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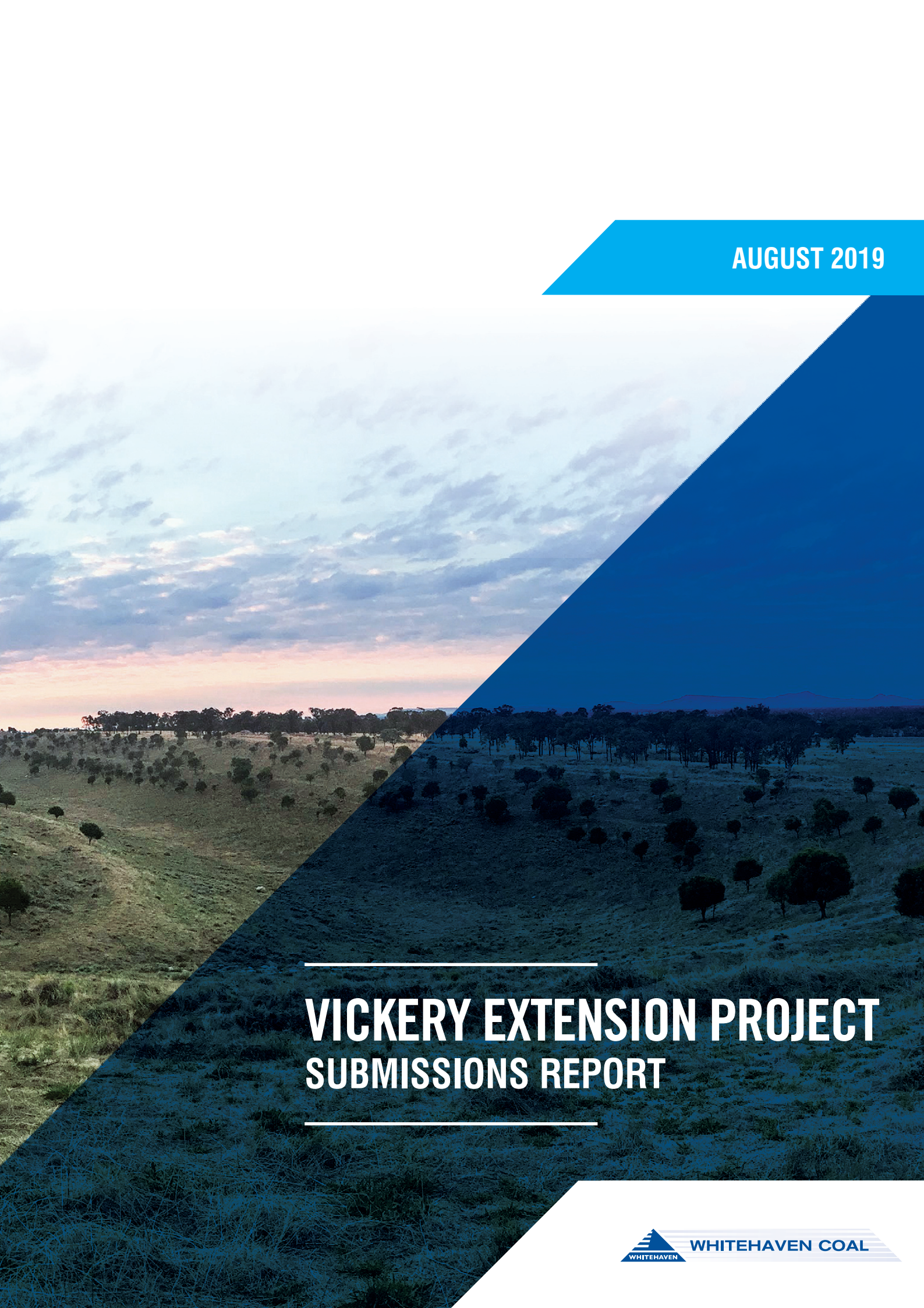

VICKERY EXTENSION PROJECT
SUBMISSIONS REPORT

WHITEHAVEN COAL

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1 INTRODUCTION

The Vickery Extension Project (the Project) is located in the Gunnedah Coalfield (Figure 1), approximately 25 kilometres (km) north of Gunnedah, within the Gunnedah Shire Council and the Narrabri Shire Council Local Government Areas (LGAs), in New South Wales (NSW) (Figure 2).

The Project would involve the extension of open cut mining operations at the approved, but yet to be constructed, Vickery Coal Project (the Approved Mine).

Vickery Coal Pty Ltd (a subsidiary of Whitehaven Coal Limited [Whitehaven]) is the applicant for the Project. Whitehaven (2018) prepared the *Vickery Extension Project Environmental Impact Statement* (the EIS) that is being assessed under the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act).

On 6 September 2018 the Minister for Planning requested the NSW Independent Planning Commission (the IPC) conduct a Public Hearing into the carrying out of the Project as well as publish a report which identifies the key issues requiring detailed consideration by the NSW Department of Planning, Infrastructure and Environment (DPIE).

The EIS was placed on public exhibition by DPIE from 13 September 2018 to 25 October 2018. During this period, government agencies, Special Interest Groups (SIGs), businesses and members of the public were invited to provide submissions on the Project to DPIE.

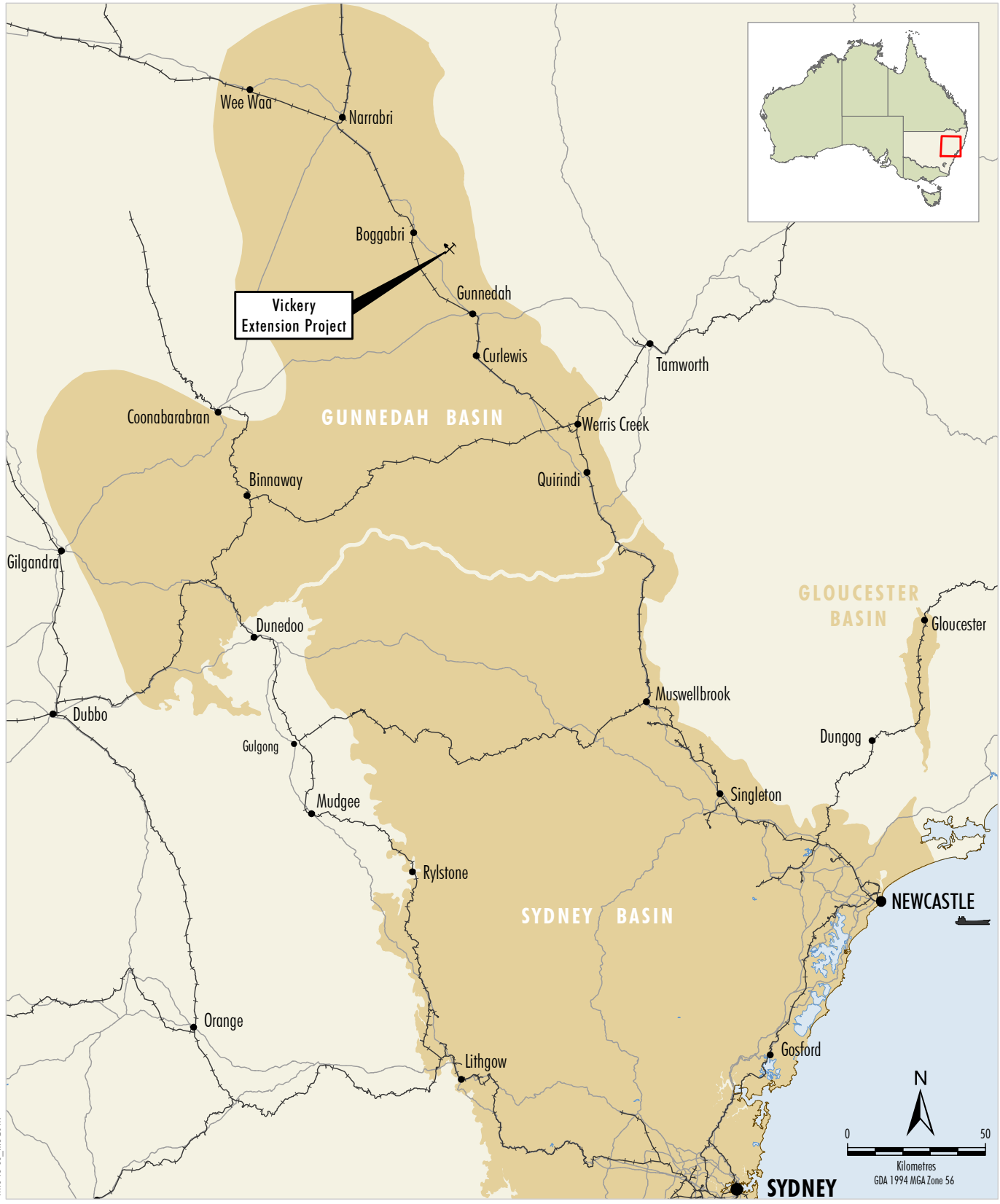
DPIE's Preliminary Issues Report was provided to the IPC on 30 November 2018 and contained initial comments on the Project EIS, including a summary and analysis of the submissions received during the public exhibition period for the EIS. DPIE also engaged a number of independent experts to peer review key aspects of the Project, including the Groundwater, Surface Water, Flooding and Economic Assessments.

Initial public hearings were conducted by the IPC on 4 and 5 February 2019, in Boggabri and Gunnedah, respectively. Members of the public also had the opportunity to provide written submissions to the IPC via their website.

The IPC's Issues Report was published on 30 April 2019. In accordance with the Minister for Planning's request, the IPC Issues Report provides an overview of the actions taken by the IPC to date with respect to the initial public hearing, summary of submissions received during the public exhibition of the EIS and during the public hearing process as well as identification of key issues requiring detailed consideration by DPIE in evaluating the merits of the Project.

DPIE subsequently requested Whitehaven prepare a Submissions Report (herein referred to as a Response to Submissions [RTS]) for the Project (this report). Accordingly, the RTS responds to:

- submissions received during the EIS exhibition period;
- DPIE's Issues report (which considered issues raised by DPIE's independent peer reviewers); and
- IPC's Issues Report (which considered submissions provided to the IPC as part of the initial public hearing process).



LEGEND

- Highway
- Major Railway
- Coalfield

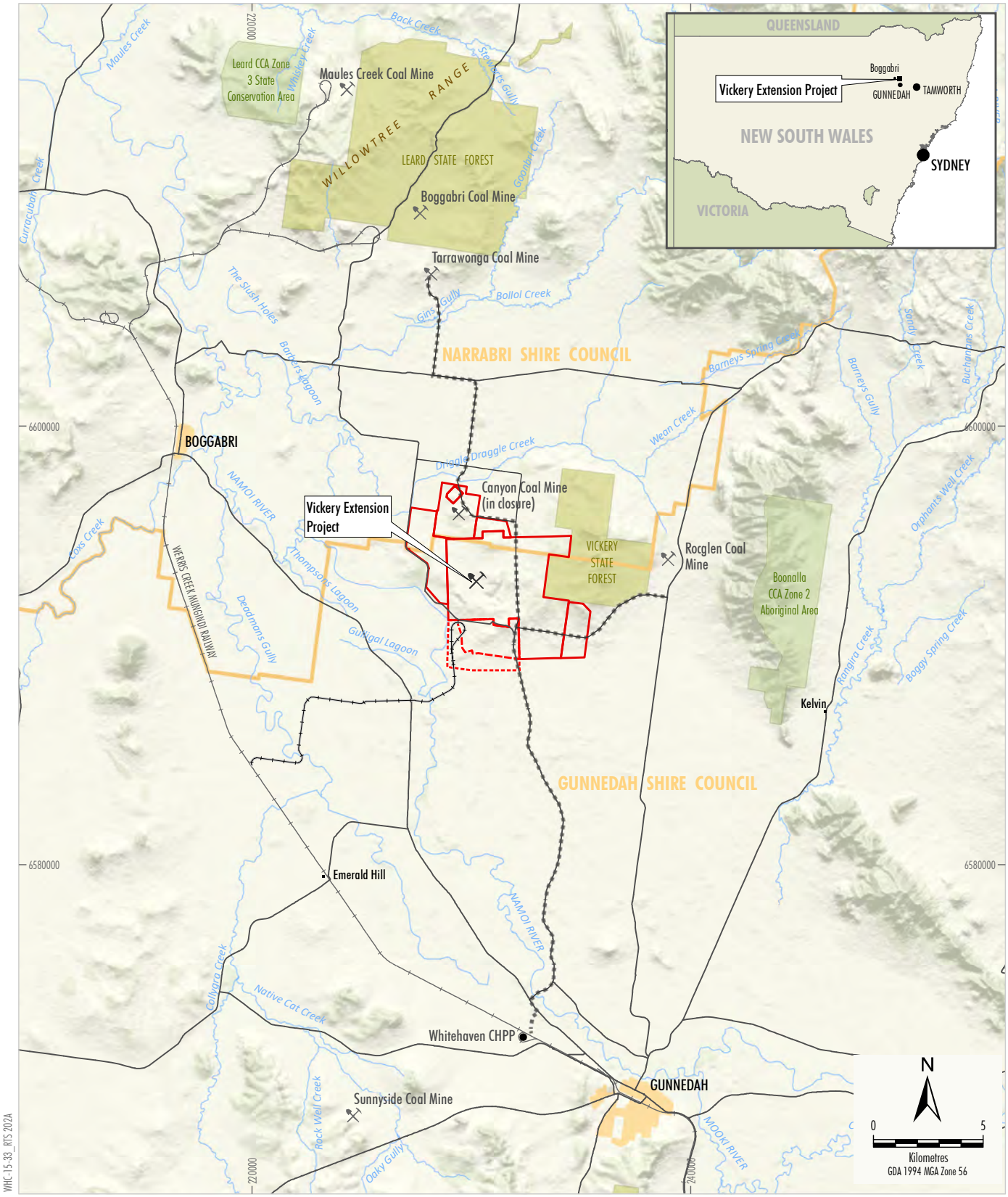
Source: Geoscience Australia (2011)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Regional Location

Figure 1



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LEGEND

- Mining Tenement Boundary (ML and CL)
- Exploration Licence Boundary (EL)
- Mining Lease Application (MLA)
- Local Government Boundary
- State Forest
- State Conservation Area, Aboriginal Area
- Major Roads
- Railway
- Approved Road Transport Route
- Indicative Project Rail Spur

Source: LPMA - Topographic Base (2010); NSW Department of Industry (2015)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project Location

Figure 2

The remainder of the RTS is generally consistent with *Guideline 4: Guidance for State Significant Projects - Preparing a Submissions Report June 2019* (DPIE, 2019) and the structure of the IPC's Issues Report, as follows:

Section 1 Provides an introduction to the Project and overview of the determination process to date.

Section 2 Provides an overview of the Project and proposed amendments.

Section 3 Provides an analysis of the submissions received by DPIE during the public exhibition period.

Section 4 Summarises actions taken since submission of the Project EIS.

Section 5 Outlines proposed changes to the Project since submission of the Project EIS.

Section 6 Provides responses to submissions, categorised consistent with the IPC's Issues Report, as follows:

- Section 6.1 Project Justification
- Section 6.2 Groundwater
- Section 6.3 Surface Water
- Section 6.4 Flooding
- Section 6.5 Water Balance
- Section 6.6 Noise and Blasting
- Section 6.7 Air Quality
- Section 6.8 Project Infrastructure Area
- Section 6.9 Biodiversity
- Section 6.10 Rehabilitation, Final Void and Final Landform
- Section 6.11 Heritage
- Section 6.12 Social and Economic
- Section 6.13 Visual Amenity
- Section 6.14 Traffic and Transport

Section 7 Provides an updated evaluation of the Project merits.

2 OVERVIEW OF THE PROJECT

The Project involves mining the coal reserves associated with the Approved Mine, as well as accessing additional coal reserves, particularly those within Exploration Licence (EL) 7407 (within Mining Lease Application [MLA] 1). Run-of-mine (ROM) coal would be mined by open cut methods over 25 years, with a peak production of up to approximately 10 million tonnes per annum (Mtpa).

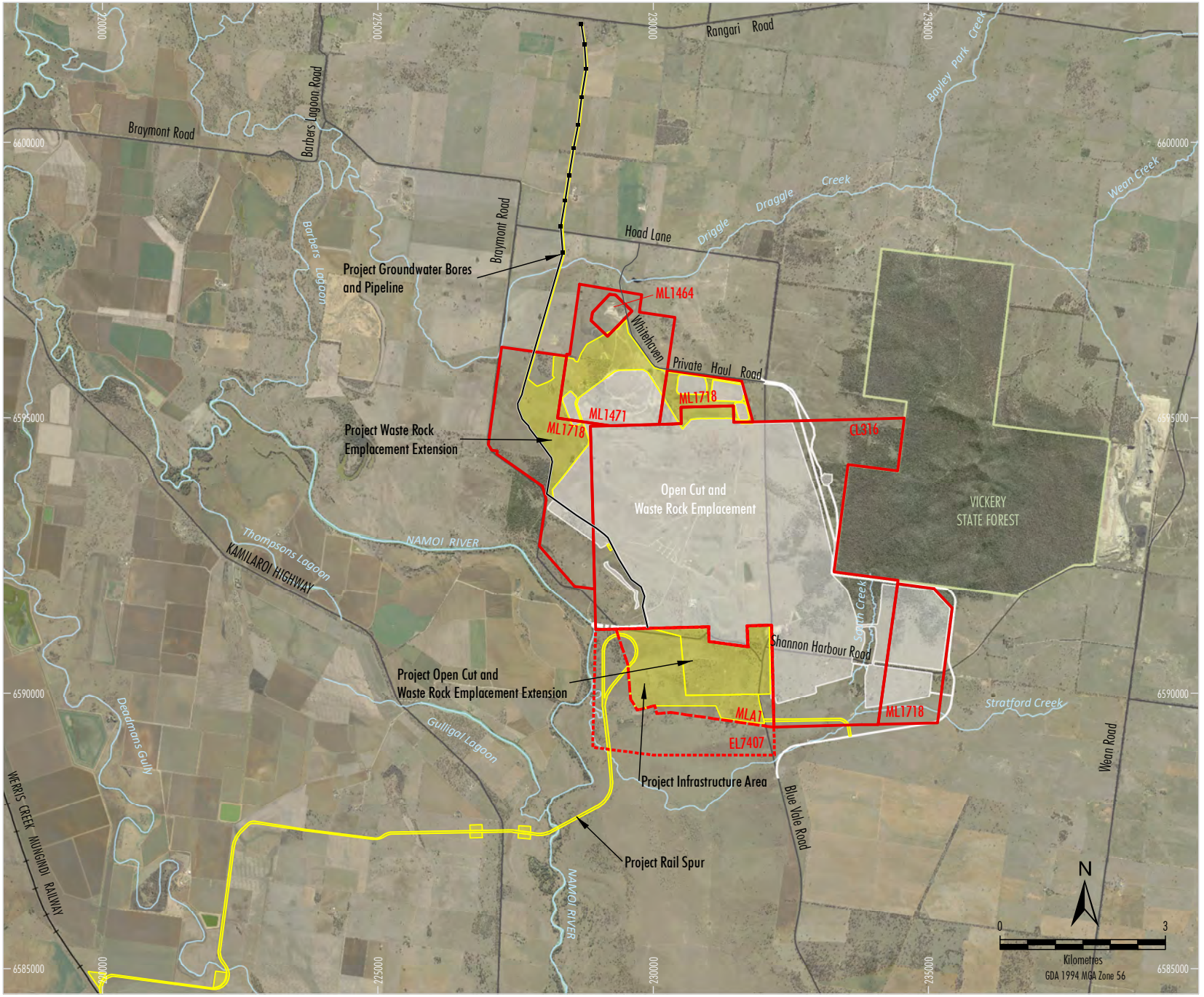
The Project would include a physical extension to the Approved Mine footprint to gain access to additional ROM coal reserves, an increase in the footprint of waste rock emplacement areas, an increase in the approved ROM coal mining rate and construction and operation of a Project Coal Handling and Preparation Plant (CHPP), train load-out facility and rail spur (Figure 3). This infrastructure would be used for the handling, processing and transport of coal from the Project, as well as other Whitehaven mining operations.

