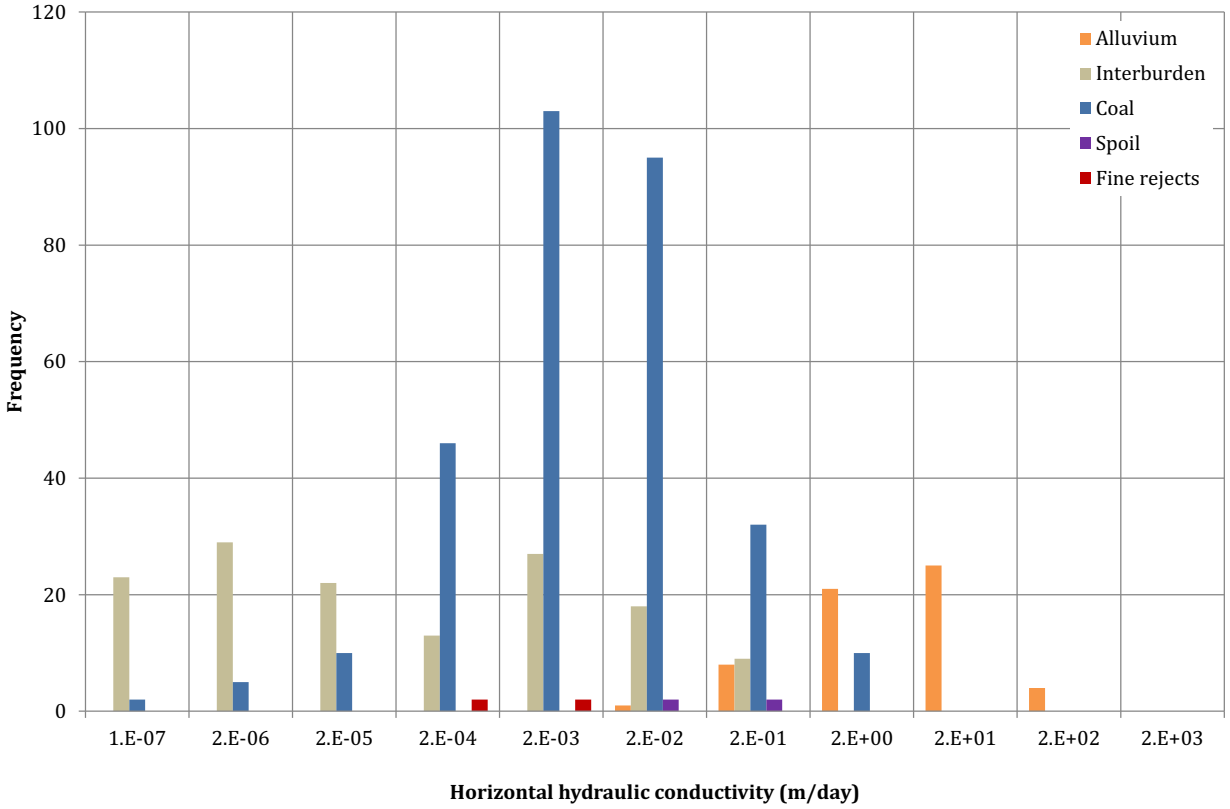


Figure 2-10 Histogram of hydraulic conductivity (Kh) distribution

Relatively recently emplaced spoil material records a high drainable porosity of around 20 per cent, and field tests of spoil at HVO North have estimated a hydraulic conductivity of between 0.7m/day and 1.6m/day (AGE, 2013; Mackie, 2009). Wickland *et al* (2010) also identified that the hydraulic conductivity of spoil material reduces with increased compaction, but to a lesser extent compared to fine rejects.

Comparing these spoil properties to those of fine rejects, the available data indicates that the hydraulic conductivity of fine rejects can range between $1.0x10^{-4}$m/day and $1.0x10^{-2}$m/day, which decreases with increased compaction/settlement (Aubertin *et al*, 1995; Wickland *et al*, 2010). This indicates that the hydraulic conductivity of fine rejects is between two and four orders of magnitude lower than that of recently placed spoil.

The difference in hydraulic conductivity for fine rejects and spoil material is largely due to consolidation behaviour and particle structure. The particle size of fine reject material recorded at site ranges between $3.8x10^{-2}$mm and 2mm, which is finer than spoil material that ranges from $1.0x10^{-1}$ mm to $2.0x10^{+3}$mm. These measurements roughly correspond with studies conducted by Wickland *et al* (2010), which gave a fine reject particle size range of $1x10^{-3}$mm and $5x10^{-2}$mm, and a spoil particle size range of $5x10^{-2}$mm and $5.0x10^{+1}$mm. In essence the fine rejects have a particle size similar to silt and clay, whilst spoils can have a wider size particle range through from clay to gravel. When considering this information it is important to note that whilst spoils are moderately permeable when initially placed, anecdotal evidence at HVO North within the backfilled Alluvial Lands area suggests physical compaction combined with physical and chemical weathering of the spoil sediments has reduced the porosity and permeability of the spoil significantly. The physically dispersive nature of the spoils is visually evident where they are present at the surface on-site and this process is expected to promote the gradual clogging of porosity within the spoils. Therefore in the long term therefore neither the spoil nor the fine rejects are expected to form productive aquifers.

Looking at the insitu material, the field data shows that the alluvium has a relatively high hydraulic conductivity that ranges between $5.3x10^{-2}$m/day and $3.70x10^{+2}$m/day. The coal seams are typically moderately to slightly permeable, with hydraulic conductivity readings generally around $1x10^{-2}$m/day, and ranging between $5.24x10^{-7}$m/day and 12m/day. The hydraulic conductivity of the interburden material is generally less than coal but is also locally variable, ranging between $1.87x10^{-7}$m/day and 1m/day, depending on the predominance of fractures in the rock mass.

2.6 Groundwater levels, flow directions and sub-surface recharge

The proposed CIP fine reject emplacement is positioned within the existing Carrington Pit, which comprises in-situ Permian coal measures, overlain by spoil material in places. This section discusses the results from review of site water level data, to illustrate the hydraulic connection and groundwater behaviour between the Carrington Pit void and surrounding Permian coal measures. Alluvial water level data was also reviewed in order to confirm that the barrier walls constructed between Carrington Pit and the alluvium are currently functioning as predicted by MER (2010), ensuring physical and hydraulic separation.

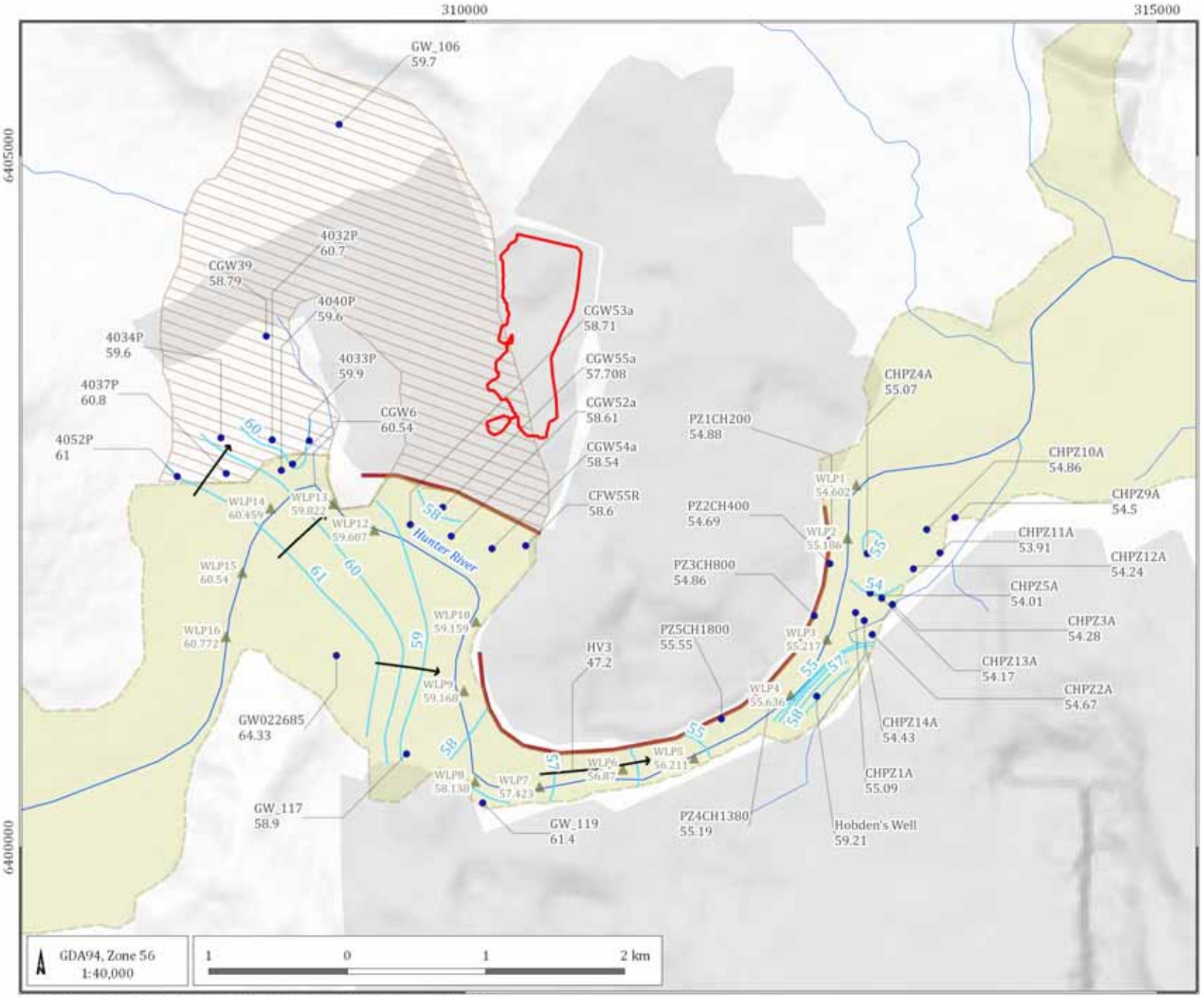
Groundwater levels allow vertical and lateral hydraulic gradients and flow directions to be determined. They can also be used to infer relative hydraulic conductivity between units. Potentiometric surfaces for key geological formations (Figure 2-11 and Figure 2-12) were prepared using recent (2015) levels recorded at site monitoring bores. Groundwater flow directions were then inferred from the potentiometric surfaces.