In comparison to the Approved Mine, the Project would:

- result in more efficient extraction of ROM coal reserves within the existing mining tenements;
- remove the requirement for ROM coal from the Project to be transported on public roads south of the Project once the Project CHPP, train load-out and rail spur infrastructure reach full operational capacity;
- remove the requirement for coal from the Project to be processed at the Whitehaven CHPP (Figure 2) once the Project CHPP, train load-out and rail spur infrastructure reach full operational capacity; and
- improve the compatibility of the final landform with the surrounding landscape by:
  - reducing the number of final voids from three with the Approved Mine to two (including the existing Blue Vale void) (compared to five final voids in the current landscape);
  - constructing the Western Emplacement with a design that better integrates with the surrounding landscape; and
  - removing the requirement to construct the approved Eastern Emplacement.

The Project would result in employment, council contributions, state royalties and expenditure in the region.

Table 1 provides a summary comparison of the Approved Mine and Project components as they were described in the EIS.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Exploration Licence Boundary (EL)
- Mining Lease Application (MLA)
- NSW State Forest
- Indicative Extent of Approved Mine
- Indicative Namoi River Pump Station and Pipeline
- Indicative Extent of Vickery Extension Project Additional Area

Source: Department of Industry (2015)
Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Approximate Extents of Approved Mine and Vickery Extension Project

Figure 3

WHC-15-33_RTS 203A

Table 1
Approved Mine and Project Summary

Project Component	Summary of the Approved Mine	Summary of the Project
Mine life	Approximately 30 years.	Approximately 25 years.
Mining method	Open cut mining to a depth of approximately 250 m below ground level.	Unchanged from the Approved Mine.
Open cut extent	One open cut.	Extension of the Approved Mine's open cut.
Annual production rate	Up to 4.5 Mtpa of ROM coal.	Up to approximately 10 Mtpa ROM coal.
Total resource	135 Mt ROM coal	179 Mt ROM coal*
Management of waste rock, coal rejects and final landform	Co-disposal of waste rock and coal rejects from the Whitehaven CHPP within the Western and Eastern Emplacements and within the footprint of the open cut voids. The Project area currently includes five final voids associated with historic mining activity. The final landform would include three final voids (Northern and Southern voids and existing Blue Vale final void).	Co-disposal of waste rock and coal rejects within the Western Emplacement and within the footprint of the open cut void. No requirement to construct the approved Eastern Emplacement. The final landform would reduce the number of final voids from five to two (the Project open cut final void and the existing Blue Vale final void).
Coal handling, processing and transport infrastructure	On-site coal crushing and screening facilities. Use of the Approved Road Transport Route to haul ROM coal from the Project to the Whitehaven CHPP for processing. Use of the Whitehaven CHPP, train load-out and rail spur infrastructure to transport product coal to market.	Use of the Approved Road Transport Route to haul ROM coal from the Project to the Whitehaven CHPP until the Project CHPP, train load-out facility and rail spur infrastructure reach full operational capacity. Ability to receive ROM coal via road from other Whitehaven mining operations for stockpiling and/or processing at the Project CHPP. On-site processing of up to approximately 13 Mtpa of ROM coal (combined) from the Project and other Whitehaven mining operations. Use of the Project train load-out facility and rail spur infrastructure to transport up to approximately 11.5 Mtpa of product coal (combined) to market from the Project and other Whitehaven mining operations.
Water management	On-site water management system, comprising water management storages and collection drains, up-catchment diversions, sediment control and open cut dewatering.	As per the Approved Mine, with construction and use of a groundwater supply borefield to the north of the Project.
Water supply	Mine water supply to be obtained from inflows to open cut areas, sediment dams and storage dams, plus surface water and/or groundwater licences as required.	Unchanged from the Approved Mine.
Workforce	Up to 60 full-time equivalent construction workforce plus additional contract personnel. Up to 250 full-time equivalent on-site operational personnel plus additional contract personnel.	Up to 500 full-time equivalent construction personnel. Up to 450 full-time equivalent on-site operational personnel.
Operating hours	Mining would occur 24 hours per day, 7 days per week.	Unchanged from the Approved Mine.

* Following the exclusion of mining coal from ML 1718 described in an Amendment Report for the Project (Section 2.1 of this RTS) the total resource for the Project would be 168 Mt.

2.1 AMENDMENT REPORT

Separate to this RTS, Whitehaven has prepared an Amendment Report for the Project to document a minor reduction in coal extraction as, due to an administrative error, mining purposes (e.g. waste emplacements, water management infrastructure) are authorised within ML 1718 but coal extraction is not authorised. Accordingly, approximately 11 million tonnes (Mt) of coal proposed to be extracted within Mining Lease (ML) 1718 in the EIS would no longer be mined as part of the Project.

In summary, when compared to the EIS, the proposed amendment would:

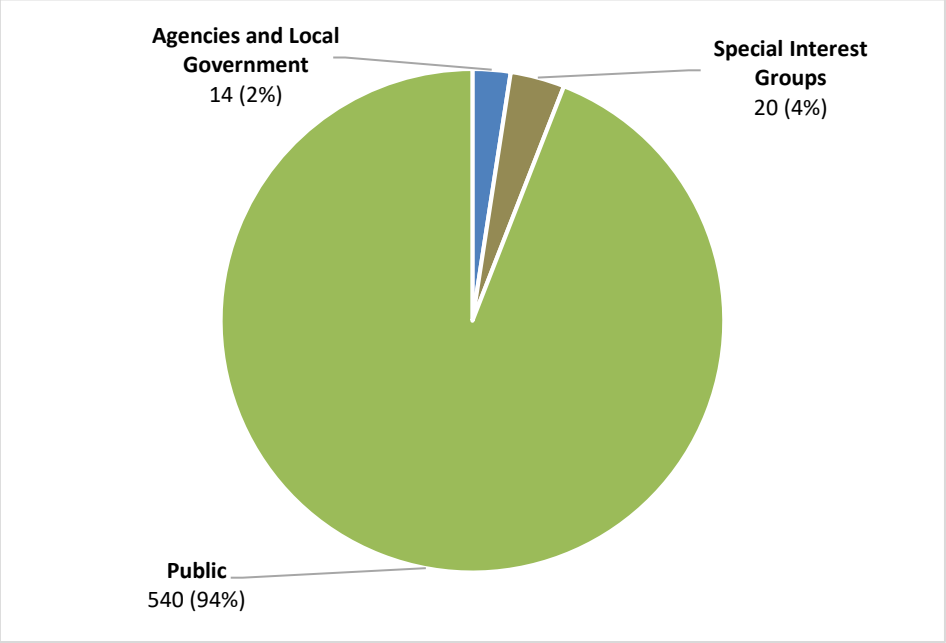
- Reduce the total resource for the Project from 179 Mt to 168 Mt.
- Result in a reduction in net benefits to NSW of $45 million (i.e. from $1.21 billion to $1.16 billion).
- Reduce Scope 1 and 2 greenhouse gas emissions from 4.1 million tonnes carbon dioxide equivalent (Mt $CO_{2\text{-}e}$) to 3.9 Mt $CO_{2\text{-}e}$, as well as reduce associated Scope 3 greenhouse gas emissions by approximately 23 Mt $CO_{2\text{-}e}$.
- Not change the peak production rate, disturbance footprint (as waste emplacement would continue to occur in ML 1718), mine life, workforce or hours of operation.
- Not result in additional environmental impacts beyond those assessed in the Project EIS (e.g. surface water, groundwater, air quality, noise).

3 ANALYSIS OF SUBMISSIONS

3.1 NUMBER OF SUBMISSIONS

A total of 560 submissions on the Project were received from Government agencies, SIGs and members of the public (including businesses). Chart 1 presents a summary of the total number of submissions by submitter category. The key issues raised in submissions are summarised in Section 3.5.

Chart 1
Summary of All Submissions



A summary of the submissions received during the public exhibition period and a register of submitters are provided in Attachments 1 and 2, respectively.

3.2 GOVERNMENT AGENCY SUBMISSIONS

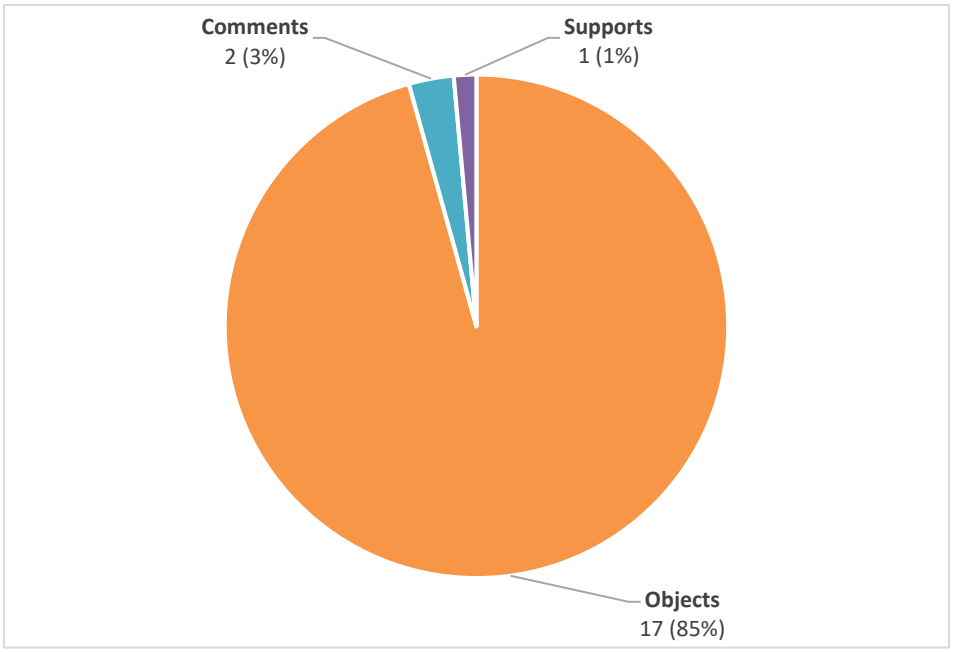
A total of 14 submissions were received from NSW Government agencies, which were in the form of comments or suggested conditions. Advice from the Independent Expert Scientific Committee was also provided to DPIE in regard to the Project.

3.3 SPECIAL INTEREST GROUP SUBMISSIONS

A total of 20 submissions were received from SIGs[1]. Of these, one supported the Project, two provided comments and 17 objected to the Project (Chart 2).

[1] Note that the Armidale Branch of the National Parks Association provided two submissions, however they have been considered as a single submission, consistent with DPIE's Preliminary Issues Report.

Chart 2
Summary of Special Interest Group Submissions



3.4 PUBLIC SUBMISSIONS

A total of 540 submissions were received from members of the public. Of these, 344 supported the Project, 12 provided comments and 184 objected to the Project (Chart 3).

Chart 3
Summary of Public Submissions

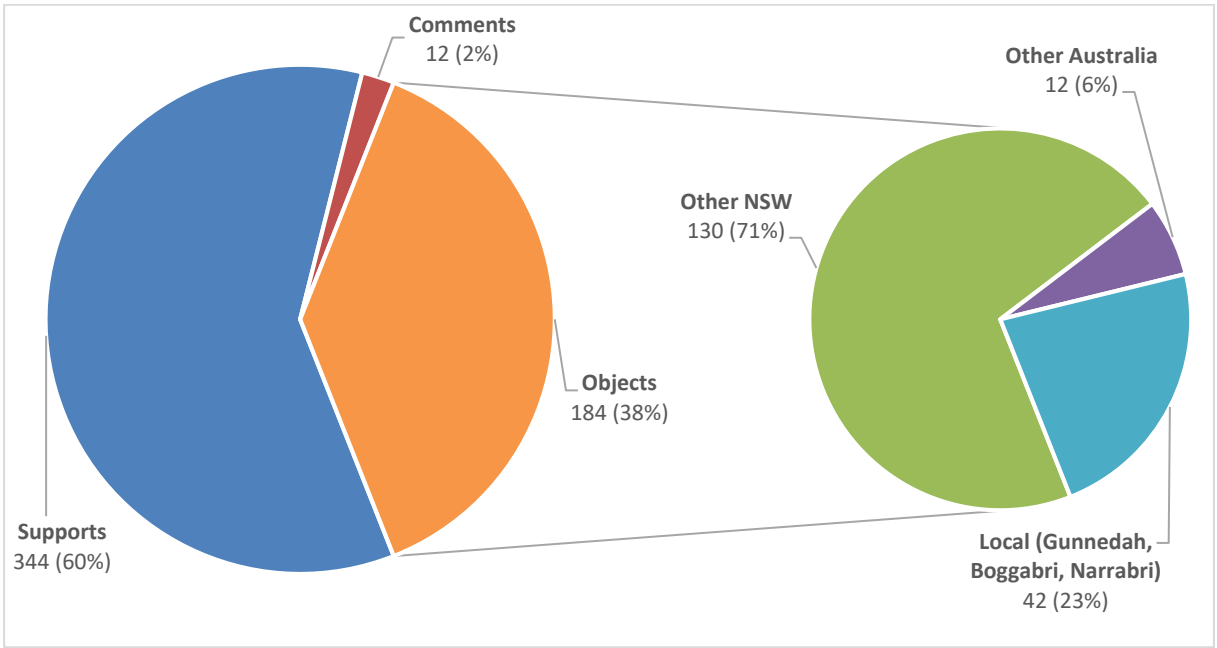


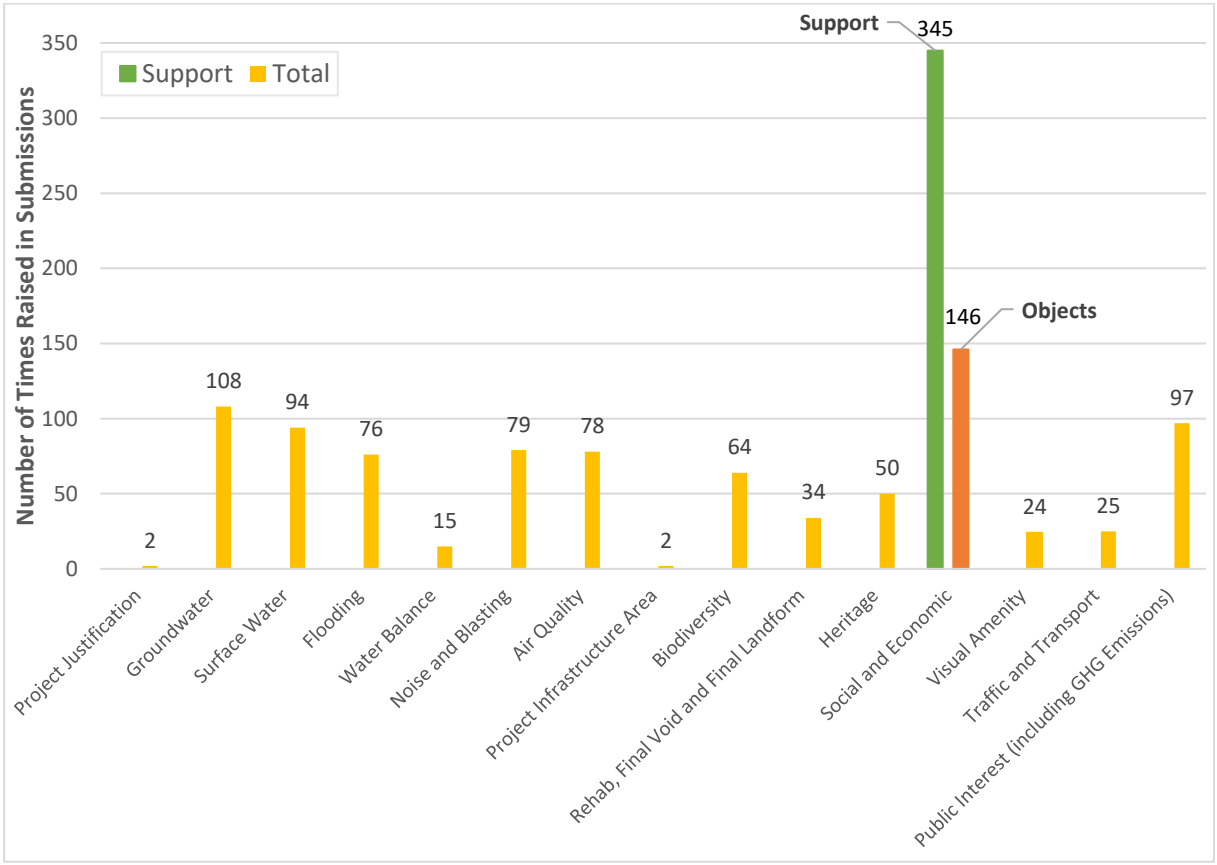
Chart 3 also presents a summary of objecting public submissions by location. Public submissions were from a range of locations including the local region (incorporating the Gunnedah, Boggabri and Narrabri townships as well as landowners in proximity of the Project), NSW more generally or interstate locations.

3.5 KEY ISSUES RAISED IN SUBMISSIONS

The most commonly raised issues in relation to the Project are illustrated in Chart 4. As shown, the most common issues related to:

- socio-economic benefits;
- potential adverse socio-economic impacts;
- public interest concerns (including greenhouse gas emissions);
- potential impacts to groundwater, surface water and flooding;
- potential noise and air quality impacts;
- potential impacts to biodiversity; and
- the Project's rehabilitation and final landform.

Chart 4
Key Issues Raised in Submissions



4 ACTIONS TAKEN SINCE LODGEMENT OF THE PROJECT EIS

4.1 ENGAGEMENT ACTIVITIES

Since the lodgement of the EIS, Whitehaven has continued to consult with NSW and Commonwealth Government agencies, DPIE's independent experts, Councils and community members regarding the Project. This has included:

- provision of property-specific information booklets to all landowners within 5 km of the Project mining area and 2 km of the Project rail spur alignment;
- other ongoing consultation with landowners and the community;
- consultation with NSW and Commonwealth Government agencies, including;
  - the NSW Office of Environment and Heritage (OEH);
  - NSW Environment Protection Authority (EPA);
  - NSW Department of Industry – Crown Lands and Water (DI Crown Lands and Water); and
  - Commonwealth Department of Environment and Energy);
- consultation with the Narrabri Shire Council and Gunnedah Shire Council; and
- consultation with DPIE and their independent expert peer reviewers.

The above is in addition to engagement on the Project from the community during the IPC Public Hearing process.

4.2 FURTHER ENVIRONMENTAL ASSESSMENT

Subsequent to the public exhibition of the Project, the following additional analysis has been undertaken in response to submissions received:

- Groundwater modelling – Section 6.2.
- Flood modelling – Section 6.4.
- Further review of all Project years regarding potential noise and air quality emissions – Sections 6.6 and 6.7.
- Noise monitoring and rail noise analysis – Section 6.6.
- Analysis of Coal Preparation Plant (CPP) noise (including cladding and location) – Section 6.6.
- Analysis of alternative mine infrastructure area layouts and locations – Section 6.8.
- Further analysis of rehabilitation data – Section 6.9.