Figure 2-11 shows that groundwater within the Quaternary alluvium generally flows in an easterly direction, following the Hunter River. The groundwater contours indicate groundwater flow in a general east to north-easterly direction within the eastern limb of the palaeochannel. The groundwater gradient appears to flatten within this eastern limb, with groundwater levels relatively stable at around 58.5mAHD. These stable levels show the effectiveness of the barrier wall at inhibiting alluvial flow towards Carrington Pit.

As presented in Figure 2-13 and discussed above, groundwater levels within alluvial bores within the eastern limb of the palaeochannel (ie CGW53a) are generally below river levels. This indicates that the Hunter River is largely losing water to the underlying alluvium in this area, with isolated occurrences of gaining conditions also visible.

The Wittingham Coal Measures occur at outcrop to the north and east of HVO North, and also occur beneath weathered regolith and alluvium. Figure 2-12 shows groundwater level contours and flow directions for the Broonie Seam, which is one of the lowermost seams mined at HVO North. The groundwater contours show localised drawdown towards the Carrington Pit void, and towards active mining at HVO South. It should be noted that while Carrington West Wing is approved at HVO North, active mining has not commenced and the western barrier wall hasn't been constructed as yet. The approved western barrier wall is designed to act as a hydraulic barrier between the Hunter River alluvium and the mine area, and will be constructed similar to the existing eastern barrier wall when required.

Figure 2-12 also shows groundwater levels recorded within the spoil across HVO North (from 2014/2015). Groundwater levels within the spoil to the west of the CIP fine reject emplacement appear to be flowing towards the Carrington Pit void. Within the rehabilitated spoil at North Pit and Alluvial Lands, water levels are 41mAHD near North Pit void. This is around 20m below the sediment level within North Pit void, indicating limited hydraulic connection between the fine reject emplacement and underlying spoil. Further south at Alluvial Lands the spoil water levels decrease to around 37mAHD, indicating drawdown within the spoil towards active mining to the south at Cheshunt Pit (HVO South). Westerly flow of water within the North Pit spoil towards Carrington Pit appears to be inhibited by a band of undisturbed Permian coal measures between the two mined out areas, which acts as a natural barrier.



HVO North - Modification 6 Groundwater Study (G1737C)

Groundwater levels and flow direction - alluvium

DATE
01/11/2016

FIGURE No:
2-11

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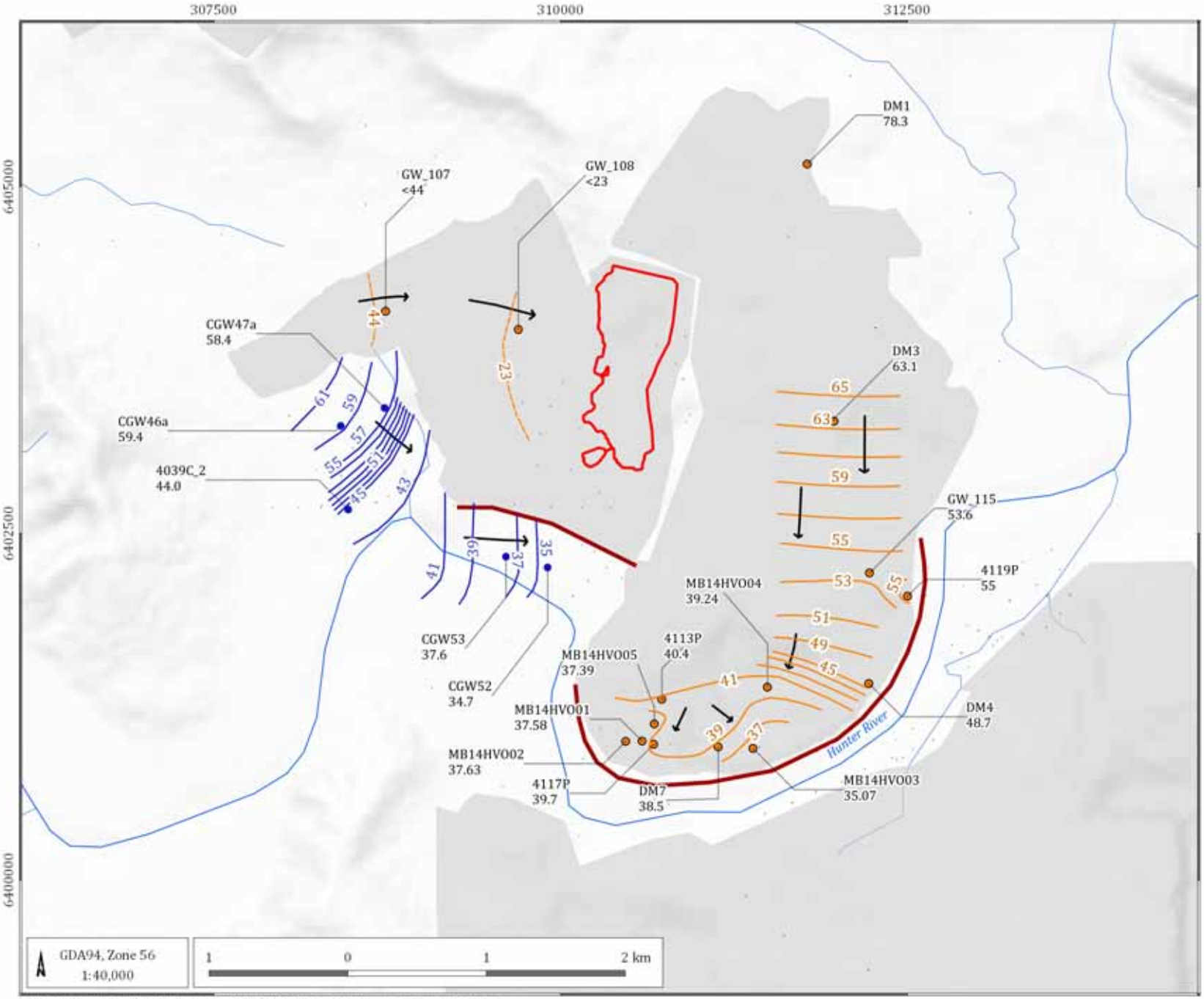


LEGEND

- CIP fine reject emplacement
- Previously mined area
- Existing barrier wall (within alluvium)
- Major drainage
- Monitoring point - Broonie Seam (water level mAHD)
- Monitoring point - spoil (water level mAHD)
- Groundwater contour - Broonie Seam (mAHD)
- Groundwater contour - spoil (mAHD)
- Inferred flow direction

HVO North - Modification 6 Groundwater Study (G1737C)

Groundwater levels and flow direction - Broonie Seam and spoil

DATE
01/11/2016

FIGURE No:
2-12

G:/Groundwater Jobs/G1737C_HVO North Mod/3_GIS/Workspaces/002_HVO North Mod Qualitative/02-12_G1737C_GW levels_BroonieSeam.qgs

As discussed above, groundwater levels have remained relatively constant within the eastern limb of the palaeochannel despite historic mining at Carrington Pit. This is due to installation of a compacted clay wall through the unconsolidated sediments, which forms a hydraulic barrier to minimise loss of groundwater flow from the alluvium into the active mine area to the north. Figure 2-13 compares groundwater level trends within the alluvium (CGW53A, CGW54A and 4039C_1) and Permian coal seam (Broonie Seam at 4039C_2) near Carrington Pit. As discussed earlier, there is no direct physical connection between the alluvium and area of the proposed CIP fine reject emplacement due to the presence of the barrier wall. However, it is important to understand how the alluvium is recharged and the hydraulic connection between the alluvium and underlying Permian coal measures.

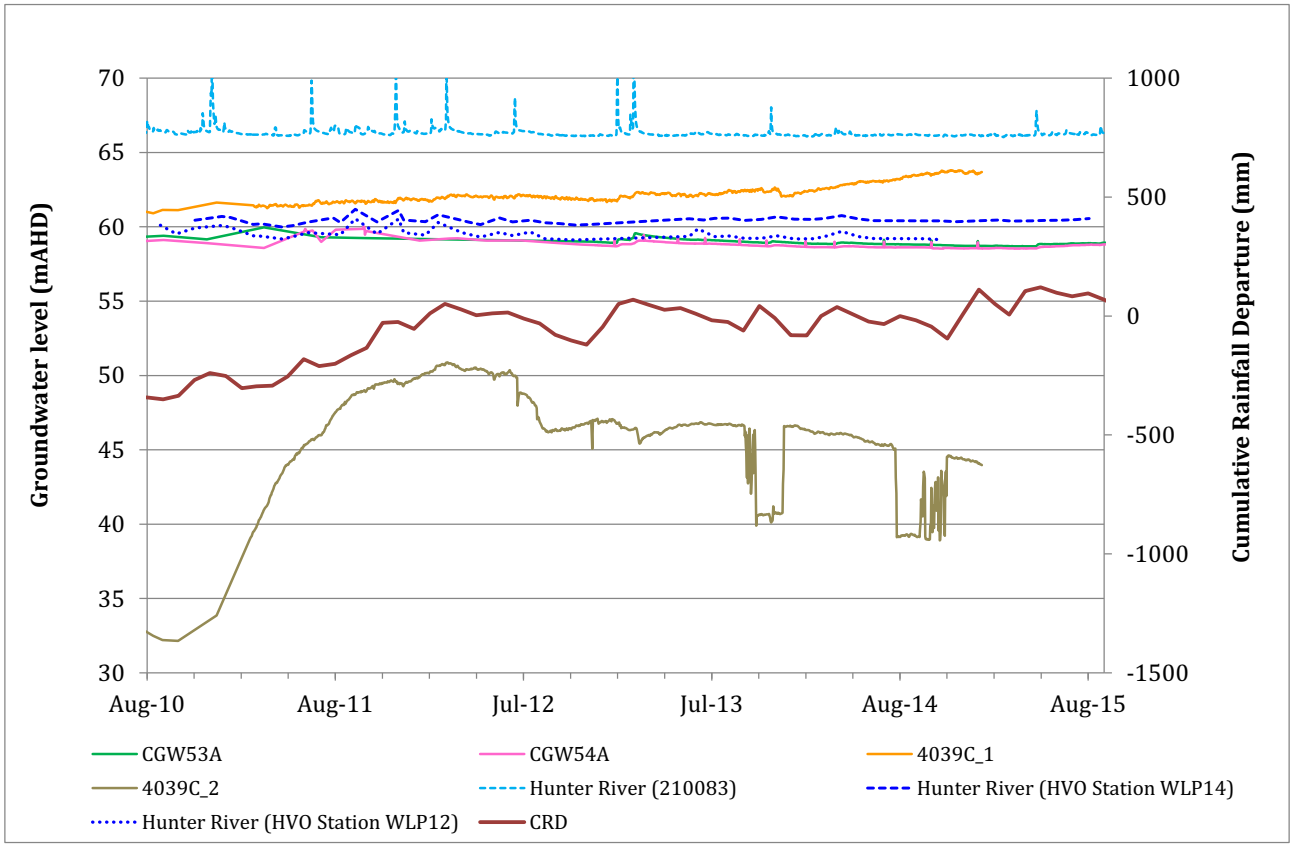


Figure 2-13 Hydrographs comparing groundwater trends in alluvium and Permian coal measures

Figure 2-13 shows that where mining is present the coal seams are depressurised, recording groundwater level elevations around 15m to 30m below alluvial groundwater levels. Therefore, where drawdown due to mining is present, as is observed around the proposed CIP fine reject emplacement, there is limited potential for upward seepage of Permian groundwater to the overlying alluvium. It should be noted that the CIP fine reject emplacement is only proposed to operate during active mine operations.