5 CHANGES TO THE PROJECT AND ADDITIONAL COMMITMENTS

The additional analysis undertaken for this RTS has resulted in the following clarifications:

- Rail Spur:
  - Following further design and constructability considerations, the Project rail spur will be completely elevated on piers west of the Namoi River.
  - The effect of this is a reduction in the extent of potential flood impacts compared to these presented in the EIS.
- CHPP noise attenuation:
  - Following further design considerations, clarification of the elements of the proposed CHPP that will be constructed to include noise cladding.

In addition, this RTS outlines commitments made in regard to the Project in response to comments outlined in the IPC's Issues Report.

Attachment 3 provides a reconciliation of the IPC's comments and Whitehaven's commitments.

6 RESPONSES TO SUBMISSIONS

6.1 PROJECT JUSTIFICATION

6.1.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to the justification for the Project included:

- justification of the requirement for the proposed extension and potential for future expansion; and
- incremental assessment of 'extension' components of the Project.

Independent Planning Commission Issues Report

Regarding the project justification, paragraph 61 of the IPC's Issues Report states:

> *Based on the information provided in paragraphs 57 to 60, the Commission considers that the Department should give the Applicant an opportunity to supply a detailed consideration of all matters provided to justify the Project, including but not limited to:*
>
> - *whether there are limitations imposed by the conditions of consent for the Approved Project, and the Tarrawonga and Rocglen Mines which are located near the Project site (see Figure 1);*
> - *any need for a CHPP and rail load out facility at the Project site itself;*
> - *the economic impacts of any limitations imposed by the current consents which prevent maximum production for the Approved Project, Tarrawonga and Rocglen Mines, and the Gunnedah CHPP and train load out facility;*
> - *the economic evidence for an annual production threshold sufficient to support a viable new CHPP and rail loop;*
> - *details of the additional resources secured within the Vickery South tenements, timing and why these were not included in the Approved Project application; and*
> - *details of the additional resources confirmed within the northern area of the Approved Project tenements, timing and why these were not included in the Approved Project application.*

6.1.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Clarification of any restrictions imposed by existing Development Consents.
2. Clarification of additional coal resources.
3. Justification for the Project 'extensions'.
4. Incremental Assessment of Project 'extensions'.

6.1.3 Responses

1. Clarification of any restrictions imposed by existing Development Consents

The Approved Mine authorises road transport of ROM coal to the Whitehaven CHPP in Gunnedah of:

- a combined total (i.e. from the Approved Mine and other Whitehaven operations using the Approved Road Transport Route) of 3.5 Mtpa prior to the commissioning of the Kamilaroi Highway Overpass; and
- a combined total of up to 4.5 Mtpa following commissioning of the Kamilaroi Highway Overpass.

These existing limits on road transport limits would prevent the maximum production rates from the Approved Mine (4.5 Mtpa), Tarrawonga Coal Mine (3 Mtpa) and Rocglen Coal Mine (1.5 Mtpa) occurring simultaneously (noting coal mining at the Rocglen Coal Mine has ceased). This is because, when the EIS for the Approved Mine was prepared, it was anticipated that commercial arrangements would be in place for coal from the Tarrawonga Coal Mine to be transported offsite via the Boggabri Coal Mine CHPP and rail loop, however, no such commercial arrangements are in place.

Accordingly, in the absence of alternative commercial arrangements or an increase in the rate of coal authorised to be transported along the Approval Road Transport Route, the Project rail spur would potentially 'unlock' ROM coal production that would otherwise be restricted by the limits on the Approved Road Transport Route. The Economic Assessment conservatively did not consider the associated socio-economic benefits associated with unlocking this ROM coal (refer to Section 6.12).

2. Clarification of additional coal resources

<u>EL 7407</u>

EL 7407, located to the immediate south of the Approved Mine (Figure 3), was owned by Coalworks Limited and Itochu Corporation until 2012. Coalworks Limited proposed the development of a small open cut coal mine within EL 7407, known as the Vickery South Project, however a mine plan and Development Application for the proposal were not submitted.

Resources in EL 7407 were not included as part of the Approved Mine as Whitehaven acquired EL 7407 through its acquisition of Coalworks Limited and Itochu Corporation's interest in EL 7407, following submission of the Approved Mine EIS. The additional resource provided by EL 7407 is approximately 33 Mt, with a value of some $2.3 billion.

<u>Northern Tenements</u>

Additional coal reserves in ML 1718 are no longer proposed to be mined as part of the Project (refer to Section 2.1 of this RTS and separate Amendment Report).

3. Justification for the Project extensions

The environmental justification for the Project CHPP, rail loop and rail spur is as follows:

- reduced amenity impacts along the Approved Road Transport Route (e.g. noise and traffic) associated with the cessation of road haulage of ROM coal to Gunnedah;

- reduced amenity impacts to private landholders near the Whitehaven CHPP (e.g. noise and air quality impacts) associated with the cessation of operations at the Whitehaven CHPP; and
- reduced greenhouse gas emissions from the consumption of diesel fuel associated with ROM coal haulage by truck to Gunnedah (from the Approved Mine, Tarrawonga Coal Mine and Rocglen Coal Mine).

While there are capital and operational costs associated with constructing and operating the Project CHPP, rail loop and rail spur, the following costs would be avoided (when compared to the Approved Mine):

- operational costs associated with ROM coal haulage by truck; and
- capital cost of the Kamilaroi Highway Overpass.

The costs associated with the Project CHPP, rail loop and rail spur are justified as they enable the increased annual production rate for the Project, as well as 'unlocking' the simultaneous transport of coal from the Tarrawonga Coal Mine at its maximum approved production rate (which would be limited to a combined total of 4.5 Mtpa as described above).

The extension of the open cut into EL 7407 represents a logical extension of the Approved Mine open cut to efficiently recover the coal resource, while avoiding environmentally sensitive features such as the alluvium surrounding the Maules Creek Formation. The value of the additional coal to be recovered from EL 7407 is some $2.3 billion.

The economic benefit of the Project extensions to Whitehaven, NSW and the local economy is evident, considering the Project would result in an additional $500 million in net benefits to NSW (compared to the Approved Mine) and result in approximately 200 additional employment opportunities during operations and 450 additional employment opportunities during construction.

4. Incremental assessment of Project extensions

The Project EIS has assessed the potential impacts of the Project in its entirety, for example:

- noise, dust and greenhouse gas emissions are based on the maximum production rate for the Project inclusive of the handling of Tarrawonga and Rocglen coal;
- groundwater modelling is based on the Project life of mine progression (cumulatively with the use of the Project borefield);
- the site water balance considers the Project life of mine progression and washing of Project, Tarrawonga and Rocglen coal at the CPP;
- road transport and socio-economic studies consider the Project's total expected workforce; and
- Aboriginal heritage and biodiversity impacts have considered the Project incremental disturbance areas cumulatively with the Approved Mine disturbance.

Notwithstanding, where relevant the potential impacts of the Project are compared to those already approved for the Approved Mine (i.e. for the purposes of impacts).

6.2 GROUNDWATER

6.2.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to groundwater included:

- depressurisation of the Upper Namoi Alluvium;
- groundwater drawdown at privately-owned bores (including cumulative impacts as a result of other mining operations in the region);
- impacts to surrounding groundwater quality from rainfall recharge and final void water;
- impacts to Namoi River baseflow quality from proposed water storage in the Blue Vale final void;
- accuracy of groundwater modelling and assumptions; and
- location of the northern borefield (particularly with regard to the Boggabri town water supply bore).

Agency Submissions

Agencies and local councils that provided comments on the Project relevant to surface water included EPA, DI Crown Lands & Water, NSW Health, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- justification of the final void with respect to impacts to surrounding water resources;
- clarification of proposed groundwater monitoring locations;
- clarification of potential impacts of advanced open cut dewatering bores;
- assessment of the northern borefield against applicable impact assessment criteria;
- accuracy of groundwater modelling (particularly with regard to cumulative impacts);
- proposed groundwater monitoring and requirement for independent review of results;
- implementation of 'make good' measures for impacts to groundwater bores;
- clarification of potential impacts to Boggabri's town water supply bore; and
- implementation of a Water Management Plan.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

As part of DPIE's Preliminary Issues Report, an Independent Expert (Hugh Middlemis of HydroGeoLogic) was engaged to peer review key aspects of the Project Groundwater Assessment. DPIE's Independent Expert requested the following additional infromation:

- further sensitivity analysis to confirm the predicted impacts; and
- analysis of final void alternatives (i.e. complete or partial backfill scenarios).

It is noted DPIE's Independent Expert also stated:

> *My professional opinion is that the Vickery Extension hydrogeological and groundwater modelling assessment is fit for the purpose of mine dewatering environmental impact assessment (including cumulative impacts) and informing management strategies and licensing.*
>
> *The recommended monitoring program and ongoing hydrogeological investigations are well-designed and will provide additional data for future model refinements and improvements in performance, and for comprehensive uncertainty analysis.*

Independent Planning Commission Issues Report

Regarding groundwater, paragraph 101 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraphs 94 to 100, the Commission considers that the Department should give detailed consideration to:*
>
> - *the Applicant's groundwater model and surface water assessment, including by reference to the information requirements highlighted by government agencies and the IESC and Additional Material provided by the Applicant to the Commission. The Department may wish to consider obtaining further information from the Applicant in this regard, including a meaningful discussion of the impacts of both the Approved Project and the Project;*
> - *the adequacy of the Applicant's justification and costing of a no void option for consideration. The justification should reflect the requirements in the EP&A Act to ensure intergenerational equity and should appropriately incorporate the cost of the long-term management of the void, including the loss of the water resources to the void;*
> - *the Applicant's consideration of long-term groundwater and water quality models for a no void option to assess the potential impacts of groundwater flow through such a rehabilitated Project site;*
> - *post-mining studies, which should provide details of the groundwater flows to the east of the site and how they interact with drawdowns from the Rocglen Mine site including any potential impacts on the water sharing plan catchment to the east;*
> - *a more extensive sensitivity study of the groundwater model be undertaken by the Applicant, or any explanation be given by the Applicant for its absence;*
> - *the provision of maps that illustrate the potential distribution of GDEs, as indicated by the IESC in paragraph 84; and*
> - *a risk analysis as indicated by the IESC in paragraph 84.*

6.2.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Accuracy of groundwater modelling and predictions.
    a. Drawdown on the Upper Namoi Alluvium.
    b. Clarification of impacts to privately-owned bores.
    c. Clarification of cumulative assessment.
    d. Clarification of impacts from use of advanced open cut dewatering bores.
    e. Surrounding groundwater quality (final void water, rainfall recharge, Blue Vale water storage).
    f. Clarification of Groundwater Dependent Ecosystem mapping.
    g. Comparison of predicted impacts to the Approved mine.
2. Additional sensitivity analysis.
3. Assessment of the Project borefield.
4. Justification of proposed final void.
5. Proposed groundwater monitoring and management measures.

Note responses related to surface water are provided in Section 6.3 and responses related to the final void justification are provided in Section 6.10.

6.2.3 Responses

1. Accuracy of groundwater modelling and predictions

a. Drawdown from Upper Namoi Alluvium

As mining operations progress, the open cut would act as a localised groundwater sink. This would cause a change in groundwater flow direction and, in some places, a localised reversal of flow direction (Appendix A of the EIS).

Numerical modelling conducted as part of the Groundwater Assessment predicts a substantial reduction in potentiometric head in the deeper Maules Creek Formation in the near vicinity of the open cut. However, drawdown of greater than 1 metre (m) would not extend beyond the immediate Project mining area and into the surrounding alluvium (Appendix A of the EIS).

This is because the Project open cut has been designed to remain within the relatively low permeability Maules Creek Formation, with the extent of the alluvium informed by site-specific investigations, such as Transient Electromagnetic (TEM) survey and investigative drilling. The Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) noted in regard to the alluvial investigations:

> *The IESC notes that a number of the studies completed for this project such as the surface water assessment and the studies to determine the extent of the alluvium have been completed to a high standard. The proponent should be commended for these studies and for obtaining peer review of many on the major reports provided in the impact assessment.*

b. Clarification of impacts to privately-owned bores

No privately-owned bores in the vicinity of the Project, as identified by the bore census conducted in 2012, are predicted to have greater than 2 m drawdown as a result of the Project (i.e. impacts are within the 'Level 1' minimal impact criteria defined in the *NSW Aquifer Interference Policy* [NSW Government, 2012] [AIP]) (Appendix B of the EIS). The greatest predicted drawdown at any privately-owned bore to the west of the Project in the Namoi River alluvium is 0.2 metres (m)[2], some 10 times less than AIP minimal impact criteria.

The modelling also considers a cumulative scenario that includes extraction from the Project borefield at a rate of 600 megalitres (ML) per annum. This is conservative as the site water balance modelling (Advisian, 2018) did not include borefield extraction above 396 ML in any year (with extraction from the borefield expected to be limited to the years where licensed extraction from the Namoi River is limited).

Notwithstanding, should monitoring or an investigation show greater than 2 m drawdown at a privately-owned bore, and the drawdown is attributable to the Project, 'make good' provisions for the affected groundwater user would be implemented in accordance with the AIP, and may include:

- deepening the affected groundwater bore;
- construction of a new groundwater bore; and/or
- provision of an alternative water supply of appropriate quality and quantity.

c. Clarification of cumulative groundwater assessment inclusions

The Project EIS provides an assessment of the proposed activities for the Project. With respect to potential groundwater impacts, the modelling considers the Project life of mine progression.

Groundwater modelling undertaken for the Project included the cumulative impacts of the Project in its entirety, the approved Rocglen and Tarrawonga Coal Mines and regional agricultural groundwater extraction (Appendix A of the EIS).

The modelling also considers a cumulative scenario that includes extraction from the Project borefield at a rate of 600 ML per annum. This is conservative as the site water balance modelling (Advisian, 2018) did not include borefield extraction above 396 ML in any year (with extraction from the borefield expected to be limited to years where licensed extraction from the Namoi River is limited).

The Groundwater Assessment has been prepared in accordance with relevant guidelines, including the AIP, the *Information Guidelines from the Independent Expert Scientific Committee's advice on coal seam gas and large coal mining development proposals* (IESC, 2015) and the *Australian Groundwater Modelling Guidelines* (Barnett et al., 2012), which all describe cumulative groundwater assessment requirements.

[2] The maximum predicted cumulative drawdown at any bore is approximately 0.6 m at bore RB1 located immediately to the south of the Rocglen Coal Mine. All other bores identified during the bore census are predicted to experience 0.2 m drawdown or less.

d. Clarification of impacts from use of in-pit dewatering bores

Advanced dewatering bores are distinct to bores associated with the Project borefield (referred to in Submissions as the 'northern borefield').

Any advanced dewatering bores would be located within the Project open cut footprint within the Maules Creek Formation (if they are required at all).

As such they will have negligible drawdown impact in comparison to the effects of the open cut progression, which is modelled in the Groundwater Assessment. These dewatering bores would be progressively removed as mining progresses (Section 5 of Appendix A of the EIS).

e. Surrounding groundwater quality (final void water, rainfall recharge, Blue Vale water storage)

Due to the open cut acting as a localised groundwater sink, no significant impacts to groundwater quality are predicted for the Project (Appendix A of the EIS).

Potential seepage from the north-western batter of the Western Emplacement into the alluvium embayment due to rainfall recharge is predicted to be minimal (due to the predominant gradient of groundwater being towards the void) and the salinity of the seepage is anticipated to be significantly lower than the existing salinity of the groundwater currently within the shallow alluvium embayment. Therefore, infiltration through the Western Emplacement would cause no adverse water quality impacts to the alluvium (Section 4.4.2 of the EIS).

Although preliminary groundwater modelling indicated the Blue Vale open cut could be mined without a significant impact on the Namoi River, its removal from the Project mine plan results in the Project mining footprint being no closer to the Namoi River than the Approved Mine footprint. The extent of the open cut is now proposed to be at least approximately 1.5 km from the Namoi River.

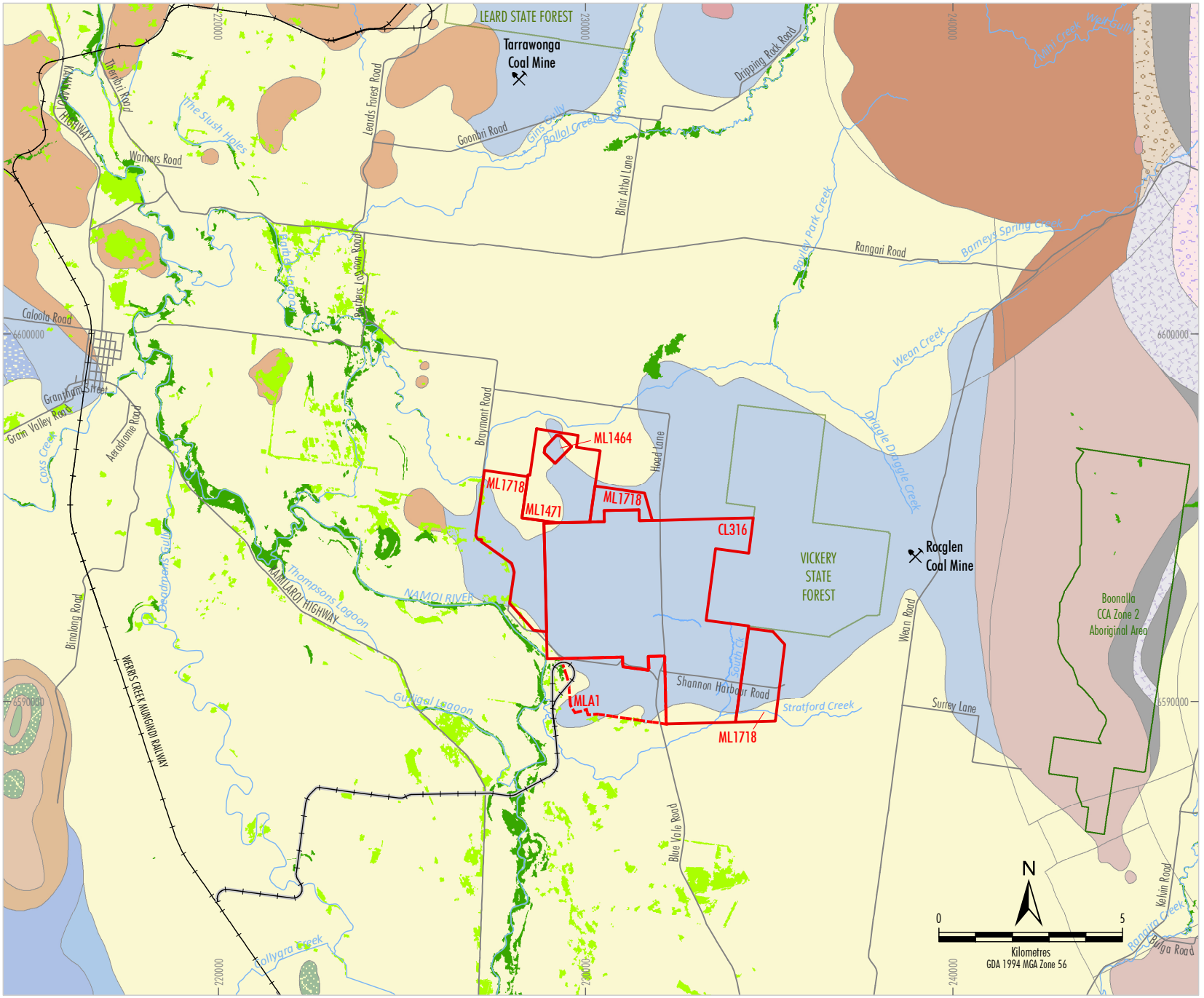
The Blue Vale void may be used to store mine water during the life of the Project. HydroSimulations (2018) conducted analysis of the potential for seepage of mine water from the Blue Vale void to impact salinity levels in the Namoi River. The analysis considered the AIP requirement of *"no increase of more than 1% per activity in the long-term average salinity in a highly connected surface water source".* It was predicted that the storage of mine water in the Blue Vale void could increase the salinity of the Namoi River baseflow by approximately 0.007% to 0.03% (HydroSimulations, 2018).

f. Clarification of Groundwater Dependent Ecosystem mapping

It is noted the IESC suggested risk analysis of potential impacts of groundwater drawdown to Groundwater Dependent Ecosystems (GDEs), along with proposed mitigation strategies if impacts cannot be avoided.