2.7 Groundwater quality

The proposed modification involves a change in the type of material used to fill Carrington Pit void to the approved final landform. The proposed modification therefore represents a change of backfill material from spoil to fine rejects. This section reviews site water quality data within spoil and fine rejects in order to identify any differences in water quality or beneficial use of water. Fine rejects water quality is based on data collected at HVO North (Dam 20W and Dam 6N) since 2008.

This section also reports on the characteristics of groundwater within the insitu strata (i.e. alluvium and Permian coal measures) and surface water in order to understand the current beneficial use of surrounding water sources.

2.7.1 Groundwater characteristics

Major ion chemistry has been presented based on averaged water quality results for each of the major groundwater units. Figure 2-14 shows the Mg/Na and Na/SO_4 scatter plots for the averaged water quality results of the spoil, fine rejects, insitu units (alluvium and Permian coal measures) as well as the surface water (Hunter River).

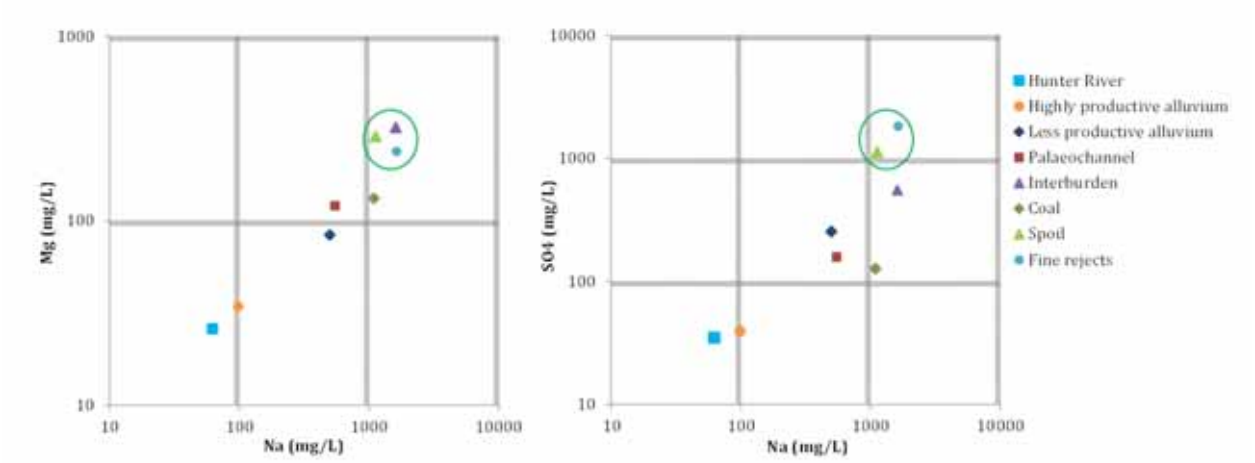


Figure 2-14 Mg/Na scatterplot and Na/SO_4 scatterplot of groundwater quality

Figure 2-14 shows that groundwater within the spoil, fine rejects and Permian coal measures have the highest average concentrations of major ions (Na, Mg and SO_4). The water quality data (see Appendix A) shows an average sulphate concentration for interburden of 554mg/L, 642mg/L for coal, 1,134mg/L for spoil and 1,824mg/L for fine rejects. These results show that sulphate concentration increases with increased processing of the Permian coal measures.

Further to this, MER (2010) conducted X-ray diffraction of waste rock sandstones, siltstones and shales and found it contained quartz, feldspar, mixed layer clays and carbonate materials. The presence of carbonate minerals naturally buffers acid generation. Further to this, review of field pH readings recorded for HVO indicates that water associated with fine rejects is generally alkaline, with an average pH of 9 (see Table 2-3). The results also showed that water within the spoil and insitu units (alluvium, coal and interburden) is generally neutral, with an average pH of 7.1 to 7.4.

Table 2-3 pH results

	Hunter River	Palaeo-channel	Less productive alluvium†	Highly productive alluvium	Interburden†	Coal	Spoil	Fine rejects
Average pH	8.1	7.4	7.3	7.2	7.2	7.2	7.1	9
Min	5.5	6.7	5.8	6.3	5.9	6.1	6.1	7.6
Max	9.1	8.6	9.9	8.3	9.9	9.9	8.8	9.3
Population	656	832	1021	483	855	2,686	214	62

The increased concentration of major ions within the spoil material indicates either limited rainfall recharge, or leaching of the minerals. Mackie (2009) conducted studies across the Hunter Valley and found that rainfall infiltration rates were up to 75 per cent lower within rehabilitated spoil (5.7mm/hr to 7.2mm/hr) compared to native pasture (21.2mm/hr). Deep percolation of rainfall into spoil was estimated to range between 1 per cent to 5.5 per cent of long term rainfall (Mackie, 2009).

2.7.2 Salinity

Salinity is a key constraint to water management and groundwater use, and can be described by total dissolved solids (TDS) concentrations. This section presents the range in salinity of water within spoil, fine rejects and insitu stratigraphy (alluvium and Permian coal measures) based on long term site data and classified using the FAO (2013) standard.

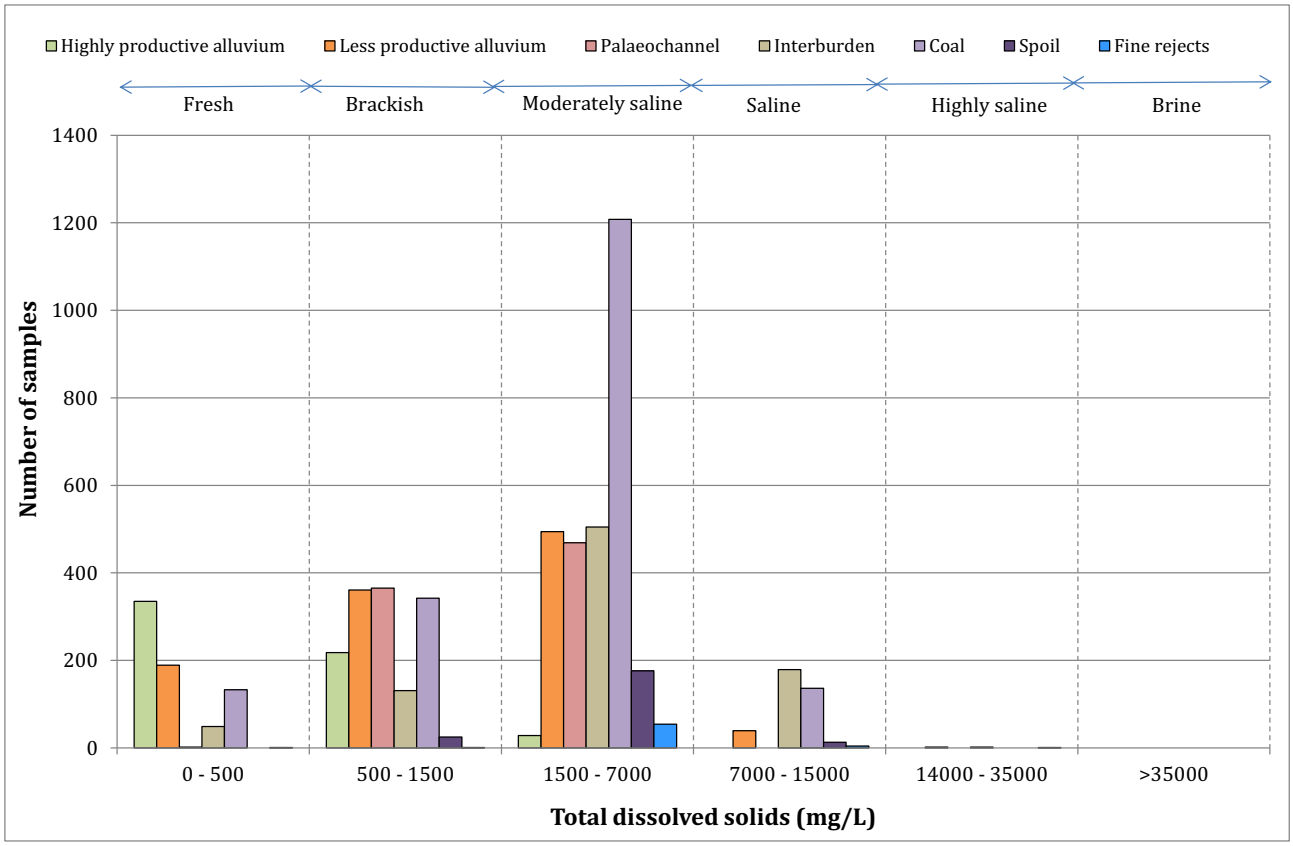


Figure 2-15 Groundwater TDS histogram

The results in Figure 2-15 show that the average salinity of water within spoil, fine rejects and Permian coal measures (coal and interburden) is within the moderately saline range defined by FAO (2013). Spoil water has an average TDS of 5,242mg/L, fine rejects water has an average TDS of 6,446mg/L, coal has an average TDS of 6,405mg/L and interburden has an average TDS of 5,873mg/L. The results also show that groundwater within the palaeochannel is generally classified as moderately saline, with an average TDS of 2,789mg/L. In comparison, water within the alluvium is generally fresh ("highly productive" alluvium) to brackish ("less productive" alluvium).

2.7.3 Beneficial use of groundwater

Coal & Allied has collected extensive water quality data across HVO since 2001 as part of the existing surface water and groundwater monitoring program. The extensive historic groundwater quality data includes over 4,000 readings for field EC and pH (each), and generally over 600 readings for major ions and metals. A summary of the water quality data is included in Appendix A.

For the purpose of this assessment, groundwater quality data has been compared to guideline values provided by ANZECC (2000) for short and long term irrigation and stock water supply, which are agricultural activities in the regional area. Water quality across the spoil, fine rejects and insitu strata (alluvium and Permian coal measures) was compared.

The results indicate that groundwater witin the spoil, fine rejects and Permian coal measures (coal and interburden) is not considered suitable for irrigation or stock water supply according to the ANZECC (2000) guidelines. Groundwater within the Permian coal measures (coal and interburden) contains elevated salinity and total aluminium concentrations that preclude it from use for stock water supply. Groundwater within the Permian coal measures also records total manganese concentrations above the ANZECC (2000) long term irrigation guideline. Total selenium concentrations are above the ANZECC (2000) guideline level for short-term irrigation for the Permian coal measures and fine rejects. Average sulphate concentrations are also greater than 1,000mg/L for spoil and fine rejects, which is above the ANZECC (2000) trigger for stock water supply (pigs).

The results for the alluvium ("highly productive" and "less productive") indicate that the groundwater is not suitable for long term irrigation according to the ANZECC (2000) due to concentrations of manganese. The results indicate that groundwater within the "highly productive" alluvium is suitable for stock water supply. The averaged laboratory TDS results show that salinity is below 1,020mg/L in the "highly productive" alluvium, and as detailed above, the 95th percentile for TDS (laboratory and calculated from EC) is 1,499mg/L. These results are below the ANZECC (2000) adverse levels for stock (eg sheep, beef cattle, dairy cattle, horses, pigs and poultry).

The averaged laboratory TDS results for the "less productive" alluvium show that salinity is generally below 4,610mg/L. However, as detailed above, the 95th percentile for TDS (laboratory and calculated from EC) is 6,702mg/L. The results show that the "less productive" alluvium has a higher salinity compared to the "highly productive" alluvium. In addition, TDS concentrations are recorded above the ANZECC (2000) guideline level for adverse impacts on pigs and poultry (3,000mg/L), dairy cattle (4,000mg/L), beef cattle (5,000mg/L) and horses (6,000mg/L). However, the TDS is below the ANZECC (2000) guideline level for adverse impacts on sheep. Overall, the results indicate that groundwater within the alluvium is not suitable for stock water supply (excluding sheep) in accordance with the ANZECC (2000) guidelines. However, alluvial groundwater is occasionally used for stock (cattle) water supply within the region.

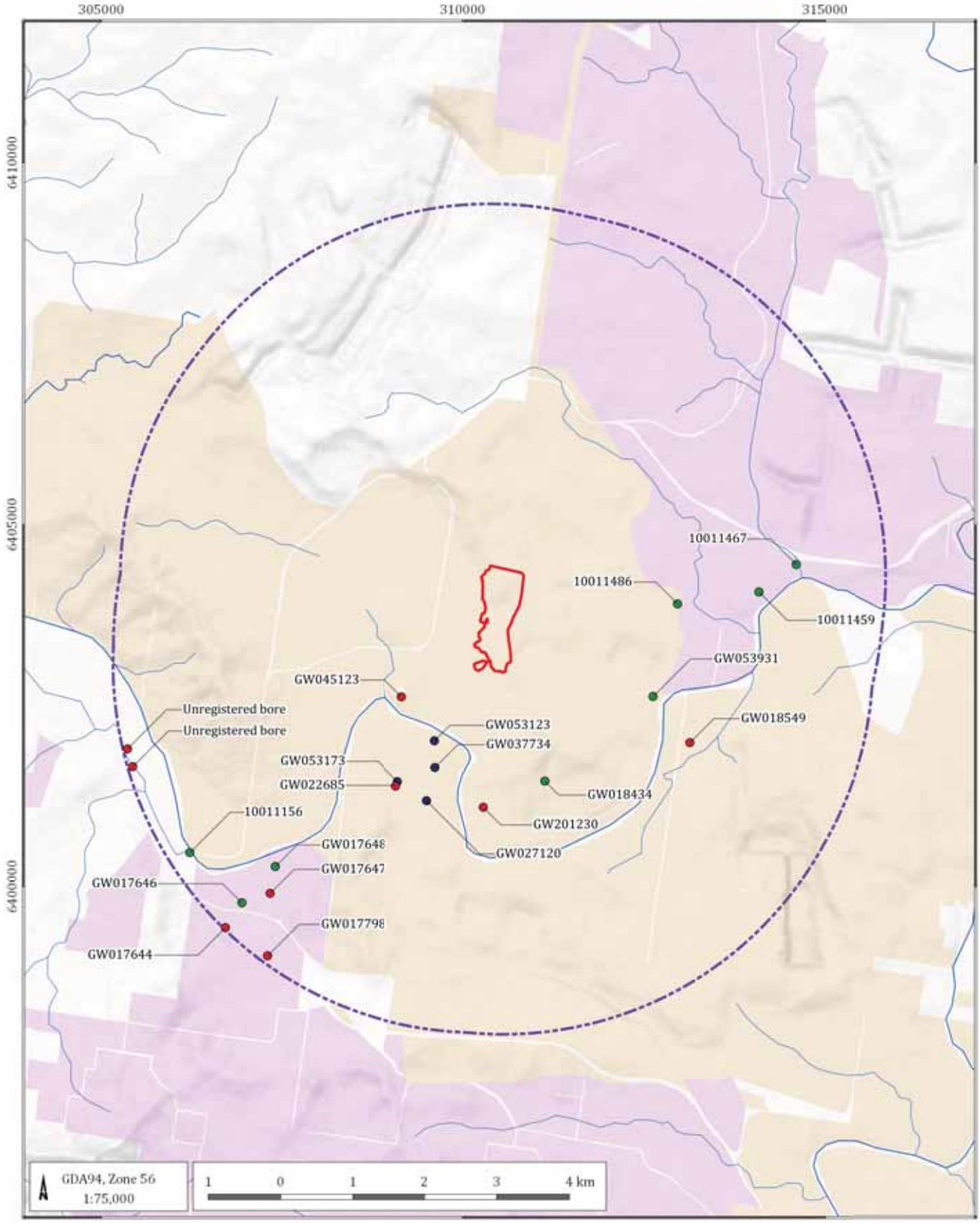
2.8 Groundwater use

2.8.1 Registered bores

A search of the National Groundwater Information System (NGIS) database identified 27 registered bores within 5km of the proposed CIP fine reject emplacement, this excludes all known mine monitoring bores. An additional two unregistered water supply bores were identified during a bore census conducted by Coal & Allied in 2015. Of the 29 registered and unregistered bores, eight are abandoned and destroyed, four are abandoned but in a usable condition, nine are existing and eight have an unknown status that are presumed existing for the purpose of this report. Of the 17 existing bores, eight are on Coal & Allied owned land, seven are located on land owned by surrounding mine operations and three are on privately owned land. Appendix B provides a summary of registered and unregistered bores (excluding known monitoring bores and destroyed bores), and Figure 2-16 shows the location of the registered and unregistered bores relative to the proposed modification.

The three private bores (two unregistered bores and 10011156) are located over 4km south-west of the proposed CIP fine reject emplacement. The unregistered bores were visited as part of bore census conducted in 2015 and found to comprise concrete wells set into alluvium, with one actively used for stock water supply.

Five registered bores are located on land owned by Wambo Mine, nearly 4km south-west of the proposed CIP fine reject emplacement. Of the five bores, three may be used for irrigation, one for stock and domestic purposes, and one is unknown. The two registered bores on land owned by Ravensworth are located over 3km east of the proposed CIP fine reject emplacement and may be used for groundwater monitoring.



LEGEND

- CIP fine reject emplacement
- 5km buffer
- Major drainage
- Minor drainage

Land ownership

- Mine Owned (Coal and Allied)
- Mine Owned (Other)

Bore status

- Abandoned but usable
- Existing
- Proposed
- Unknown

HVO North - Modification 6 Groundwater Study (G1737C)

Groundwater use

DATE 01/11/2016

FIGURE No: **2-16**

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2.8.2 Ecosystems that potentially use groundwater

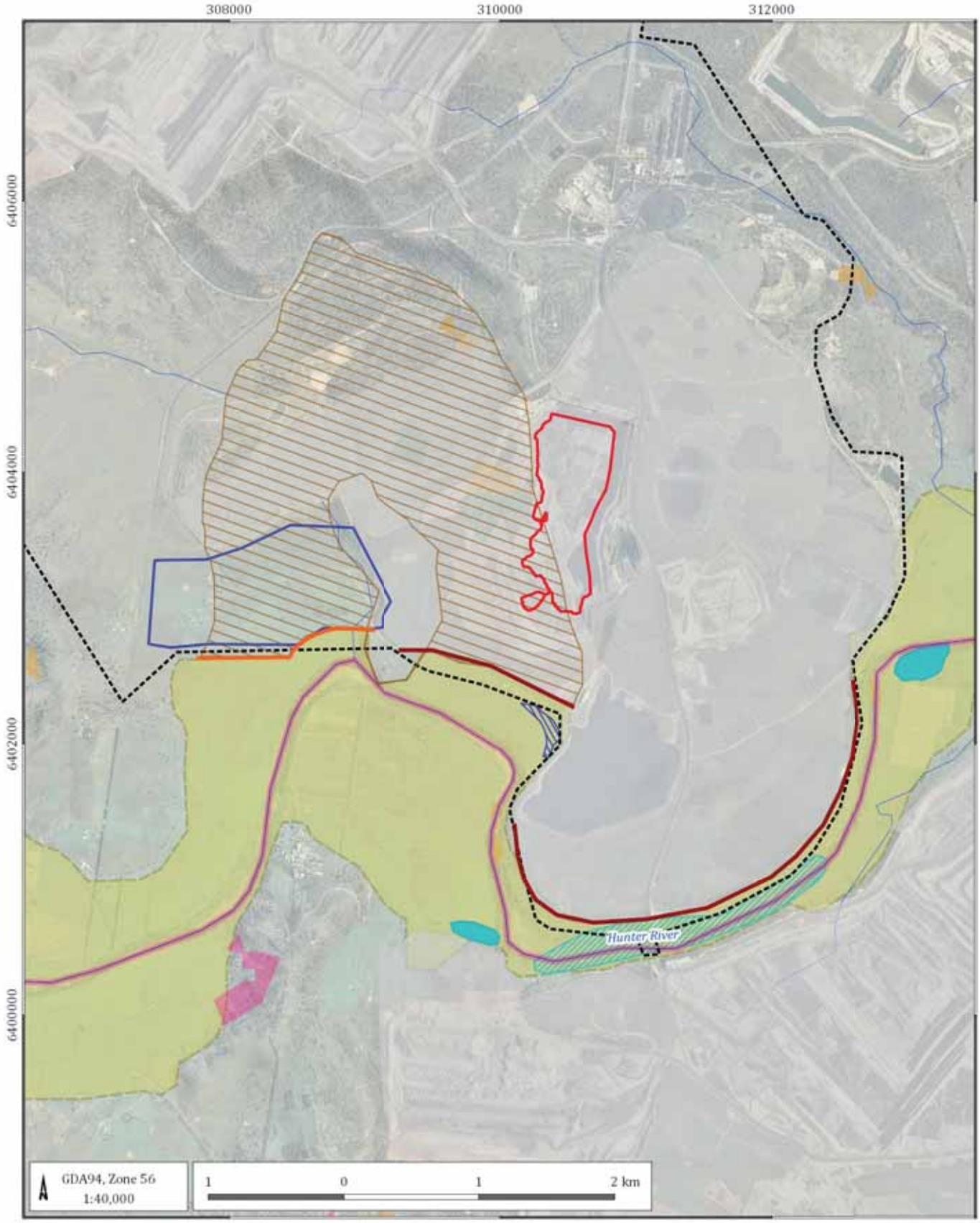
Groundwater Dependent Ecosystems (GDEs) are defined as ecosystems that rely in some part for their survival on groundwater. Dependence ranges from complete reliance for some systems to others that rely partially on groundwater, particularly during times of drought. In general, the majority of Australian ecosystems have little dependence on groundwater; however, there are some localised or extensive ecosystems in Australia with at least a high dependence on groundwater (Hatton and Evans 1998).