Mapping of moderate to high potential GDEs in the vicinity of the Project is provided in Figure 4, consistent with the *Groundwater Dependent Ecosystems Atlas* (Bureau of Meteorology, 2019). As the Project open cut is constrained to the Maules Creek Formation, the groundwater modelling indicates the 1 m drawdown contour would not extend beyond the Maules Creek Formation towards the Namoi River and its alluvium. Therefore negligible impact to potential GDEs is predicted.

There are no high priority GDEs identified in the Upper Namoi Groundwater Sources or Porous Rock Groundwater Sources in the vicinity of the Project in accordance with the definition in the relevant Water Sharing Plans.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- State Forest
- State Conservation Area, Aboriginal Area
- Indicative Project Rail Spur

Potential Groundwater Dependent Ecosystem

- Moderate potential GDE
- High potential GDE

Source: Department of Industry (2015); DPI - Gunnedah Coalfield South (2013); BOM (2019)

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Groundwater Dependent Ecosystem Mapping

Figure 4

WHC-15-33_RTS 228B

The Namoi River is considered a GDE however, in accordance with the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (NSW Office of Water, 2012), it is not considered to be a high value GDE.

The Project would present a low risk to the Namoi River (as defined in the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* [NSW Office of Water, 2012]) because (Appendices A and B):

- the predicted baseflow reduction in the Namoi River due to the Project is negligible; and
- the Project is predicted to have negligible impact on water quality in the Namoi River.

g. Comparison of predicted impacts to the Approved Mine

The predicted impacts of the Project and the Approved Mine with respect to groundwater are effectively unchanged. That is, predicted drawdown is limited beyond the Maules Creek Formation due to the open cut avoiding the alluvium. As such, for both the Project and the Approved Mine no greater than 'minimal impact' as defined in the AIP was predicted.

Minor differences in predicted inflows are associated with the following:

- the Approved Mine involved two simultaneous advancing open cut faces, whereas the Project involves one;
- the Approved Mine life is 30 years where-as the Project life is 25 years; and
- additional calibration and verification data being available for the modelling for the Project.

2. Additional sensitivity analysis

The following response provides:

- the results of additional sensitivity analysis;
- further discussion of why the risk context of impacts from the Project to groundwater being significantly different from the EIS predictions can be considered to be fairly low; and
- details of Whitehaven's commitment to ongoing maintenance and verification of model predictions to resolve any residual model uncertainty.

Additional Calibration Sensitivity Analysis

In response to the request for further sensitivity and uncertainty analysis, HydroSimulations conducted additional calibration sensitivity analysis to determine the sensitivity of the groundwater model to changes in the following parameters:

- horizontal hydraulic conductivity (Kh);
- vertical hydraulic conductivity (Kv);
- storage coefficients (S);
- specific yield (Sy); and
- recharge (Rch).

Table 2 presents the results for the base-case model and each of the sensitivity scenarios, including the root mean square (RMS) (i.e. normally distributed error between the modelled and measured water levels), scaled RMS (SRMS) (which accounts for total measured head change across the model domain) and the change in SRMS compared to the base case model.

The calibration sensitivity analysis indicates the groundwater model is most sensitive to changes in horizontal hydraulic conductivity, as these scenarios recorded the greatest decrease in calibration performance and variation in modelled bore water levels. This indicates the horizontal hydraulic conductivity value used in the model is suitable (i.e. as alternative values would materially decrease calibration performance).

The calibration scenarios were applied to a selection of bores to determine the difference in observed and modelled water levels averaged over the calibration period (i.e. 2006 to 2011) (Table 3).

No sensitivity scenario consistently improved the calibration of all modelled bore water levels, however model calibration performance improved slightly with a:

- decrease in vertical hydraulic conductivity;
- increase in specific yield; and
- reduction in recharge.

It is noted the sensitivity analysis presented in HydroSimulations (2018) considered variations in vertical hydraulic conductivity.

Table 2
Calibration Sensitivity Statistics

Run ID	Scenario	RMS (m)	SRMS (%)	SRMS Change
Base	Base-case	3.91	5.24	-
Kh+	Hydraulic Conductivity (horizontal) +1 OM	6.19	8.29	158%
Kh-	Hydraulic Conductivity (horizontal) -1 OM	5.78	7.75	148%
Kv+	Hydraulic Conductivity (vertical) +1 OM	4.12	5.53	106%
Kv-	Hydraulic Conductivity (vertical) -1 OM	3.73	5.00	95%
S+	Storage Coefficient +1 OM (upper bound $1x10^{-4}$)	3.98	5.34	102%
S-	Storage Coefficient -1 OM (upper bound $1x10^{-4}$)	4.00	5.37	102%
Sy-	Specific Yield / Factor of 3	4.08	5.47	104%
Sy+	Specific Yield x Factor of 3	3.12	5.12	98%
Rch+	Recharge x Factor of 3	4.99	6.70	128%
Rch-	Recharge / Factor of 3	3.64	4.88	93%

Table 3
Calibration Sensitivity Average Residuals

Bore ID	Layer	Base	Kh+	Kh-	Kv+	Kv-	S+	S-	Sy+	Sy-	Rch+	Rch-
GW031856	1 (Qa)	-14.6	-3.1	-22.7	-14.5	-14.9	-14.6	-14.6	-14.6	-14.6	-20.0	-10.9
GW036462_1	1 (Qa)	5.2	7.4	0.9	5.3	5.2	5.3	5.3	5.6	5.0	3.7	5.8
GW036484_1	1 (Qa)	-6.5	-3.7	-12.6	-6.5	-6.4	-6.4	-6.4	-6.1	-6.6	-8.3	-5.7
MP-2	1	5.9	15.7	-7.6	6.7	4.8	5.9	5.9	6.0	6.0	1.0	10.8
MW1	9	-5.1	13.3	-8.0	-5.8	-3.6	-5.0	-5.0	-5.0	-5.1	-9.0	-0.8
MW3	1	-6.7	13.0	-8.9	-7.0	-6.5	-6.7	-6.6	-6.7	-6.7	-11.1	0.7
MW6	2	-9.4	12.0	-11.8	-9.6	-8.1	-9.4	-9.1	-9.5	-9.4	-15.6	-1.4
VNW223	2	7.5	10.1	5.3	7.6	8.1	8.6	8.8	10.0	4.2	6.4	7.9
WB-10	1	5.9	7.6	2.0	5.9	5.7	5.9	5.9	6.2	5.5	4.3	6.4
WB-12	1	6.4	8.7	1.0	6.4	6.2	6.4	6.4	6.8	6.0	4.6	7.0
WB-3	1	6.7	16.3	6.5	8.0	4.8	6.7	7.1	6.8	6.7	4.5	9.3
WB-5	2	11.3	18.5	10.5	13.5	9.0	11.3	12.0	11.6	11.2	8.5	13.2
WB-7	3	-0.4	11.5	-13.8	-0.7	-0.7	-0.4	1.9	-0.4	-0.4	-5.9	2.6
GW_10	1	-3.0	1.4	-14.7	-2.9	-2.4	-3.0	-3.0	-2.8	-3.2	-9.0	-0.5
GW_11	1	1.2	2.9	-4.1	1.2	1.2	1.2	1.2	1.4	1.2	-1.2	2.4
GW_2	1	1.1	2.7	-4.1	1.1	1.0	1.1	1.1	1.2	1.0	-1.6	2.3
GW_4	1	-4.3	-1.8	-11.2	-4.3	-4.4	-4.3	-4.3	-4.2	-4.4	-8.0	-2.6
GW_5	1	-1.6	1.3	-8.5	-1.6	-1.7	-1.6	-1.6	-1.6	-1.7	-5.4	0.3
GW_7	1	-3.4	1.6	-4.8	-3.7	-4.1	-3.4	-3.4	-3.3	-3.5	-5.9	-1.4
GW_9	1	1.1	7.7	-1.4	2.8	1.1	1.3	1.1	1.9	0.8	-3.0	4.3

In addition, implementing decreases in vertical hydraulic conductivity, increases in specific yield and decreases in recharge would reduce the predicted saturation thickness of the alluvium. The model values, therefore, are considered to provide a conservative estimate of potential impacts as they demonstrate a larger saturated extent of alluvium and greater potential area for drawdown.

Reconciliation of Project Groundwater Model against Sources of Uncertainty

The Independent Expert Scientific Committee's Information Guideline explanatory note "*Uncertainty analysis – Guidance for groundwater modelling within a risk management framework*" (Middlemis and Peeters, 2018) describes that:

> *Groundwater models are simplified representations of 'real world' systems that are continuously refined with new evidence, conceptualisations and uncertainties, to investigate the effects of management options on future eventualities. While models cannot predict the future with total confidence, decision-makers and stakeholders use model results to inform decisions on the acceptable level of risk in a specific context (e.g. potential impact). Model results should therefore be accompanied by uncertainty analyses that qualify or quantify the confidence we have in the modelled outcomes for specified courses of action.*
>
> *…*

For the purpose of this explanatory note, it is helpful to consider four sources of scientific uncertainty affecting groundwater model simulations:

- ***structural/conceptual**—geological structure and hydrogeological conceptualisation assumptions applied to derive a simplified view of a complex hydrogeological reality (any system aspect that cannot be changed in an automated way in a model)*
- ***parameterisation**—hydrogeological property values and assumptions applied to represent complex reality in space and time (any system aspect that can be changed in an automated way in a model via parameterisation)*
- ***measurement error**—combination of uncertainties associated with the measurement of complex system states (heads, discharges), parameters and variability (3D spatial and temporal) with those induced by upscaling or downscaling (site-specific data, climate data)*
- ***scenario uncertainties**—guessing future stresses, dynamics and boundary condition changes (e.g. mining, climate variability, land and water use change).*

To further demonstrate why the model is considered to have negligible uncertainty, and can be considered fit for purpose to inform decision-makers in regard to potential impacts associated with the Project, a reconciliation of the groundwater model against sources of uncertainty is provided in Table 4.

Table 4
Reconciliation of the Project Groundwater Model against Sources of Uncertainty

Source of Uncertainty^	Comment
Structural/ conceptual	▪ Geology/structure in the model is based on the site geological model, extent of alluvium (as defined by site-specific data such as TEM survey/drill logs). ▪ Extent of the open cut is limited to within to the Maules Creek Formation, which constrains the potential for drawdown in the alluvium.
Parameterisation	▪ Extensive site-specific data is available to constrain hydrogeological parameters (Upper Namoi Groundwater Flow Model [McNeilage, 2006], bore logs, hydrogeological investigations, core analysis, pumping tests). ▪ Long record of monitoring of the effects of existing operations (Canyon and Tarrawonga) to the alluvium is available (with limited drawdown observed from these other existing operations). ▪ Additional sensitivity analysis conducted in response to Peer Review – varying Kv, Kh, S, Sy and recharge to understand sensitivity of model performance/calibration.
Measurement error	▪ Extensive breadth of data (spatially and temporally) at site and across model domain, with data collected by trained specialists.
Scenario uncertainties	▪ Sensitivity analysis of impact of changes to Kv and recharge on model predictions and additional calibration sensitivity analysis. ▪ Future stresses to the groundwater system are limited to direct stressors of the Mauls Creek Formation, and are well understood as they are based on Annual Mine Plan snapshots for the Project. ▪ Mine closure scenarios conducted for final void and fully backfilled option.

^ After Middlemis and Peeters (2018)

In summary, the setting of the open cut within the Maules Creek Formation, and the extensive data available for model development (including observations of previous mining operations at the Project site and nearby) minimises the potential for model uncertainty. This includes the following key factors:

- The open cut is confined to the relatively low permeability Maules Creek Formation and avoids the alluvium, as confirmed by site-specific investigations (e.g. drilling and TEM surveys to refine the alluvial boundary).
- Extensive site-specific data is available to constrain hydrogeological parameters (e.g. data from bore logs and hydrogeological investigations).

- There is a long record of monitoring of the effects of existing operations (such as the Canyon and Tarrawonga Coal Mines, which are located within the model domain) to the alluvium, with limited historic drawdown observed.
- The model has been calibrated to monitoring data, including the simulation of historic stresses to the groundwater system from existing mining operations within the model domain.
- Sensitivity analysis was conducted in the Groundwater Assessment (Kv and recharge) and in response to peer review (varying Kv, Kh, S, Sy and recharge).

Risk Context

As the Project open cut is constrained to the Maules Creek Formation, the groundwater modelling indicates the 1 m drawdown contour would not extend beyond the Maules Creek Formation towards the Namoi River and its alluvium.

A key stakeholder concern in regard to groundwater is the potential for impacts to agricultural production bores. In this regard, no greater than 0.2 m drawdown is predicted at agricultural production bores in the Namoi River alluvium (e.g. Gunnedah Formation)[3]. This is some 10 times lower than the 'minimal impact' criterion of 2 m drawdown at water supply works specified in the AIP.

Given the above, the Project is expected to result in negligible impacts to users of the groundwater in the Namoi River alluvium.

It is noted the peer reviewer considered that "*… it could be argued the risk context is fairly low in this case, given its setting in the low permeability Maules Creek Formation and benchmarking to low dewatering rates and lack of widespread drawdown impacts from nearby mines…*".

When considering the low risk setting of the site, reconciliation of the model against the sources of uncertainty, the sensitivity analysis conducted (which indicates the model has negligible uncertainty) and the negligible predicted impacts to users of groundwater in the Namoi River alluvium, further sensitivity and uncertainty analysis is not considered to be warranted to inform decision-makers in regard to potential impacts associated the Project.

It is considered this position is supported by the following from the Australian Groundwater Model Guideline (Barnett *et al*., 2012) (emphasis added):

> *Given that the consequences of management decisions vary, it follows that the extent of and resources devoted to an uncertainty analysis may depend on the consequences.* ***For events with low impact, a qualitative, limited uncertainty analysis may be sufficient for informing a decision****. For events with a high impact, on the other hand, the risks might be better assessed and associated decision made using a more robust and comprehensive uncertainty analysis.*

[3] The maximum predicted cumulative drawdown at any bore is approximately 0.6 m at bore RB1 located immediately to the south of the Rocglen Coal Mine. All other bores identified during the bore census are predicted to experience 0.2 m drawdown or less.

Groundwater Monitoring

Whitehaven agrees with the peer reviewer's statement that:

> *Even after improved uncertainty assessments, uncertainties will remain, and the ongoing monitoring program is well designed to provide the data in due course for model improvements and assessment of uncertainties.*

Ongoing groundwater monitoring would be undertaken for the Project, with the results of this monitoring to be used to confirm any residual uncertainty in the modelling and inform ongoing licensing requirements. The groundwater monitoring results would be compared to model predictions, with the model revised and recalibrated every 5 years as required. This is consistent with the recommendations of Dr Franz Kalf in his peer review of the Groundwater Assessment (as per the peer review letter included in this EIS).

To confirm the accuracy of groundwater modelling predictions, Whitehaven commits to ongoing groundwater monitoring with the results of this monitoring to be used to confirm any residual uncertainty and inform ongoing licensing requirements. The groundwater monitoring results would be compared to model predictions, with the model revised and recalibrated every 5 years as required.

3. Assessment of Project borefield

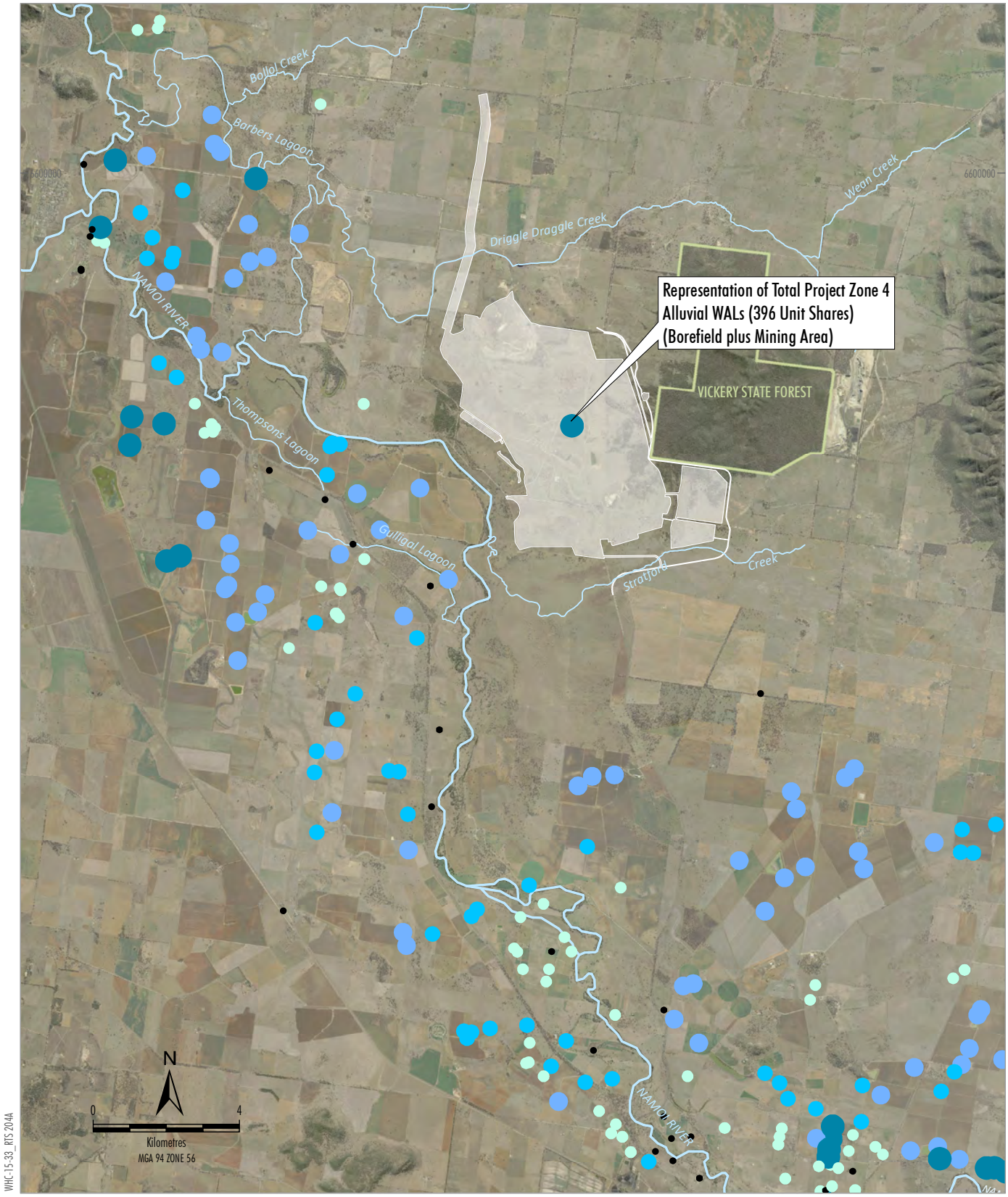
Justification of location

The Project borefield (referred to in submissions as the "northern borefield") is proposed to provide a supplementary water source. Water would be extracted from the groundwater supply borefield during periods when required (e.g. when supply from the mine storages is insufficient to meet the Project water demand, and sufficient allocation from the Namoi River is unavailable). Under typical climate sequences, the borefield would only be required to meet the Project's operational demands during the early years of the Project.