The Commonwealth Government has established the National Atlas of Groundwater Dependent Ecosystems (GDEs) (the Atlas), based on the current knowledge of GDEs across Australia. The Atlas shows known and potential GDEs and is considered the most comprehensive inventory of the location and characteristics of GDEs in Australia. The GDE Atlas has been mapped across HVO North in Figure 2-17. There are no GDEs within or adjacent to the proposed modification along the Hunter River or Wollombi Brook.

Ecology surveys were conducted on behalf of the proponent for the HVO North Coal Project (ERM 2005) and for the nearby Warkworth Continuation Project (Cumberland Ecology, 2014) along the Hunter River and Wollombi Brook. The vegetation mapping from these studies is also shown in Figure 2-17. The surveys found that there are no known threatened aquatic fauna or flora within HVO North. However, an endangered species under the *Threatened Species Conservation Act 1995,* the River Red Gum (*Eucalyptus camaldulensis*), is known to occur along the Hunter River near HVO North.

Carrington Billabong is an ephemeral freshwater wetland located south of Carrington Pit that has River Red Gums present. As discussed in Section 2.6, despite active mining at Carrington Pit, water levels around Carrington Billabong have remained relatively stable between 57mAHD and 60mAHD. These stable levels are due to installation of a barrier wall through the unconsolidated sediments, up to a height of 65mAHD. In addition, the stable groundwater levels indicate limited hydraulic connection between the palaeochannel alluvium and the underlying depressurised coal measures. Groundwater levels within this area are largely driven by recharge from rainfall and streamflow, particularly following peak flood events. Due to the large storage capacity and relatively low leakage rates (MER 2005) the alluvium remains saturated for prolonged periods between recharge events.

A River Red Gum Restoration Strategy (Umwelt 2007) was prepared by Coal & Allied for the stands of River Red Gum within the HVO North development consent boundary. The interpolated groundwater contours and flow directions of the alluvium are presented in Figure 2-11.



LEGEND

- HVO North development consent boundary
- CIP fine reject emplacement
- Carrington West Wing
- Previously mined area
- Quaternary alluvium (1:25K AGE)
- Paleochannel (MER, 2005)
- Existing barrier wall
- Approved future barrier wall
- Major drainage

Surface and subsurface GDEs (GDE Atlas)

- High potential for groundwater interaction
- Moderate potential for groundwater interaction

Vegetation mapping (ERM, 2008)

- Carrington Billabong
- Scattered occurences of River Red Gums
- Stand of River Red Gums

HVO North - Modification 6 Groundwater Study (G1737C)

Ecosystems that potentially use groundwater

DATE 01/11/2016

FIGURE No: **2-17**

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3 Conceptual groundwater model

This section describes the processes that control and influence the storage and movement of groundwater in the hydrogeological system at HVO. This conceptual groundwater model is based upon the extensive data and knowledge of the area, as discussed in Section 1.4 and presented in the previous sections. Figure 3-1 represents a cross-section from south to north through HVO. The cross section graphically shows the main processes influencing the groundwater regime, including recharge, flow directions and discharge.

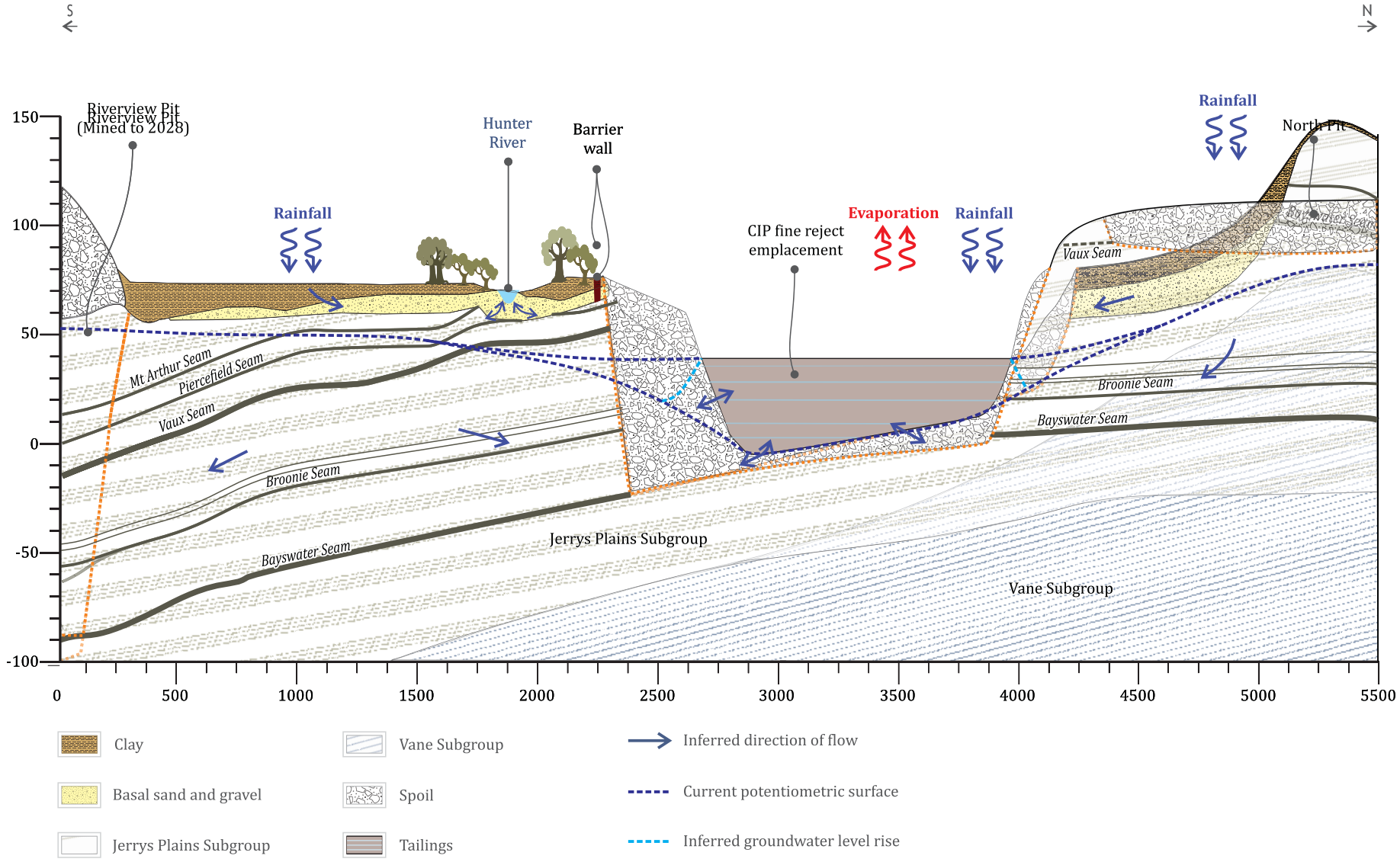
The main groundwater bearing unit occurring near HVO North is the Quaternary alluvium (clay and basal sand and gravel in Figure 3-18), with less productive groundwater occurring within coal seams of the Jerry's Plains Sub-group.

Groundwater flows from areas of high head (pressure plus elevation) to low head. The Permian coal measures outcrop north to east of HVO North. Recharge occurs from direct rainfall to the ground surface, infiltrating into the formations through the thin soil cover and weathered profile. The coal measures also occur at subcrop in localised zones beneath alluvium associated with the Hunter River, where the unit is recharged by downward seepage where gradients promote this flow.

The potentiometric surface and flow direction is a subdued reflection of topography. Groundwater within the Hunter River alluvium flows in an easterly direction. The Quaternary alluvium is an unconfined groundwater system that is recharged by rainfall infiltration, streamflow and upward leakage from the underlying stratigraphy, particularly in undisturbed areas (ie away from active mining). Regionally, the Hunter River is predominantly gaining water from the surrounding alluvium, as well as from rainfall and regulated flow (ie dam releases). However, there are also areas where the rivers recharge the underlying alluvium. These losing conditions can occur around areas of active mining, where the connectivity is enhanced due to depressurisation of the underlying coal measures. Losing conditions also occur within the more topographically elevated tributaries of the main water courses, where the water table is deeper and not connected directly to the streams.

The coal measures form unconfined groundwater systems at outcrop, becoming confined as they dip towards the south-west. The direction of groundwater flow for the Permian coal measures is influenced by the local geomorphology and structural geology, as well as the long history of mining within the region. This includes discharge of Permian groundwater via evaporative processes within low elevation void areas that act as groundwater 'sinks'.