The use of the northern borefield would be in accordance with Whitehaven's licensed entitlements and the extraction and positioning rules of Clause 36 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003* (Section 6.4 of Appendix A of the EIS).

Figure 5 shows the distribution of existing licensed allocations for the Zone 4 alluvium, based on Water Access Licence title searches. As shown, the Zone 4 alluvial licences held by Whitehaven for the Project are insignificant in the context of the currently licensed extraction in the vicinity of the Project (Figure 5).

The northern borefield (i.e. water supply borefield) has been modelled cumulatively with drawdown due to Project mining (as well as other mining operations and agricultural users) to confirm predicted impacts to other water users are insignificant (Section 6.4 of Appendix A of the EIS).



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LEGEND

NSW State Forest

Project Mining Area and Borefield

Total Alluvial WAL Allocations

- 0 - 10 ML/year
- 10 - 50 ML/year
- 50 - 100 ML/year
- 100 - 250 ML/year
- 250 - 500 ML/year

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Alluvium Water Access Licences in the Vicinity of the Project

Source: Geoscience Australia (2006); DPI Water (2016); Whitehaven (2016)

Figure 5

As shown on Figure 6, the northern borefield is located entirely on Whitehaven-owned land and is approximately:

- 3.7 km from the boundary of the nearest privately-owned property.
- 5 km from the closest privately-owned bore.
- 6 km from the Boggabri town water supply bore.

Associated groundwater drawdown

Predicted groundwater drawdowns in the 'highly productive' aquifers associated with the Upper Namoi Alluvium from the use of the Project borefield cumulatively with mining operations are within the AIP 'minimal' impact criterion of less than 2 m.

The predicted cumulative drawdown at all privately-owned bores in the vicinity of the Project borefield is less than 0.2 m.

The incremental drawdown associated with the Project borefield only (compared to the cumulative scenario) is negligible at all privately-owned bores.

The Boggabri town water supply bore location is shown on Figure 6. Based on the predictions at privately-owned bores that are closer to the Project borefield (i.e. 'YA1', approximately 5 km from the Project borefield), predicted cumulative drawdown from the Project borefield plus mining is expected to be less than 0.2 m at the Boggabri town water supply bore.

On this basis, further modelling of the potential groundwater drawdown at the Boggabri town water supply bore is not considered to be warranted.

Secondary approval of the Project borefield

Following Project determination and prior to any water extraction from the Project borefield, Whitehaven would be required to lodge an application with WaterNSW under section 71W of the *Water Management Act, 2000* to redistribute the Water Access Licences to be allocated to the Project borefield.

At that time, the application would be subject to assessment of the borefield against relevant DI Water dealing criteria to confirm it complies with the relevant provisions of the *Water Management Act, 2000*.

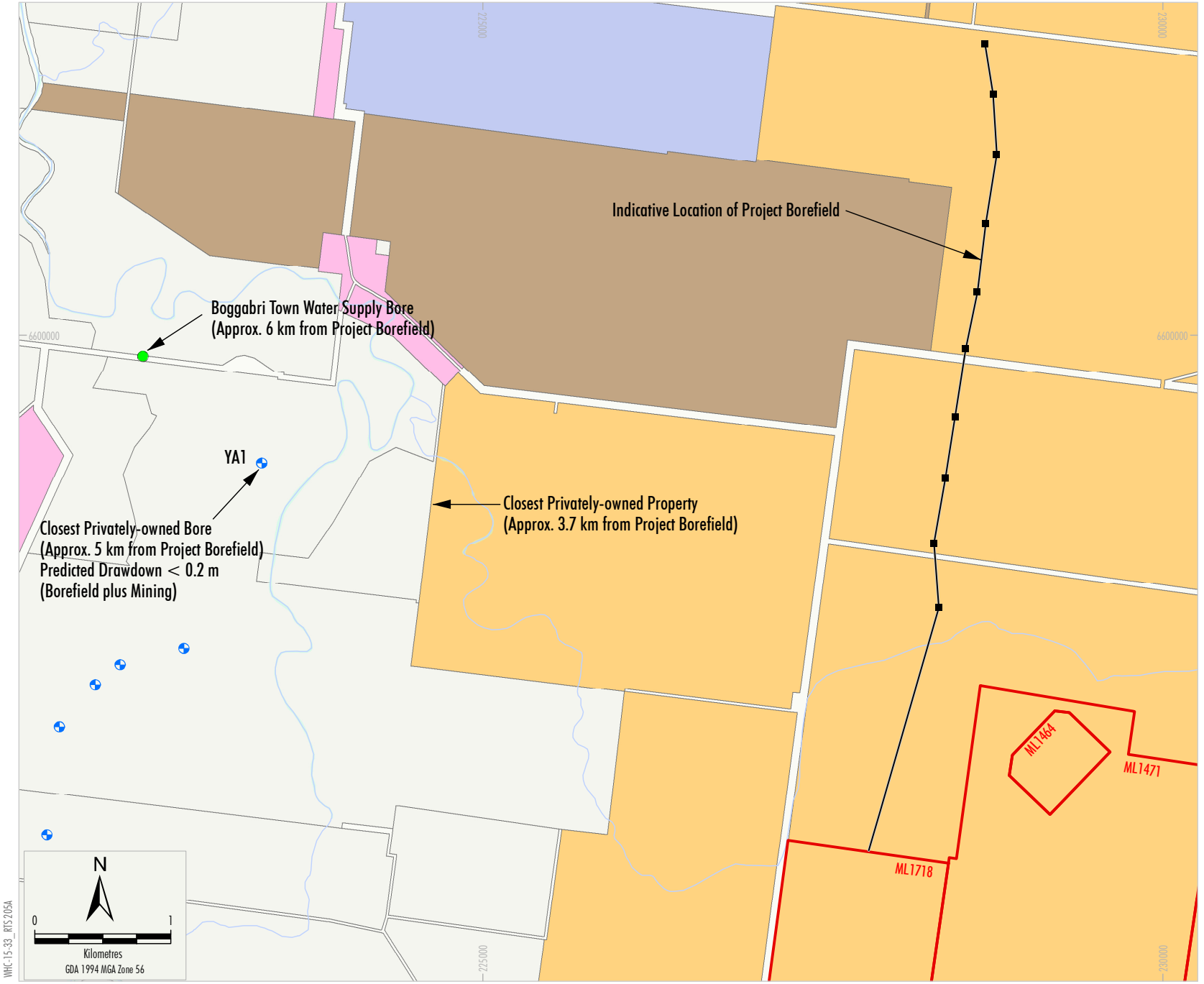
Whitehaven will continue to consult with WaterNSW and DI Water regarding this process.

4. Justification of proposed final void

Consideration of Alternative Final Landform Options

In response to the peer reviewer's comments, HydroSimulations conducted additional groundwater modelling for a scenario where the final void is completely backfilled.

This additional modelling indicates groundwater levels within a backfilled void would recover to higher levels than the surrounding groundwater table (Figure 7). As a result, groundwater would flow from the mining area towards the surrounding Namoi River alluvium.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Crown Land
- Whitehaven Owned Land
- Whitehaven/Idemitsu Boggabri Coal Joint Owned Land
- Idemitsu Boggabri Coal Owned Land
- Privately Owned Land and Other Land
- Indicative Location of Groundwater Bores and Pipeline
- Privately-owned Groundwater Bore Identified During Bore Census (2012)

Source: Department of Land and Property Information - Land Tenure (2016); Department of Industry (2017); Whitehaven Coal (2016)

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Privately-owned Bores in the Vicinity of the Project Borefield

Figure 6

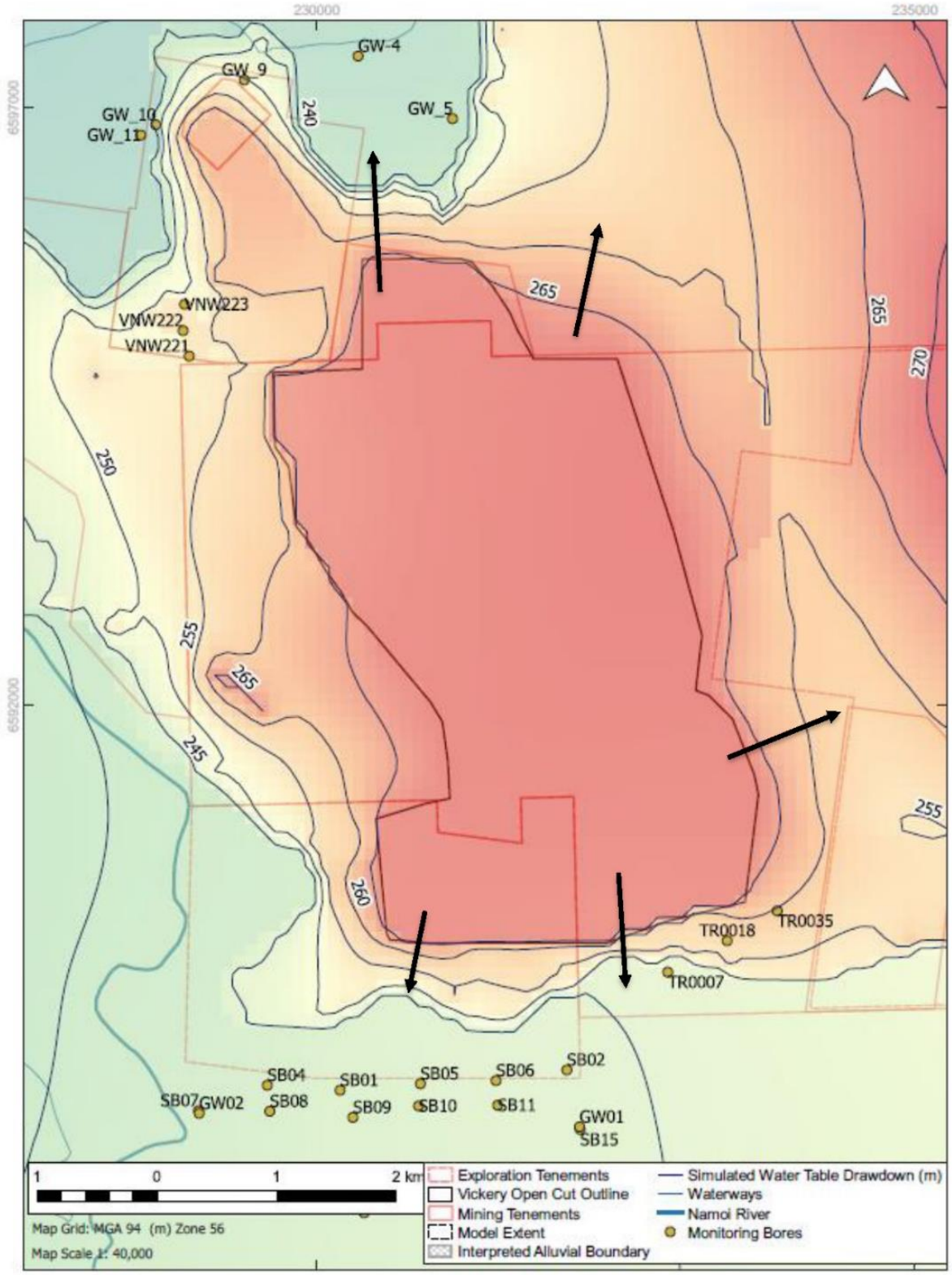


Figure 7: Simulated Water Table (m AHD) at the End of 100 Years Recovery for the Fully Backfilled Void Scenario (Source: HydroSimulations)

On this basis, it is considered this scenario (backfilled void) is environmentally inferior, as lower quality groundwater (i.e. infiltration into the backfilled void) would flow towards the Namoi River alluvium (rather than to the final void for the preferred scenario where it acts as a groundwater sink).

This scenario (backfilled void) is also economically inferior, with the cost of backfill estimated to be $600 million (with the NSW Division of Resources and Geoscience [DRG] in its submission considering this estimate to be conservatively low as the costs did not incorporate the significant operational expense of redesigning the emplacement strategy for the Project, particularly with regard to distance required to be travelled by overburden haul trucks).

Demonstration the Final Void would act as a Groundwater Sink

The Project Surface Water Assessment (Appendix A of the EIS) determined that the Project final void pit lake water level would be at least approximately 130 m to 170 m below the pre-mining groundwater table. On this basis, the Project Groundwater Assessment (Appendix B of the EIS) concluded the final void would remain a permanent local groundwater sink.

The final void water balance considered groundwater inflows (as derived by the groundwater model) along with rainfall and evaporation (evapotranspiration for the Project area derived by interpolation of the spatial data from the digital version of the Bureau of Meteorology's *Climatic Atlas of Australia: Evapotranspiration*). It is noted that in the Project area the rate of evaporation exceeds long-term average rainfall in all months (see Table 4-1 of the EIS).

In order to account for possible long-term future changes in the climate, the water balance analysis assesses the impact of the following scenarios (Plate 1):

- Scenario 1: maximum rainfall reduction (-23%) + minimum evaporation increase (+9.8%);
- Scenario 2: maximum rainfall increase (+18%) + minimum evaporation increase (+9.8%);
- Scenario 3: maximum rainfall reduction (-23%) + maximum evaporation increase (+18.1%); and
- Scenario 4: maximum rainfall increase (+18%) + maximum evaporation increase (+18.1%).

Based on the analysis undertaken, in particular the greater than 100 m of freeboard between the predicted final void water body level and the surrounding pre-mining groundwater table, it was considered there would be negligible risk that the final void would not act as a localised sink.

HydroSimulations has also conducted additional analysis to examine the effects of increased recharge (5% of average rainfall on the waste emplacement compared to 1% assumed for the base case modelling). The results for both scenarios show that after 100 years of recovery the final void would behave as a strong sink (Figures 8a and 8b).

Any post-mining drawdown associated with the Project final void would be suitably licensed. While Figure 50 of HydroSimulations (2018) shows cumulative water table drawdowns in the porous rock reaching the trace of the Mooki Thrust fault, through comparison of the cumulative versus Project-only drawdowns, it is clear these drawdowns are due to the modelling of the Rocglen Coal Mine pit, not the Project.

Whitehaven commits to holding sufficient water licences to account for any post-mining take.

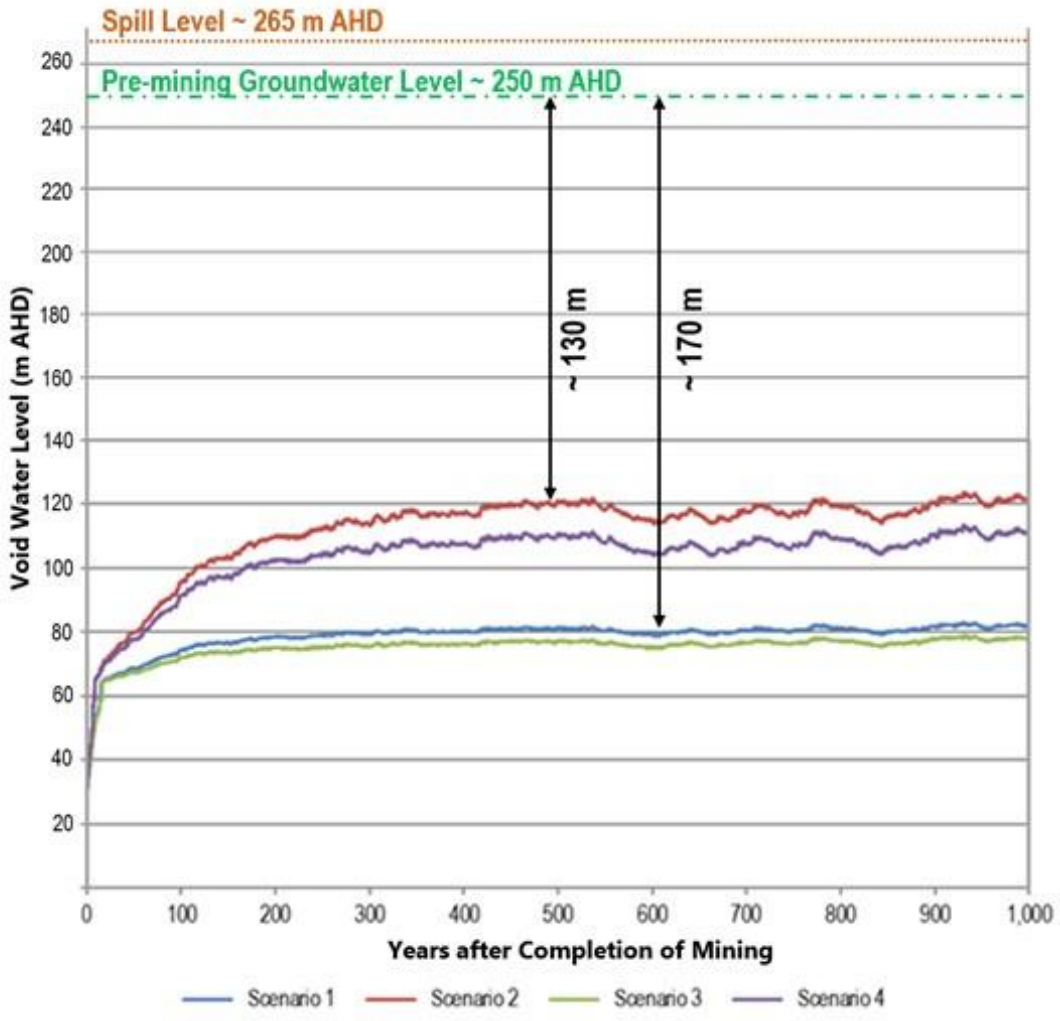


Plate 1: Modelled Final Void Water Levels for Different Climate Scenarios (After Advisian, 2018)

Consideration of Density-driven Plumes

Density-driven flow can occur where there is less than approximately 5 m of freeboard between a saline water source and the surrounding groundwater table. As a worst-case scenario, density-driven flow has been observed with up to 9 m freeboard from a final void pit lake with significantly higher salinity than predicted for the Project.

As the Project final void is predicted to have at least 130 m of freeboard between the equilibrium pit lake water level and the pre-mining groundwater table there is considered to be nil risk of density-driven flow from the final void.