Alluvial groundwater is generally considered suitable for stock water supply. However, most agricultural producers (crop and cattle) utilise surface water resources (Hunter River) in preference to alluvial groundwater. Water within the Permian coal measures, spoil and fine rejects is not considered suitable for irrigation or stock water supply, according to ANZECC (2000) guidelines. There is no significant usage of groundwater from the Permian coal measures, likely due to the poor quality and presence of perennial surface water flows (Hunter River and Wollombi Brook) and the more productive alluvial aquifer.



Schematic section showing conceptual hydrogeology - south to north

Figure 3-1

HVO North - Modification 6 Groundwater Study (G1737C)

4 Impact assessment

To address regulatory requirements for project approvals, numerical groundwater modelling and impact assessments were conducted for the existing HVO North operations. The most recent study was conducted for Carrington West Wing by MER (2010), which details the predicted take of groundwater, potential impacts on receptors and groundwater response to the now approved final landform.

Sections 4.1 to 4.4 below discus the potential for the proposed CIP fine reject emplacement to create additional impact beyond that already for the HVO North operations. The sections discuss potential for changes to water levels, water quality, ecosystems and other groundwater users.

4.1 Groundwater levels

MER (2010) predicted that during active mining at Carrington West Wing, the zone of groundwater level drawdown within the Permian coal measures could extend up to 2km from the active mine area. MER (2010) also modelled the change in the groundwater regime post mining for the now approved final landform. The proposed modification has been designed so there is no change from this approved final landform.

Numerical modelling by MER (2010) found that groundwater levels recovered 50 years from establishment of the approved final landform. Predictions by MER (2010) indicated that water within the mine spoil will be drawn towards the final void from over 2km away. Groundwater levels would stabilise at about 40mAHD, with groundwater flowing through the spoil into the open void. This void lake level is around 25m below the barrier wall level (65mAHD) and about 20m below the average level of the Hunter River. MER (2010) found that at this stabilised level the average net contributions to the pit from rainfall, runoff and infiltration, are adequately balanced by evaporative losses from the 100ha void. Figure 4-1 illustrates the MER (2010) predicted steady state water table within spoils and the flow paths predicted to form towards the evaporative sink post mining.

As discussed in Section 2.6, water levels within the spoil and Permian coal measures are drawn down around the current Carrington Pit void and active mining at HVO South. Spoil water levels around Carrington Pit are generally below 20mAHD, while groundwater levels within the Permian coal measures are generally below 40mAHD near the proposed modification. These drawn down groundwater levels indicate that the Carrington Pit void is currently acting as a hydraulic 'sink'. Groundwater is drawn towards the 'sink' and removed from the system via evaporation, in line with predictions by MER (2010) for the approved operations.

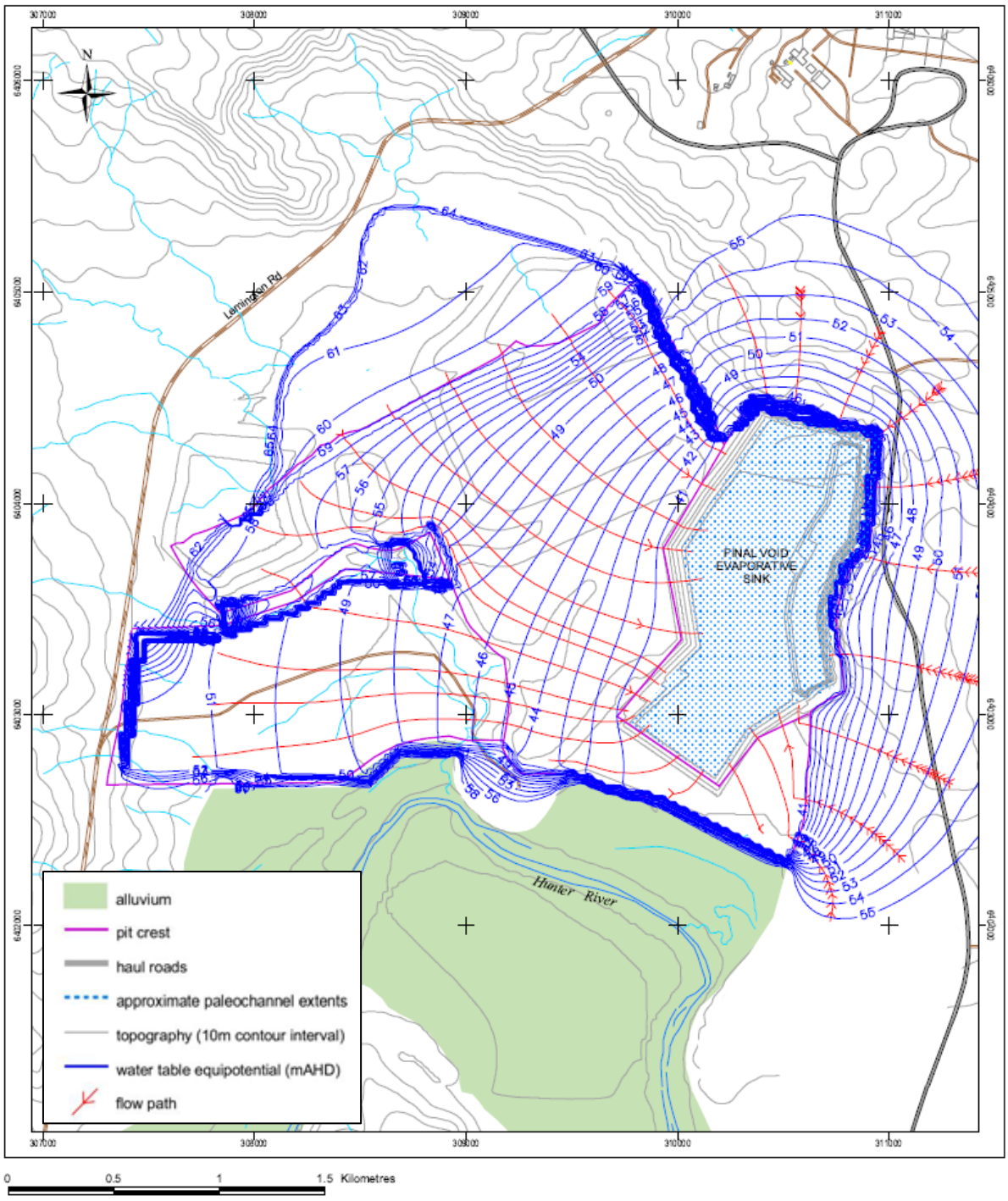


Figure 4-1 Predicted groundwater flow direction post mining (MER 2010)

Figure 4-2 compares the design and main hydraulic features of the approved final void and the proposed CIP fine reject emplacement. As shown in Figure 4-2, both the approved final void and proposed CIP fine reject emplacement will be impounded within an existing open-cut void (Carrington Pit void), surrounded by spoil and low permeability coal measures. As a result there is no direct connection between the void area and alluvial sediments, with barrier walls further separating spoil from the Hunter River alluvium. In addition, Carrington Pit will be filled from 0mAHD up to around 38mAHD and capped at around 40mAHD for the proposed modification and approved final landform, which is below the regional water table.

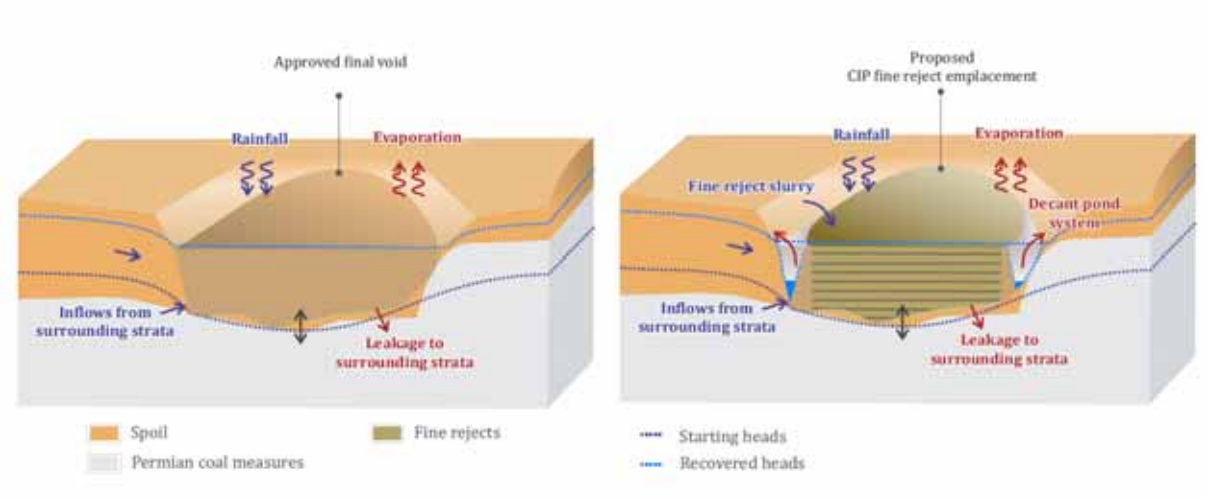


Figure 4-2 Schematic showing hydraulic features of approved final void and proposed CIP fine reject emplacement

The approved final void and proposed modification have similar inputs (i.e. rainfall and inflows from surrounding strata), as well as outputs (i.e. evaporation). As detailed within Section 2.1, evaporation at the site is around 1,570mm/year, which is more than twice average annual rainfall of 624mm/year. The combination of high evaporation and comparatively low rainfall is a large driver in the function of the 100ha final void as a groundwater 'sink', removing water from the groundwater system through evaporation. Flood modelling for the approved operations also indicates that the location of the proposed CIP fine reject emplacement is outside 100 year Average Recurrence Interval (ARI) (Water Solutions, 2010).

As shown in Figure 4-2, an additional input to the system for the proposed modification would be from water that makes up the fine reject slurry mixture. To help address this, the proposed modification includes design of a decant pond to remove excess water from the fine reject emplacement. In addition, the proposed CIP fine reject emplacement is designed to minimise the outward hydraulic gradient from the facility by filling the existing Carrington Pit void to a maximum height of 38mAHD, which is below the long term regional water table level. The process of partially, not fully backfilling the void promotes an inward hydraulic gradient from the surrounding geology to the proposed CIP fine reject emplacement and reduces the risk of leakage out of the facility to surrounding strata.

Another difference between the approved final void and proposed modification is the change in hydraulic properties of the material used to fill the void to 38mAHD. As discussed in Section 2.5, fine rejects can exhibit particle size and hydraulic conductivity up to four orders of magnitude lower than spoil. In theory the lower hydraulic conductivity material in the void has the potential to reduce the rate of flow of water from surrounding strata into the Carrington Pit void. However the flux of groundwater into the void from the Permian coal measures is very low and not expected to be significant enough to be impeded by the fine rejects material. The additional water that is pumped into the void with the fine rejects may induce a short term (i.e. during active operation) increase in groundwater head within the Permian coal measures up groundwater gradient of Carrington Pit (north to north-east). However, movement of water into the void area is influenced by the wider regional groundwater levels and hydraulic gradients that have formed a sink towards the open void. As a result, the change in hydraulic conductivity would not obstruct flow to the final void.

4.2 Groundwater quality

As discussed in Section 2.7, the water quality data indicates that groundwater from the Permian coal measures, spoil and fine rejects is not considered suitable for irrigation or stock water supply according to ANZECC (2000) guidelines.

Mineralogical analysis (XRD) of core samples and hydrochemical reaction path modelling was conducted by MER (2010) in order to predict the final void water quality. MER (2010) predicted that the water quality within the void would reflect contributions from the coal measures, spoil and rainfall runoff entering the void. The long-term water quality for the approved final void is likely to have a pH range of 7.5 to 9.5, TDS of up to 4000mg/L, and a Na>Mg>Ca and HCO_3>Cl >SO_4 water type (MER 2010). Based on this, the quality of water within the approved final void would not be considered suitable for long term irrigation, stock or domestic supply according to ANZECC (2000) guidelines.

MER (2010) also looked at the change in quality if fine rejects were emplaced within the void and found the water type would likely become more SO_4 dominant. This corresponds with the results discussed in Section 2.7, which found that on average water from fine rejects had a slightly higher sulphate concentration (1,824mg/L) compared to spoil material (1,134mg/L). However, this difference does not change the beneficial use of water within the final void according to ANZECC (2000) guidelines.

For the approved final void, MER (2010) predicted that irrespective of the change in water quality, the final void will act as a permanent groundwater 'sink' , therefore no void water would escape into the surrounding groundwater system. As discussed in Section 4.1, the proposed modification will not change the final landform design. Therefore, the proposed modification would maintain predicted groundwater conditions for the approved final void plan.

4.3 Impact on registered bores

As discussed in Section 2.8.1, there are 17 existing bores within 5km of the proposed CIP fine reject emplacement, of which eight are on Coal & Allied land, three are on private land and seven are on land owned by other mines. All bores on private land or land owned by other mines are located over 4km from the proposed CIP fine reject emplacement.

As discussed in Section 4.1, the proposed CIP fine reject emplacement will be rehabilitated with no change to the approved final void. This ensures that conditions of a groundwater 'sink' within the Carrington Pit void will be maintained, preventing any changes to groundwater conditions for surrounding users. As predicted by MER (2005) and MER (2010), the approved final void design for HVO North will not impact on any private bores.

4.4 Impact on ecosystems

As discussed in Section 2.8.2, there are no known threatened aquatic fauna or flora within or near the proposed modification. However, an at risk plant community of River Red Gums have been identified at Carrington Billabong, which is located approximately 800m south of the proposed CIP fine reject emplacement. Groundwater monitoring is specifically carried out in this area to monitor any drawdown or depressurisation within the alluvial sediments as a result of mining. The presence of the artificial barrier wall in this location has mitigated any potential impact to the GDE from mining. In this regard the barrier wall is considered to be effective.

The proposed CIP fine reject emplacement is designed so there is no change from the approved final landform. As predicted by MER (2010), with the Carrington Pit void rehabilitated to 40mAHD there are no predicted groundwater level impacts on the alluvium. As a result, the proposed modification is not predicted to cause any adverse changes in groundwater levels or quality near ecosystems.

5 Water monitoring and management plan

Management of water resources is integrated at HVO. In accordance with Condition 27 of Schedule 4 of DA 450-10-2003, HVO developed the WMP (RTCA 2016) in consultation with the now DPI Water and EPA. The WMP (RTCA 2016) also covers management of active and inactive facilities for fine and course rejects, in accordance with Condition 29 of DA 450-10-2003.

The plan fulfils the requirements of the HVO Environment Protection Licence 640, project approval for HVO South (PA 06_0261), development consent for HVO North (DA 450-10-2003) together with commitments made in the respective environmental assessments, environmental impact statements and relevant legislation, standards and guidelines.

5.1 Fine Rejects monitoring plan

In accordance with the HVO WMP that address Condition 29 of DA 450-10-2003, surface water monitoring of fine rejects water quality will be conducted on a quarterly basis for EC, pH and TSS, and a comprehensive analysis of water quality will be conducted on an annual basis. Comprehensive analysis includes major ions TDS, Al, As, B, Ca, Cd, Cl, (CO_3), Cu, Hg, K, Mg, Na, Ni, Pb, Se, SO_4 (or S), Zn, Total Alkalinity, Bicarbonate Alkalinity, Carbonate Alkalinity, Hydroxide Alkalinity.

Coal & Allied engages qualified suitably experienced contractors to carry out sampling and analysis. Sampling is undertaken in accordance with relevant Australian Standards and other regulatory guidelines. Samples are analysed by laboratories that are National Association of Testing Authorities (NATA) accredited or equivalent for the parameters being analysed.

5.2 Groundwater monitoring plan

Groundwater monitoring at HVO North is currently undertaken in accordance with the HVO groundwater monitoring program (GMP), which is included in the HVO WMP. Currently manual groundwater level monitoring is conducted on a monthly, quarterly or 6-monthly basis, in addition to daily readings recorded dataloggers. In addition, groundwater quality monitoring conducted at HVO on a quarterly or 6-monthly basis for field water quality (EC and pH), and on a six monthly to annual basis for more comprehensive water quality analysis at selected bores. The comprehensive water quality suit is stipulated within the HVO WMP.

Groundwater levels and quality will continue to be monitored as per the existing HVO WMP. Ongoing monitoring will enable natural groundwater level and quality changes during and post mine operation activities. Yearly reporting of the water level and water quality results from the monitoring network will be included in the annual review. The annual review will also identify if any additional monitoring sites are required, or if optimisation of the existing monitoring sites should be undertaken.

6 Conclusions

This report relates to the groundwater related impacts associated with the HVO North CIP fine reject emplacement Modification under DA 450-10-2003. Numerous previous studies have been conducted across HVO North, including numerical groundwater modelling for the approved Carrington West Wing (MER, 2010) and the approved out of pit FRE (AGE, 2013). As part of this assessment, all previous groundwater assessments were reviewed in order to understand the current groundwater conditions and approved groundwater impacts. The assessment also included review of extensive baseline data from the HVO surface and groundwater monitoring network.

The proposed CIP fine reject emplacement is planned to commence in 2018 from an elevation of around 0mAHD, and cease in 2026 with a maximum fill level of 38mAHD. When operation of the CIP fine reject emplacement is complete, it will be capped to an elevation of around 40mAHD, keeping the fine rejects below the long term permanent water table level. The proposed modification does not include any excavation of insitu material and has been designed to maintain the approved final landform proposed within Carrington Pit. The key difference of the modification is the change in the fine rejects material used to fill the void to the approved final landform, compared to using spoil material.

The groundwater related impacts and conditions of the approved final landform were assessed by MER (2010), who predicted that groundwater within the mine area spoil will be drawn into the 'sink' from over 2km from the 100ha final void. In additions, it was predicted that groundwater levels within the void would be maintained at around 40mAHD. The approved final void and proposed modification have similar water balance inputs (i.e. rainfall and inflows from surrounding strata) and outputs (i.e. evaporation). Both the approved final void and proposed CIP fine reject emplacement will be impounded within the Carrington Pit void, surrounded by spoil and low permeability coal measures and physically separated from alluvium.

The proposed modification does include an additional input from water that makes up the fine reject slurry mixture. However, the proposed modification includes a decant system and is designed to minimise the outward hydraulic gradient due to the low in-fill elevation. Fine rejects also exhibit lower hydraulic conductivity compared to spoil material, which has the potential to cause short term (during operation) and localised changes in groundwater movement. However, movement of water into the void area is influenced by the wider regional groundwater levels and hydraulic gradients that have formed a 'sink' towards the open void. As a result, the change in hydraulic conductivity would not obstruct flow to the final void. This flow towards the final void is largely driven by the geometry of the void (low elevation) and climatic conditions, where evaporation is more than twice average annual rainfall. This is shown in current groundwater conditions that show flow towards the existing Carrington Pit void, and corresponds with predictions by MER (2010) for the approved final void.

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Appendix A

Water quality data summary

Analyte		Unit	ANZECC Short term irrigation	ANZECC Long term irrigation	ANZECC Stock water	Hunter River	Palaeo-channel	Less productive alluvium†	Highly productive alluvium	Interburden†	Coal	Spoil	Fine rejects
pH (Field)	Av.	pH unit	6.0 - 8.5	6.0 - 8.5	-	8.1	7.4	7.3	7.2	7.2	7.2	7.1	9
	Min.					5.5	6.7	5.8	6.3	5.9	6.1	6.1	7.6
	Max.					9.1	8.6	9.9	8.3	9.9	9.9	8.8	9.3
EC (Field)	Av.	µS/cm	-	-	-	693	4243	4609	1019	7487	7041	6915	6524
	Min.					70	1009	13	21	17	500	1189	440
	Max.					1490	11830	27900	8050	23100	23100	13280	22200
TDS (Laboratory)	Av.	mg/L	-	-	3,000 - 13,000*	506	2789	2068	569	**5873**	**6405**	**5242**	**6446**
	Min.					81	426	212	24	74	692	794	2600
	Max.					3800	6650	8894	2600	15200	15200	10790	19450
TSS (Laboratory)	Av.	mg/L	-	-	-	37	-	81	162	80	290	50	58
	Min.					1	-	16	1	2	290	12	1
	Max.					988	-	268	8900	580	290	111	698
Silicon (t)	Av.	mg/L	-	-	-	14	31	30	23	23	23	11	3
	Min.					3	13	12	14	12	12	0	1.7
	Max.					19	42	75	30	56	56	16	4
Chloride (t)	Av.	mg/L	-	-	-	212	717	1019	147	2513	2899	1634	-
	Min.					202	245	21	60	3	213	188	-
	Max.					222	2620	3510	574	7740	7740	3830	-
Calcium (t)	Av.	mg/L	-	-	1000	34	80	120	48	129	116	120	71
	Min.					2.7	18.0	3.0	9.0	2.0	10.0	14.0	23