It is noted that while the peer reviewer raised density-driven plumes as a final void consideration, it was also acknowledged density-driven may not occur at all (emphasis added):

> *"…If this process results in hyper-saline pit void lakes, there is the potential for density-driven plumes to move away from the lake (McCullough and Schultze, 2015),* ***but that typically takes many hundreds or thousands of years (if at all)****."*

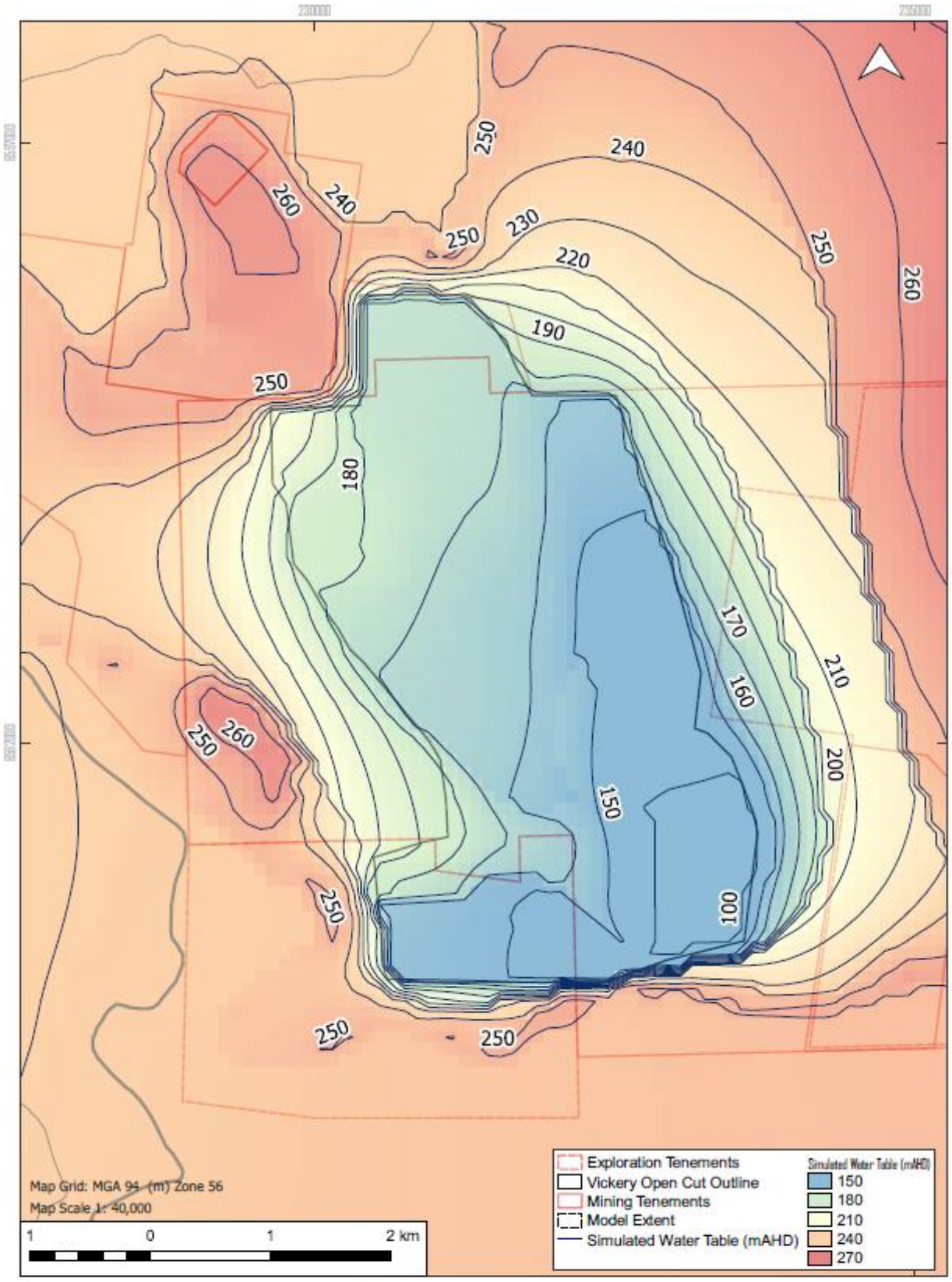


Figure 8a: Simulated Water Table at the End of 100 Years' Recovery (5% Rainfall Recharge of Waste Emplacement) (Source: HydroSimulations)

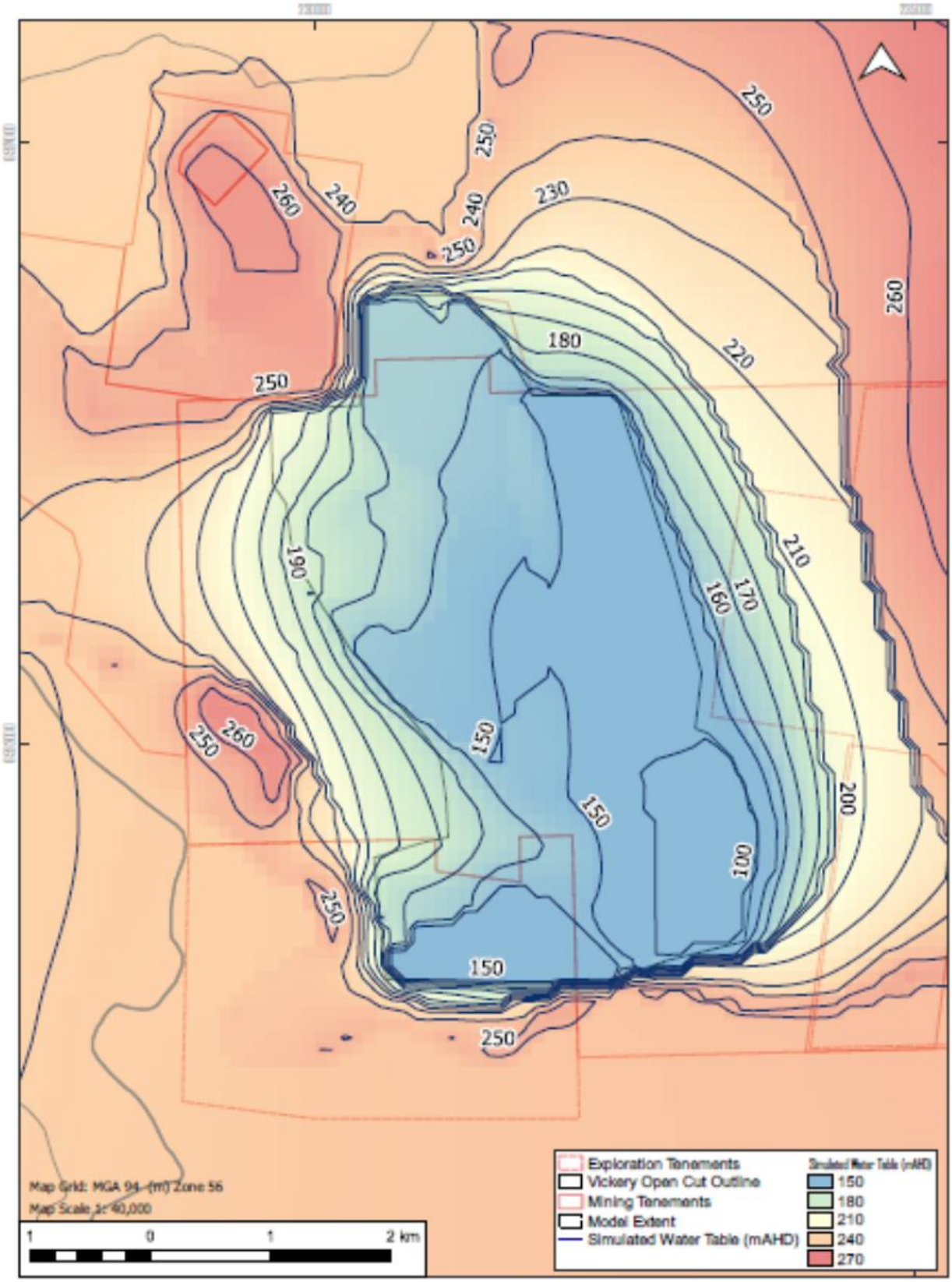


Figure 8b: Simulated Water Table at the End of 100 Years' Recovery (1% Rainfall Recharge of Waste Emplacement) (Source: HydroSimulations)

Further Assessment of the Final Void

Whitehaven commits to the following in regard to the final landform:

- One final void that acts as a groundwater sink (in addition to the existing Blue Vale void which would be retained).
- Conducting ongoing review of the mine plan during operations such that the size of the final void (depth and area) and catchment area reporting to the final void is minimised as far as is reasonable and feasible. In this regard it is noted the Project final void would be an improvement in comparison to the Approved Mine, for which two final voids are approved at the completion of mining (in addition to the existing Blue Vale void).

Considering the above, further assessment of alternate final landforms or justification for the final void is not considered to be necessary given:

- The Project final landform is an improvement compared to the Approved Mine.
- The Project final void would comply with the requirements of the Approved Mine Development Consent with respect to remaining a groundwater sink.
- The cost of completely backfilling the final void is considered to be prohibitive for the Project.
- The cost of partially backfilling the final void is also cost-prohibitive, and would still result in a depression in the landscape but without the environmental benefit of the void acting as groundwater sink. Under a partial backfill scenario lower quality groundwater could migrate out of the void to the surrounding groundwater system, whereas this cannot occur where the final void acts as a groundwater sink.

To protect groundwater quality post-mining, Whitehaven commits to the following in regard to the final landform:

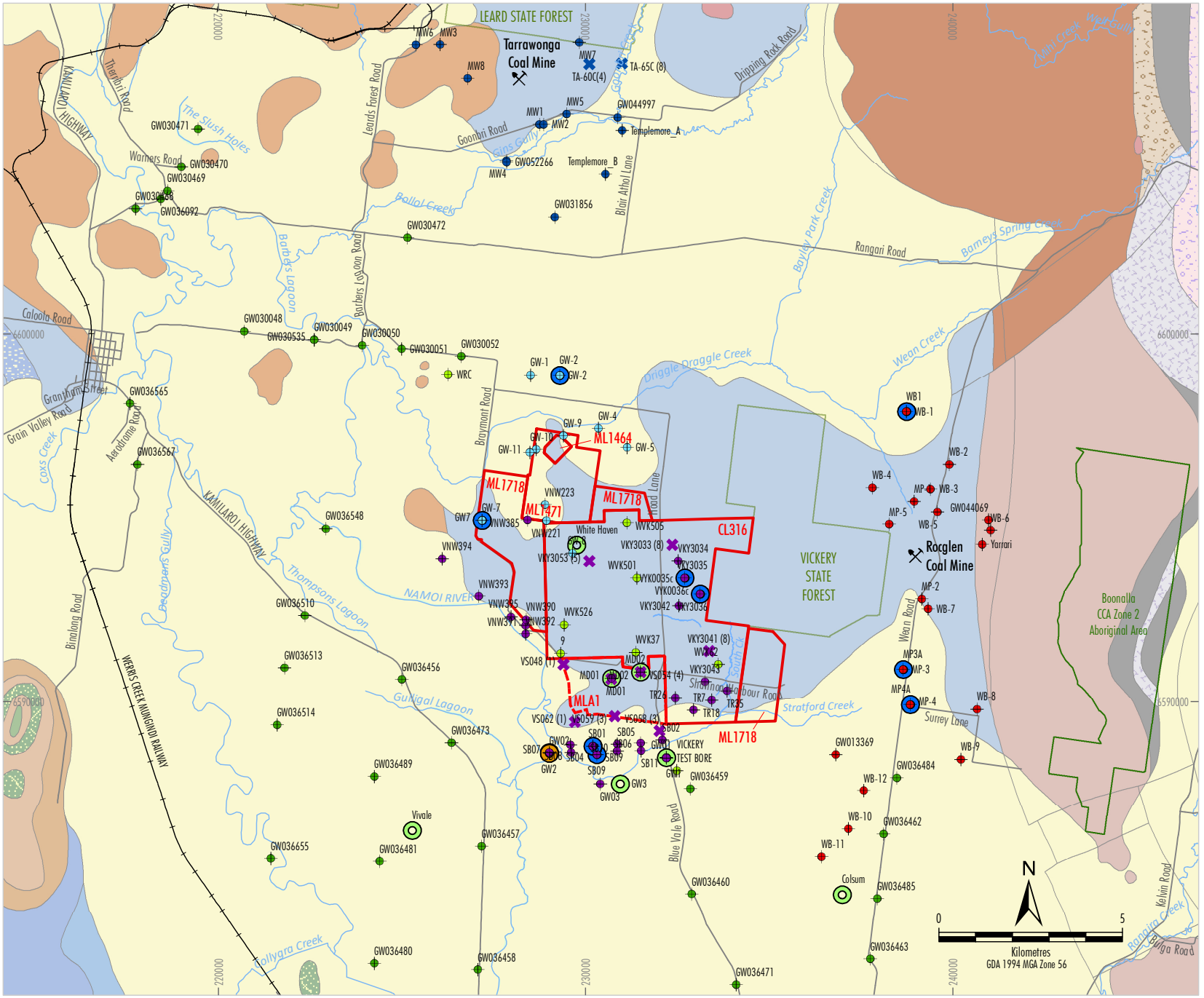
- **One final void that acts as a permanent groundwater sink (in addition to the existing Blue Vale void which would be retained).**
- **Conducting ongoing review of the mine plan during operations such that the size of the final void (depth and area) and catchment area reporting to the final void is minimised as far as is reasonable and feasible.**

  In this regard it is noted the Project final void would be an improvement in comparison to the Approved Mine, for which two final voids are approved at the completion of mining (in addition to the existing Blue Vale void).

5. Proposed groundwater monitoring and management measures

A Water Management Plan would be developed for the Project in consideration of the requirements of any relevant Development Consent conditions for the Project.

The existing groundwater monitoring network (Figure 9) would be reviewed as part of preparation of the Water Management Plan with consolidation of the network as required.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- State Forest
- State Conservation Area, Aboriginal Area
- Vickery Standpipe
- Vickery VWP
- Stygofauna Sampling Location (2012)
- Stygofauna Sampling Location (2012 and 2016)
- Stygofauna Sampling Location (2016)
- Canyon Standpipe
- Rocglen Standpipe
- Tarrawonga Standpipe
- Tarrawonga Vibrating Wire Piezometer
- Namoi Valley Project Standpipe
- DPI Water Standpipe

Source: Department of Industry (2015); DPI - Gunnedah Coalfield South (2013)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Groundwater Monitoring Locations

Figure 9

WHC-15-33_RTS 207A

Should monitoring or an investigation show greater than 2 m drawdown at a privately-owned bore, and the drawdown is attributable to the Project, 'make good' provisions for the affected groundwater user would be implemented in accordance with the AIP, and may include:

- deepening the affected groundwater bore;
- construction of a new groundwater bore; and/or
- provision of an alternative water supply of appropriate quality and quantity.

Due to the open cut acting as a localised groundwater sink, no significant adverse impacts to groundwater quality are predicted for the Project. Notwithstanding, groundwater quality management measures would be detailed in the Water Management Plan.

6.3 SURFACE WATER

6.3.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to surface water included:

- proximity of the Project to the Namoi River and associated potential for water quality impacts;
- impacts to the existing surface water flow regime as a result of the Blue Vale Road realignment (particularly South Creek);
- design criteria for sediment dam overflow and predicted frequency of discharge; and
- wastewater management.

Agency Submissions

Agencies and local councils that provided comments on the Project relevant to surface water included EPA, DI Crown Lands & Water, NSW Health, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- potential water quality impacts from sediment dam discharges;
- assessment of worst-case climatic conditions;
- reuse of mine water;
- permeability of mine water storages;
- long-term salinity build up within the final void pit lake;
- assessment of the diversion of South Creek;
- confirmation of ability to achieve vegetated buffer requirements for South Creek and Stratford Creek, as well as volume of flow reduction;
- acid mine drainage;
- proposed surface water quality monitoring program (incorporating site-specific triggers); and
- implementation of a Water Management Plan.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

As part of DPIE's Preliminary Issues Report, an Independent Expert (Martin Giles of BMT) was engaged to peer review key aspects of the Project Surface Water Assessment. DPIE's Independent Expert requested the following additional information:

- existing water quality for a wider range of analytes; and
- potential for discharge from sediment dams and the final void to adversely impact local water quality.

It is noted DPIE's Independent Expert also stated:

> *The review determined that the parameters and methodology adopted for the modelling of surface water are appropriate. The results obtained from the modelling can be used to consider the water balance of the mine and the likelihood of discharges occurring from the mine to receiving downstream watercourses.*

Independent Planning Commission Issues Report

Regarding surface water, paragraph 139 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraphs 131 to 138, and the Additional Material now available, the Commission considers that the Department should give detailed consideration to:*
>
> - *how the Applicant proposes to ensure that the walls of sedimentation dams and other site water storages are constructed to the appropriate standard of impermeability;*
> - *the commitment of the Applicant to an appropriate water quality monitoring program for water contained in sediment basins and other mine storages. Detail of any such program should include whether it includes a full range of analytes, including those outlined in paragraph 137, that will aid in its meeting discharge standards consistently with the quality of target watercourses and, by pre-commencement monitoring, sets up appropriate trigger values for acceptable discharge;*

Paragraph 137 of the IPC's Issues Report states:

> *The Commission considers that the monitoring of groundwater analytes provided by the Applicant at the supplementary meeting, held 25 February 2019, is likely to be adequate for the Department's purposes.*

6.3.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Accuracy of surface water modelling and predictions.
    a. Baseline water quality assessment.
    b. Clarification of worst-case climatic conditions.
    c. Potential for contamination of surface water from acid mine drainage.
2. Dam design and performance.
    a. Justification of sediment dam design criteria.
    b. Frequency of controlled releases and overflows from sediment dams.
    c. Permeability of mine water storages.
    d. Potential impacts to downstream water quality.
3. Surface water flow regime – South Creek and Stratford Creek.
    a. Clarification of proposed diversions and vegetated buffer requirements.
    b. Confirmation of volume of flow reduction.
4. Proposed surface water monitoring and management measures.

The responses in the section are related to surface water quality predictions and water management. Responses related to the site water balance, flooding and groundwater (including the final void) are provided in Sections 6.5, 6.4 and 6.2 respectively.

6.3.3 Responses

1. Accuracy of surface water modelling and predictions

a. Baseline water quality assessment

Baseline surface water quality data considered for the Project Surface Water Assessment (Advisian, 2018) was drawn from the following sources:

- database records for regional monitoring sites operated by the DI Crown Lands and Water;
- monitoring conducted by Whitehaven in the vicinity of the Project for the Approved Mine and the Project;
- monitoring of mine water dams, sediment dams and final void water bodies at Whitehaven's existing mining operations and other mining operations in the region; and
- water quality data included in the Approved Mien EIS (Vickery Joint Venture, 1986) for the original Vickery Coal Mine.

The key water course relevant to the Project is the Namoi River. Baseline water quality data for the Namoi River (Section 6.1 of the Project Surface Water Assessment [Advisian, 2018]) has been included from the Gunnedah monitoring site (Station 419001) (data available for the period between 1995 and 2019).

The baseline data indicated existing turbidity and Electrical Conductivity (EC) levels in the Namoi River are elevated relative to Australian and New Zealand Environmental and Conservation Council (ANZECC) default trigger values for aquatic ecosystems.

Other watercourses within and in the vicinity of the Project are ephemeral (Plates 2a and 2b) and are characterised by low or no flow conditions, which limits the ability to collect meaningful water quality data. There have been limited opportunities to collect baseline surface water quality data in local streams due to the prevailing drought conditions that have been experienced in the region.