Analyte		Unit	ANZECC Short term irrigation	ANZECC Long term irrigation	ANZECC Stock water	Hunter River	Palaeo-channel	Less productive alluvium†	Highly productive alluvium	Interburden†	Coal	Spoil	Fine rejects
	Max.					66	243	2877	196	2172	288	232	238
Sodium (t)	Av.	mg/L	-	-	-	62	547	498	98	1606	1729	1125	1632
	Min.					14	41	16	36	13	140	258	779
	Max.					174	1790	2500	735	4350	4350	2130	3660
Magnesium (t)	Av.	mg/L	-	-	-	26	120	84	34	321	309	287	237
	Min.					2.70	31.00	0.05	8.00	0.11	6.00	33.00	90
	Max.					50	377	386	111	2590	726	592	695
Sulphate (t)	Av.	mg/L	-	-	1000 – 2400 (pigs)	35	158	255	39	554	642	**1134**	**1824**
	Min.					8.2	6.0	0.5	4.0	0.5	0.5	128.0	805
	Max.					80	822	1930	364	7470	7470	2560	4400
Potassium (t)	Av.	mg/L	-	-	-	3.8	7.2	42.9	3.9	48.3	38.1	30.2	46
	Min.					2.0	0.5	0.5	0.5	1.4	1.4	13.0	22
	Max.					7	56	1874	28	1586	390	58	103
Iron (d)	Av.	mg/L	-	-	-	0.3	0.3	1.4	0.4	0.5	0.5	4.7	-
	Min.					0.00	0.01	0.01	0.01	0.01	0.01	0.02	-
	Max.					1.3	3.2	28.6	8.2	6.6	6.6	38.8	-
Aluminium (t)	Av.	mg/L	20	5	5	2.0	**6.5**	**11.1**	**12.8**	**11.8**	**14.9**	**1.2**	0.2
	Min.					0.060	0.005	0.003	0.003	0.020	0.020	0.005	0.04
	Max.					12	160	410	260	255	255	20	1
Arsenic (t)	Av.	mg/L	2	0.1	0.5	<0.001	0.002	0.002	0.001	**0.2**	**0.2**	0.04	0.006

Analyte		Unit	ANZECC Short term irrigation	ANZECC Long term irrigation	ANZECC Stock water	Hunter River	Palaeo-channel	Less productive alluvium†	Highly productive alluvium	Interburden†	Coal	Spoil	Fine rejects
	Min.					<0.001	0.001	0.001	0.001	0.001	0.001	0.001	<0.001
	Max.					<0.001	0.07	0.02	0.01	8.00	8.00	0.25	0.02
Barium (t)	Av.	mg/L	-	-	-	0.1	0.2	0.3	0.2	19.4	23.6	0.1	0.05
	Min.					0.00	0.019	0.005	0.018	0.01	0.01	0.02	0.02
	Max.					0.6	2.7	6.1	1.5	660	660	0.4	0.1
Beryllium (t)	Av.	mg/L	0.5	0.1	-	<0.001	-	<0.001	<0.001	-	-	-	-
	Min.					<0.001	-	<0.001	<0.001	-	-	-	-
	Max.					<0.001	-	<0.001	<0.001	-	-	-	-
Boron (t)	Av.	mg/L	refer to guideline	0.5	7 (cattle)	0.04	0.10	0.06	0.04	0.2	0.2	0.1	0.1
	Min.					0.00002	0.03	0.03	0.02	0.03	0.03	0.03	0.06
	Max.					0.2	0.4	0.5	0.2	0.8	0.8	0.2	0.2
Cadmium (t)	Av.	mg/L	0.05	0.01	0.01	<0.0001	-	<0.0001	-	<0.0001	-	-	-
	Min.					<0.0001	-	<0.0001	-	<0.0001	-	-	-
	Max.					<0.0001	-	<0.0001	-	<0.0001	-	-	-
Chromium (t)	Av.	mg/L	1	0.1	1	0.0008	-	0.0008	0.0008	0.001	-	-	-
	Min.					0.0005	-	0.0005	0.0005	0.001	-	-	-
	Max.					0.001	-	0.0010	0.0010	0.001	-	-	-
Cobalt (t)	Av.	mg/L	0.1	0.05	1	<0.001	-	<0.001	<0.001	0.002	-	-	-
	Min.					<0.001	-	<0.001	<0.001	0.002	-	-	-
	Max.					<0.001	-	<0.001	<0.001	0.002	-	-	-

Analyte		Unit	ANZECC Short term irrigation	ANZECC Long term irrigation	ANZECC Stock water	Hunter River	Palaeo-channel	Less productive alluvium†	Highly productive alluvium	Interburden†	Coal	Spoil	Fine rejects
Copper (t)	Av.	mg/L	5	0.2	1 (cattle)	0.002	-	1.1	<0.001	1.0	-	-	-
	Min.					0.001	-	0.001	<0.001	0.001	-	-	-
	Max.					0.003	-	8.5	<0.001	4.3	-	-	-
Iron (t)	Av.	mg/L	10	0.2	-	0.6	-	46.5	0.003	13.7	-	-	-
	Min.					0.4	-	0.1	0.003	0.2	-	-	-
	Max.					0.8	-	397	0.003	123.0	-	-	-
Lead (t)	Av.	mg/L	5	2	0.1	<0.001	-	0.03	<0.001	0.04	<0.001	<0.001	-
	Min.					<0.001	-	0.001	<0.001	0.001	<0.001	<0.001	-
	Max.					<0.001	-	0.1	<0.001	0.3	<0.001	<0.001	-
Lithium (t)	Av.	mg/L	2.5	2.5	-	<0.005	0.01	0.02	0.01	0.2	0.2	0.05	0.1
	Min.					<0.005	0.0005	0.0005	0.0005	0.003	0.003	0.008	0.06
	Max.					<0.005	0.3	0.6	0.1	1.0	1.0	0.1	0.3
Manganese (t)	Av.	mg/L	10	0.2	-	0.1	**0.9**	**2.6**	**0.7**	**1.9**	**2.9**	**0.7**	0.03
	Min.					0.02	0.004	0.0030	0.0005	0.006	0.006	0.03	0.002
	Max.					0.4	15	60	4	61	61	2	0.2
Mercury (t)	Av.	mg/L	0.002	0.002	0.002	<0.0001	-	<0.0001	<0.0001	-	-	-	-
	Min.					<0.0001	-	<0.0001	<0.0001	-	-	-	-
	Max.					<0.0001	-	<0.0001	<0.0001	-	-	-	-
Molybdenum (t)	Av.	mg/L	0.05	0.01	0.15	<0.001	-	0.003	0.004	-	-	-	-
	Min.					<0.001	-	0.003	0.001	-	-	-	-

Analyte		Unit	ANZECC Short term irrigation	ANZECC Long term irrigation	ANZECC Stock water	Hunter River	Palaeo-channel	Less productive alluvium†	Highly productive alluvium	Interburden†	Coal	Spoil	Fine rejects
	Max.					<0.001	-	0.00	0.01	-	-	-	-
Nickel (t)	Av.	mg/L	2	0.2	1	0.002	-	0.018	0.001	0.02	-	-	-
	Min.					0.002	-	0.003	0.001	0.002	-	-	-
	Max.					0.002	-	0.06	0.00	0.10	-	-	-
Selenium (t)	Av.	mg/L	0.05	0.02	0.02	0.03	0.006	0.004	0.004	**0.06**	**0.06**	0.006	**0.02**
	Min.					0.0001	0.001	0.001	0.001	0.001	0.001	0.001	0.01
	Max.					0.5	0.02	0.02	0.02	0.5	0.50	0.05	0.05
Strontium (t)	Av.	mg/L	-	-	-	0.3	1.8	1.1	0.5	5.4	5.4	3.0	2
	Min.					0.101	0.4	0.1	0.3	0.2	0.2	0.001	1
	Max.					1	7	13	2	14	14	6	5.6
Zinc (t)	Av.	mg/L	2	2	20	0.009	0.1	0.2	0.3	0.1	0.1	0.1	0.005
	Min.					0.002	0.001	0.003	0.003	0.003	0.003	0.003	<0.005
	Max.					0.07	5	11	16	2	2	2	0.01

Notes: *Values below the limit of reporting were set at half of the limit for the calculations*

** Maximum concentration at which good condition might be expected, with 13,000 mg/L for sheep, 5,000 mg/L for beef cattle, 4,000 mg/L for dairy cattle, 6,000 mg/L for horses and 3,000 mg/L for pigs and poultry.*

† Includes water quality data from HVO and available water quality data collected at neighbouring mines

Appendix B

Registered bore details

Bore ID	Easting (GDA 94 z56)	Northing (GDA 94 z56)	Lithology	Bore status	Bore use	Land ownership
10011156	306218	6400469	Alluvium	Unknown	Unknown	Private
Unregistered bore	305430	6401656	Alluvium	EX	Unknown	Private
Unregistered bore	305357	6402148	Alluvium	EX	Unknown	Private
GW017644	306708	6399431	Weathered Permian	EX	Irrigation	Mine owned - Wambo
GW017647	307326	6401901	Weathered Permian	EX	Stock and domestic	Mine owned - Wambo
GW017798	307290	6399042	Weathered Permian	EX	Irrigation	Mine owned - Wambo
GW017646	306937	6399774	Alluvium	Unknown	Unknown	Mine owned - Wambo
GW017648	307397	6400276	Alluvium	Unknown	Irrigation	Mine owned - Wambo
10011459	314088	6404069	Unknown	Unknown	Unknown	Mine owned – Ravensworth
10011467	314603	6404449	Unknown	Unknown	Unknown	Mine owned – Ravensworth
GW018549	313134	6401987	Alluvium	EX	Unknown	Coal & Allied
GW022685	309073	6401387	Alluvium	EX	Irrigation	Coal & Allied
GW045123	309153	6402621	Alluvium	EX	Domestic	Coal & Allied
GW201230	310284	6401095	Alluvium	EX	Exploration	Coal & Allied
GW027120	309501	6401185	Alluvium	AU	Irrigation	Coal & Allied
GW037734	309616	6401644	Alluvium	AU	Irrigation	Coal & Allied
GW053123	309609	6402013	Alluvium	AU	Irrigation	Coal & Allied
GW053173	309098	6401449	Alluvium	AU	Irrigation	Coal & Allied
GW018434	311134	6401457	Alluvium	Unknown	Water supply	Coal & Allied
GW053931	312626	6402625	Alluvium	Unknown	Irrigation	Coal & Allied
10011486	312965	6403904	Unknown	Unknown	Unknown	Coal & Allied

Notes: *EX – bore documented as existing*

AU – bore documented as abandoned but in a usable condition

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