Notwithstanding, the results of 75 surface water quality samples collected from these ephemeral streams since 2011 were used to inform the Project Surface Water Assessment (Advisian, 2018).

b. Clarification of worst-case climatic conditions

The site water modelling is based on 124 years of daily rainfall records, and as such, considers the full range of climatic conditions (i.e. rainfall and evaporation) that have been experienced over this period. The records include the Federation drought and significant droughts in 1935 to 1948, 1979 to 1983 and 1992 to 1996.

If the worst-case climatic condition is considered to be the lowest rainfall conditions ("dry conditions"), there would be no discharge from the site as water collected on-site would be used to meet water demands.

Plate 2a North-west Drainage Line

Plate 2b South Creek

WHC-15-33_RTS_006A

Source: Advisian (2018)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Example of Ephemeral Watercourses
Within the Vicinity of the Project

Plate 2a and 2b

If the worst-case climatic condition is considered to be the highest rainfall conditions ("wet conditions"), then during these times there would be high dilution in the receiving environment of any water released via sediment dam overflows. No releases of mine water or coal contact water are predicted based on the worst-case climate sequence modelled.

c. Potential for contamination of surface water from acid mine drainage

Coal rejects material is typically expected to be non-to-slightly saline and non-acid forming. Any potentially acid forming coal rejects are predicted to only have a low capacity to generate acid (Section 2.9.2 of the EIS). The majority of the overburden and interburden generated from the Project would generally be expected to have a low sulfur content and be non-acid forming with a low salinity risk (Section 2.8.3 of the EIS).

Dewatered coal rejects would be co-disposed with waste rock. No reject material would be placed within 30 m of the edge of the western emplacement and reject material would be covered with at least 5 m of inert material on the outer surfaces of the waste rock emplacement (Section 2.9.3 of the EIS). Dewatered coal reject material would be co-disposed in locations such that infiltration and runoff would report to the mine water system (Appendix B of the EIS).

3. Dam design and performance

a. Justification of sediment dam design criteria

The Project has been designed as a nil discharge mine water site. That is, no mine water or 'coal contact water' will be discharged from the site (Section 10.2 of Appendix C of the EIS).

Consistent with the SEARs for the Project (including EPA's input to the SEARs), sediment dams capturing potentially sediment laden water, but not mine or coal contact water, have been designed according to standard practice detailed in the publication titled *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004).

The Project sediment dams have been designed to avoid the need for discharge, however in keeping with the design principles outlined by Landcom (2004), could result in a release in certain weather conditions, corresponding to 38.4 millimetres (mm) of rainfall over 5 consecutive days.

Advisian (2018) concluded that the frequency of discharges from Project sediment dams would be less than that prescribed in Landcom (2004). This is because:

- the sediment dams are inherently over-designed at the start of the Project to account for the maximum reporting catchment area over the Project life; and
- water captured in sediment dams would be preferentially used to meet on site water demands to reduce the reliance on water from external sources which would reduce the likelihood of overflow as well as reliance on water from external sources, such as the Namoi River or groundwater bores.

b. Frequency of controlled releases and overflows from sediment dams

In the event of a rainfall event that exceeds the Landcom (2004) sediment dam design criteria (38.4 mm over 5 days) releases from sediment dams could occur via:

- Controlled releases.
  - Controlled releases are required to restore the capacity of the sediment dam within 5 days of a rainfall event that exceeds the design criteria (i.e. to provide capacity to capture runoff during subsequent rainfall events).
  - Prior to controlled release, water in the sediment dam would be sampled and analysed to confirm its suitability for discharge in accordance with Environment Protection Licence (EPL) requirements, including demonstrating a total suspended solids (TSS) concentration of less than 50 milligrams per litre (mg/L), consistent with the TSS limit in contemporary EPLs. Various treatment methods (e.g. flocculation) are available to reduce TSS concentrations, if required, to meet the limit of 50 mg/L prior to release.
- Overflows.
  - Overflows occur during rainfall events that exceed the design criteria, via dedicated spillways and in accordance with EPL requirements.

For the median climate sequence, overflows from sediment dams are predicted to occur for a maximum of 12 days over the 26 year life of the Project (i.e. less than 1 day per year).

c. Permeability of mine water storages

Mine water storages would be designed and constructed with permeabilities consistent with relevant guidelines and any Development Consent/EPL conditions. All dams constructed for the Project would be engineered structures and built in accordance with design specifications.

Whitehaven commits to constructing water storages to permeability standards specified in any Development Consent or EPL conditions, with all storages constructed for the Project to be engineered structures built as designed.

d. Potential impacts to downstream water quality

Potential impacts to downstream water quality would be managed by avoiding the release of mine/coal contact water and managing sediment-laden runoff in accordance with Landcom (2004). It is not considered necessary to model the effect of the infrequent overflow events from sediment dams to water quality in the Namoi River, given these events would occur when there would be a significant dilution effect in the receiving environment due to higher creek/river flows. On this basis, potential impacts to surface water quality were assessed by Advisian (2018) to be negligible.

To prevent and minimise the potential for downstream water quality impacts, Whitehaven commits to bunding of infrastructure areas (to avoid flood inundation up to at least the 1% AEP event) and constructing water storages with design capacities in accordance with any Development Consent and EPL conditions and appropriate standards.

DPIE's Independent Peer Reviewer (Martin Giles of BMT) recommended a water quality monitoring program be implemented for the Project sediment dams to confirm potential impact to downstream watercourses. Whitehaven agrees with this recommendation.

Consistent with recommendations of Geo-Environmental Management Pty Ltd (GEM) (2018) and Advisian (2018), Whitehaven commits to monitoring of water quality in sediment dams capturing runoff from the waste emplacement, which would include monitoring of the following parameters: pH, EC, total alkalinity/acidity, sulphate, aluminium, arsenic, molybdenum and selenium (in addition to TSS).

In addition, and consistent with contemporary EPL conditions, the following parameters would be monitored during a controlled discharge from a sediment dam (i.e. when releases to restore the capacity of the dam are required following a rainfall event that exceeds the dam design capacity, and when there is insufficient storage available in other on-site storages): pH, EC, TSS, oil and grease and total organic carbon.

This is consistent with the following comments from the IPC:

> *135.*
> *… in the Commission's view, the Department in its assessment should consider whether it would be appropriate for the Applicant to commit to a water quality monitoring program for water contained in sediment basins and other mine storages that includes a full range of analytes that will aid in its meeting discharge standards …*
>
> *…*
>
> *137.*
> *The Commission considers that the monitoring of groundwater analytes provided by the Applicant at the supplementary meeting* [i.e. those described in the above]*, held 25 February 2019, is likely to be adequate for the Department's purposes.*

Whitehaven commits to monitoring of water quality in sediment dams capturing runoff from the waste emplacement, which would include monitoring of the following parameters: pH, EC, total alkalinity/acidity, sulphate, aluminium, arsenic, molybdenum and selenium (in addition to total suspended solids [TSS]). The suite of parameters would be reviewed after a period of two years and adjusted according to the variability detected.

In addition, and consistent with contemporary EPL conditions, the following parameters would be monitored during a controlled discharge from a sediment dam (i.e. when releases to restore the capacity of the dam are required following a rainfall event that exceeds the dam design capacity, and when there is insufficient storage available in other on-site storages): pH, EC, TSS, oil and grease and total organic carbon.

In addition, Whitehaven agrees with the EPA's comment that trigger values can be developed based on ANZECC and/or site specific measurements both upstream and downstream of the Project, to confirm negligible impacts to water quality from the Project. These triggers will be described in a Water Management Plan to be developed for the Project.

Whitehaven commits to ongoing monitoring in the receiving environment to establish water quality trigger levels in accordance with ANZECC, which would be described in any Water Management Plan for the Project.

It was also recommended by the peer reviewer that the design capacity of the sediment dams be increased beyond standard practice (i.e. Landcom [2004]), to further reduce the frequency of controlled discharges and overflows. This (oversizing sediment dams) is consistent with the design principles for sediment dams for the Project (refer to the discussion above in regard to oversizing of sediment dams and Advisian [2018] which describes oversizing the capacity of sediment dams by 20%).

4. Surface water flow regime – South Creek and Stratford Creek.

a. Clarification of proposed diversions and vegetated buffer requirements

There is no proposal (or requirement) for a diversion of South Creek for the Project (or for the Approved Mine).

The secondary infrastructure area (previously the eastern emplacement for the Approved Mine) and flood protection bunds have been designed to avoid South Creek and Stratford Creek, including a 40 m vegetation buffer to minimise impacts to flooding (see Figure 11 from the Approved Mine Surface Water Assessment, provided below as Figure 10).

Consistent with Condition 29 of Schedule 3 of the Approved Mine Development Consent (SSD 5000), surface water diversions will be designed in accordance with the following performance measures:

- *Design, install and maintain the clean water system to capture and convey the 100 year ARI flood*
- *Maximise as far as reasonable and feasible the diversion of clean water around disturbed areas on-site*

b. Confirmation of volume of flow reduction.

The catchment of Stratford Creek would reduce over the life of the Project by a maximum of 2%, which can be attributed to internal drainage in the final void catchment (Section 9.2 of Appendix B of the EIS).

The Driggle Draggle Creek catchment would reduce over the life of the Project by a maximum of 3.4% which can be attributed to a decrease in the catchment due to the proposed final landform.

The South Creek catchment will not change significantly (less than 2%) as a result of the Project.

5. Proposed surface water monitoring and management measures.

The Project surface water management and monitoring program will be developed to validate and verify the EIS predictions.

Leading up to commissioning, surface water monitoring will be undertaken at points upstream and downstream on watercourses closest to the Project mining area (monitoring locations would be selected during development of the Water Management Plan).

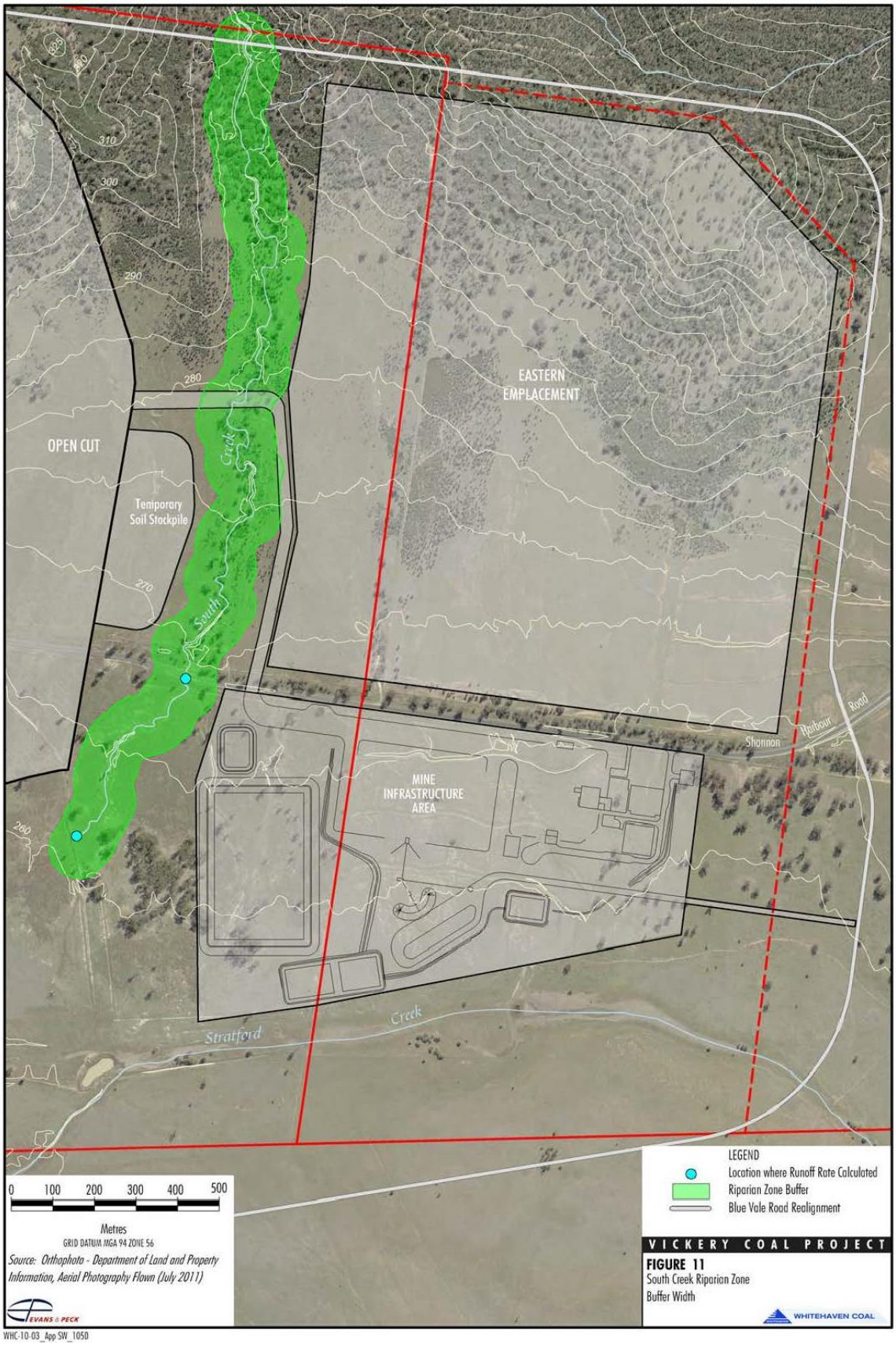


Figure 10: South Creek Riparian Zone Buffer Width

Consistent with the recommendations of Advisian (2018) and GEM (2018), surface water monitoring will be undertaken at points upstream and downstream on watercourses closest to the Project mining area (monitoring locations would be selected during development of the Water Management Plan) as follows:

- Water quality monitoring of sediment dams would include analysis of pH, TSS, EC, total alkalinity/acidity, sulphate, aluminium, arsenic, molybdenum and selenium. After a two-year monitoring period the parameters being monitored would be reviewed.
- Water quality monitoring during a controlled discharge would be conducted in accordance with an EPL for the Project and would include analysis of EC, TSS, pH, oil and grease and total organic carbon.
- Water quality monitoring at selected locations along the ephemeral creeks surrounding the Project (on an opportunistic basis) would include EC, TDS, TSS, turbidity, pH, oil and grease and total organic carbon.

Sewage and wastewater from on-site ablution facilities would be collected and treated in a biocycle sewage treatment system and serviced by a licensed waste disposal contractor on an as-needed basis. Treated effluent would be irrigated at a small wastewater disposal area in accordance with the Environmental Guidelines: Use of Effluent by Irrigation (NSW Department of Environment and Conservation, 2004) (Section 2.13 of the EIS).

The monitoring and management measures above would be described in the Water Management plan for the Project.

6.4 FLOODING

6.4.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to flooding included:

- detailed rail spur design not provided in the EIS;
- justification of proposed rail spur alignment;
- suitability of use of the *Draft Floodplain Management Plan for the Upper Namoi Valley Floodplain 2016* (Draft FMP) criteria;
- assessment of coincident flooding of Namoi River and tributaries;
- potential for flooding of the Project mining area;
- accuracy of predicted flood impacts at privately-owned dwellings and properties;
- potential impacts of the Rail Spur on aquifer recharge and increased erosion potential; and
- assessment of 'extreme' rainfall events.

Agency Submissions

Agencies and local councils that provided comments on the Project relevant to flooding included OEH, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- clarification of impact to flow distribution for the 1% Average Exceedance Probability (AEP) event;
- clarification of cumulative impact assessment;
- potential erosion impacts where there is a measurable increase in velocity;
- impacts of flooding on access to privately-owned residences;
- provision of updated modelling following detailed rail spur design (i.e. post-determination); and
- construction of the Blue Vale Road realignment above the 1% AEP flood level.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

As part of DPIE's Preliminary Issues Report, an Independent Expert (Erin Askew of WMA Water) was engaged to peer review key aspects of the Project Flooding Assessment. DPIE's Independent Expert requested further information to clarify:

- structure of the rail spur; and
- justification of consistency with the Draft FMP criteria.

It is noted DPIE's Independent Expert also stated:

> *Following review of the Flood Assessment and that review being supplemented with discussions with the proponent's flood assessment specialist (WRM), it has been determined that the assessment generally appears to be undertaken in accordance with industry best practice.*

Independent Planning Commission Issues Report

Regarding flooding, paragraph 139 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraphs 131 to 138, and the Additional Material now available, the Commission considers that the Department should give detailed consideration to:*
>
> …
>
> - *whether the flood study could be performed for the Namoi, Stratford and South Creeks alone, and also for the combination of them occurring simultaneously unless the Applicant can show that the extreme floods on the smaller tributaries are not embedded in the storms that cause the larger floods in the Namoi;*
> - *whether this flood study could also be carried out for any alternative infrastructure options suggested elsewhere in this report (e.g. CHPP in the SE corner, and any other location option investigated);*
> - *whether the flood studies around the rail loader, final void, and CHPP which were done using an empirical factor for the probable maximum flood (PMF) estimating the PMF discharge to be 3 x the 1% AEP flood could instead be done using either:*
>   - *the GSDM method for PMF estimation developed by the Bureau of Meteorology; or*
>   - *the PMF methodology recommended in Australian Rainfall and Runoff; and*
> - *whether a QRA of the off-site water quality consequences of flood exceedances of the on-site infrastructure (i.e. dams, stockpiles, CHPP) could be carried out.*

6.4.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Justification of the Project rail spur design.
2. Accuracy of flood modelling and predictions.
   a. Justification of the application of Draft FMP assessment criteria.
   b. Justification of 'extreme' flood event assessment.
   c. Justification of flood model extent.
   d. Clarification of change in flow distribution for the 1% AEP event.
   e. Clarification of cumulative flooding assessment.
   f. Clarification of potential erosion impacts.
   g. Clarification of predictions at privately-owned residences and properties.
3. Design flood immunity of Blue Vale Road realignment.

4. Clarification of flooding impacts in the Project mining area.
5. Coincident flooding of Namoi River and tributaries.
6. Justification of Probable Maximum Flood assessment methodology.

This section provides responses to issues relating to flood modelling and impacts. Responses relating to potential downstream water quality impacts resulting from sediment dams and mine water dams are provided in Section 6.3.3. Responses relating to Project alternative infrastructure locations suggested by IPC are provided in Section 6.8.

6.4.3 Responses

1. Justification of rail spur design

The objective of the flood modelling included in the EIS was to demonstrate that the proposed location of the Project rail spur would comply with the design objectives of the Draft FMP and the *Carroll to Boggabri Floodplain Management Plan 2006* (Department of Natural Resources, 2006), which includes impacts to flood levels, velocities and distributions on privately-owned land.

Since lodgement of the Project EIS, the Draft FMP has been finalised (i.e. *Floodplain Management Plan for the Upper Namoi Valley Floodplain 2019* [FMP]). Updates incorporated in the FMP do not affect the outcomes of the Project rail spur flooding impact assessment (i.e. hydraulic assessment criteria remain the same).

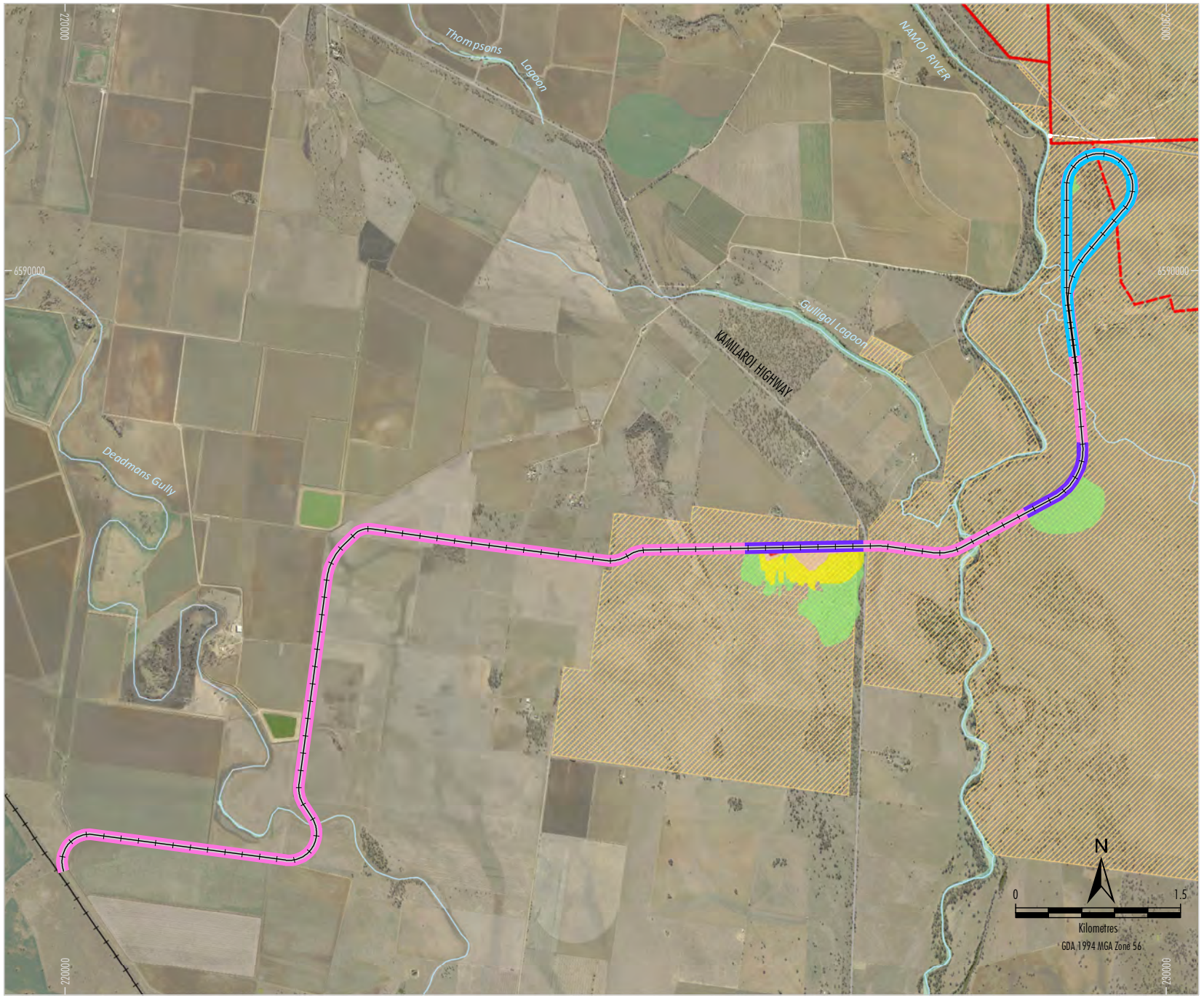
Initial conceptual design decisions involved elevating the Project rail spur above predicted flood levels (i.e. a superstructure supported on either pylon-like structures or in-filled embankment sections) and conceptually locating openings to provide for minimal impact to existing flooding regimes. Proceeding with a conceptual design involved an iterative approach during flood modelling, whereby the distribution of openings under the superstructure of the Project rail spur was adjusted to achieve consistency with the Draft FMP (Figure 11).

The Project rail spur construction materials would be determined during detailed design. Notwithstanding, as the superstructure is elevated clear of predicted flood levels, the ultimate composition of the Project rail spur does not impact on the flood assessment.

The flood modelling objective was achieved as the conceptual design modelled for the EIS, incorporating the design aspects outlined above, demonstrated compliance with the objectives of the Draft FMP and negligible changes to flood levels, velocities and distributions on privately-owned land.

Subsequently, further design development of the conceptual rail spur alignment and consideration of constructability issues following submission of the Project EIS determined that the Project rail spur would be completely elevated on pylon-like structures west of the Namoi River. At the point where the elevated rail spur joins the Main Line embankment there will be a short transition zone. The superstructure of the rail spur would be elevated above the 1 in 100 year flood level. An example of such an elevated structure is the existing Maules Creek and Boggabri Coal Mine Rail Spur where it crosses the Namoi River floodplain (refer Plates 3a and 3b, below) although the Vickery superstructure will generally be at a lower elevation.

Conceptual 3D drawings of the Project rail spur are provided in Plates 4 to 6. The conceptual drawings are consistent with the revised conceptual design (i.e. completely elevated west of the Namoi River).



LEGEND

- Mining Lease Application (MLA)
- Mining Tenement Boundary (ML and CL)
- Whitehaven-owned Land
- Indicative Rail Spur Alignment

Predicted Change in Water Level
Due to the Project Rail Spur (1% AEP Flood Event)

- 5cm < dWL < 10cm
- 10cm < dWL < 15cm
- 15cm < dWL < 20cm
- 20cm < dWL < 30cm

Project Rail Spur Conceptual Design

- Embankment
- Embankment/Culvert
- Elevated Structure

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); WRM Water and Environment (2019)

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VICKERY EXTENSION PROJECT

Conceptual Project Rail Spur Design (Presented in the EIS) Predicted Flooding Impacts (1 % AEP)

Figure 11

WHC-15-33_RTS 208A

Plate 3a Maules Creek and Boggabri Coal Mine Rail Spur

Plate 3b Maules Creek and Boggabri Coal Mine Rail Spur

Source: Whitehaven (2019)

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VICKERY EXTENSION PROJECT

Maules Creek and Boggabri Coal Mine
Rail Spur

Plate 3a and 3b

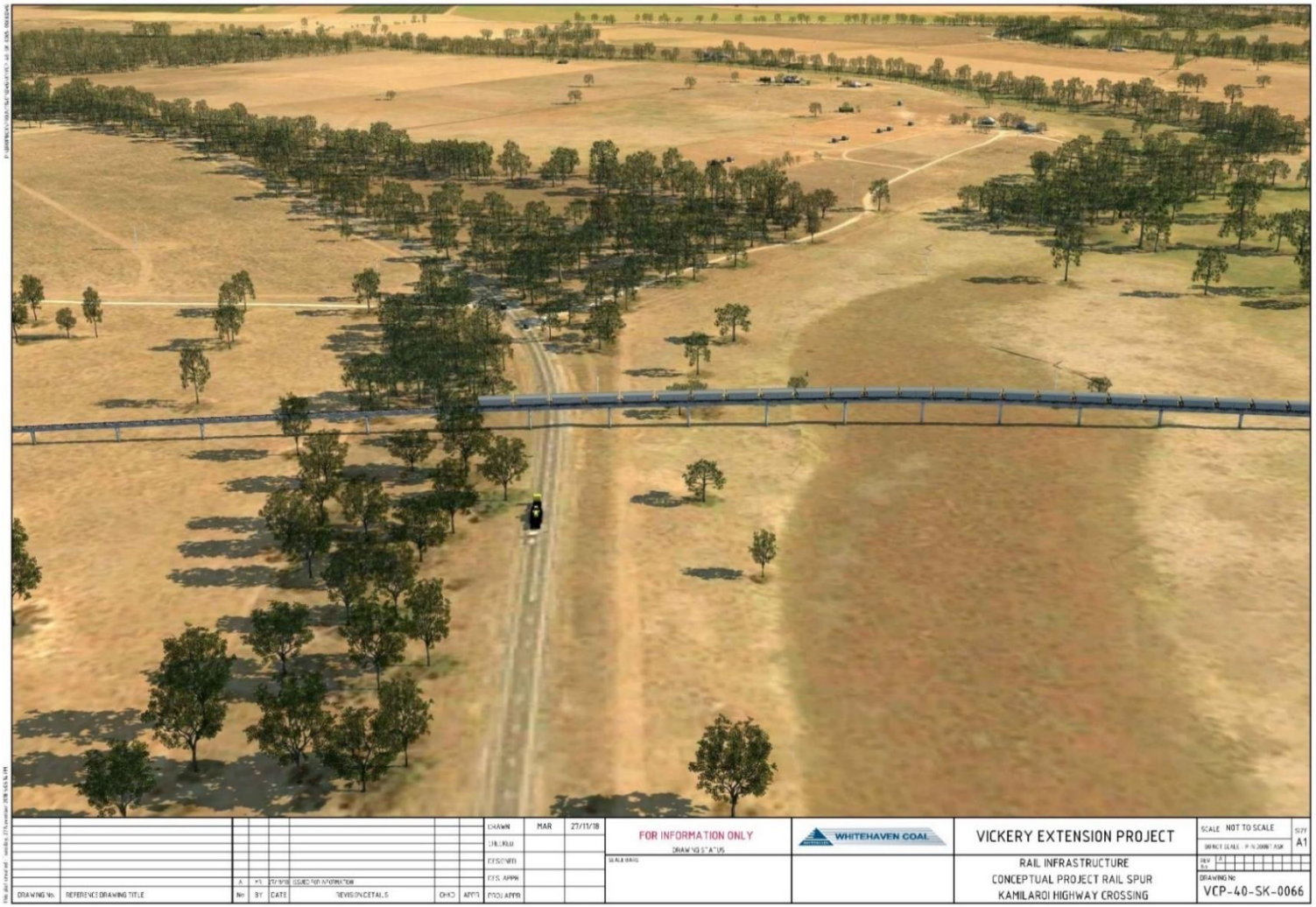


Plate 4: Conceptual Project Rail Spur Crossing of the Kamilaroi Highway (Source: Whitehaven)

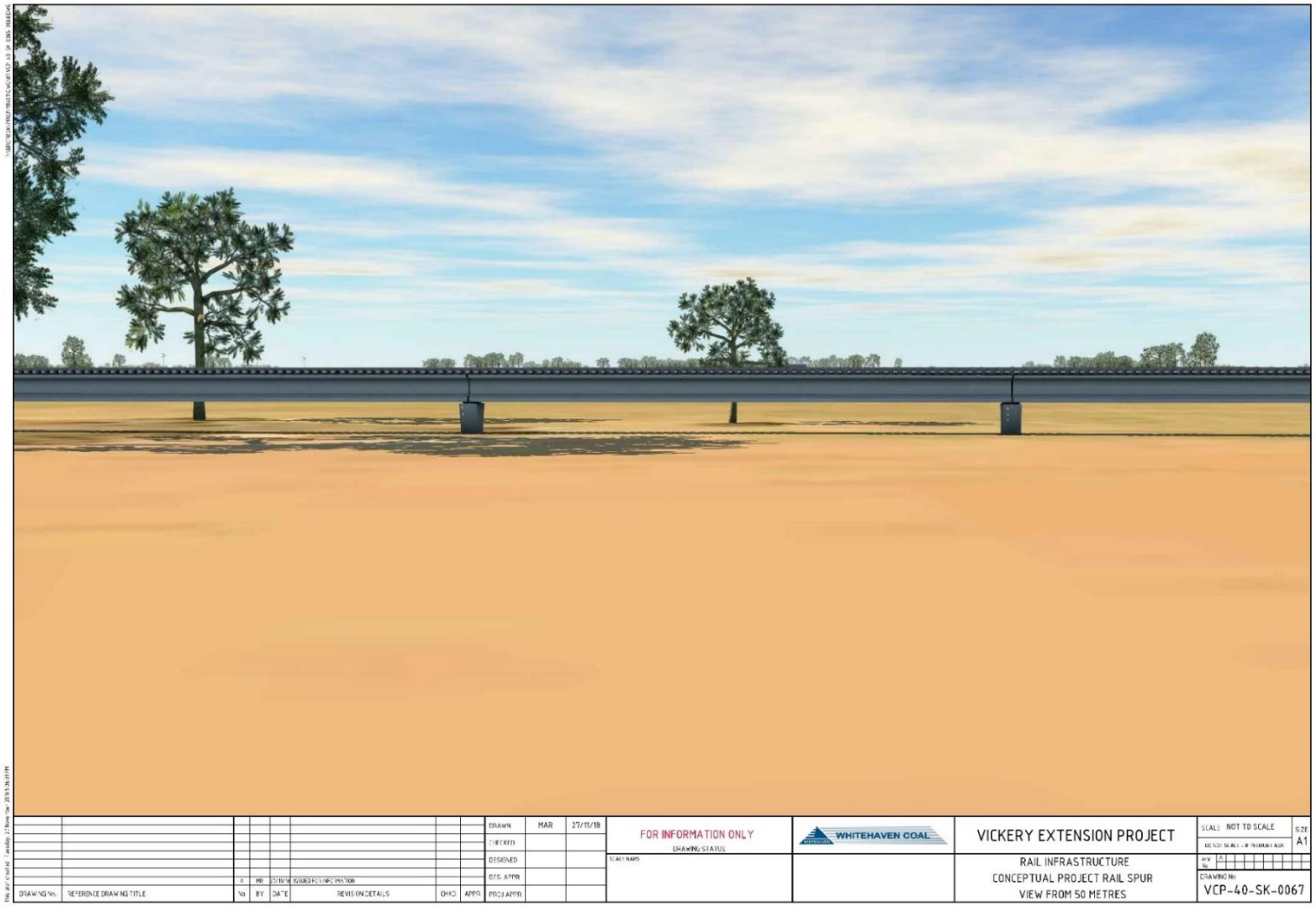


Plate 5: Indicative Conceptual View of Project Rail Spur at a Distance of Approximately 50 m (Source: Whitehaven)

Plate 6: Indicative Conceptual View of Project Rail Spur at a distance of Approximately 500 m (Source: Whitehaven)

It is noted the objectives of the FMP relevant to privately-owned land are for "large design floods", which approximate the 1 in 20 year (i.e. 5% AEP) flood event. Therefore, the Project rail spur conceptual design, which includes provision to elevate the superstructure above the 1 in 100 year (i.e. 1% AEP) flood level, is considered to be conservative and prevents impacts for flood events well above what is required by the FMP.

WRM has remodelled the Project rail spur to reflect that it will be completely elevated west of the Namoi River (Figure 12), with associated flood impact reduced in comparison to the presented in the EIS (Figure 11).

Consistent with industry best practice, following determination of the Project, Whitehaven will engage suitably qualified and experienced infrastructure design and construction contractors to identify the most appropriate design of the Project rail spur, taking into consideration structural adequacy, cost efficiency and potential flood impacts. Whitehaven will provide DPIE and OEH with the final detailed rail spur design and updated flood assessment results to confirm compliance with the objectives of the FMP.

It is standard practice for Project infrastructure to be conditioned such that detailed design (conducted post approval) confirms that the infrastructure will achieve the predicted outcomes and/or performance measures identified during the assessment phase.

For example, regarding the approved Kamilaroi Highway Overpass, Condition 26 of the Approved Mine Development Consent (SSD-5000) provides:

> *The Applicant must obtain an approval under Part 8 of the Water Act 1912 for all applicable works associated with the Kamilaroi Highway overpass. The Applicant shall ensure that the design and construction of the Kamilaroi Highway overpass is consistent with the Boggabri to Carroll Flood Plain Management Plan, to the satisfaction of NOW.*

2. Accuracy of flood modelling and predictions

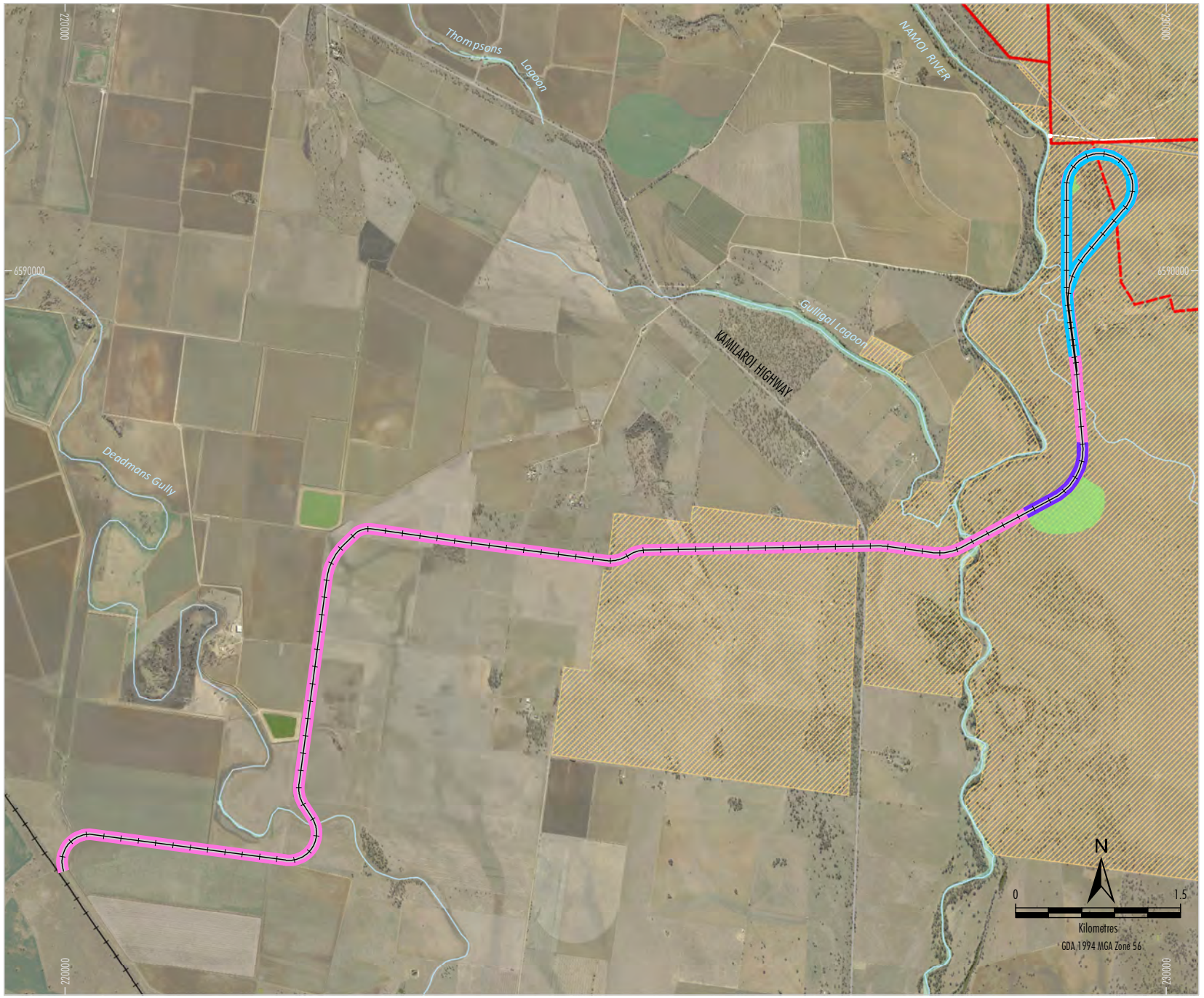
a. Justification of application of Draft FMP assessment criteria

Rural floodplain management is currently in transition from rural floodplain management planning under Part 8 of the *Water Act, 1912* to the *Water Management Act, 2000*.

The *Carroll to Boggabri Floodplain Management Plan* was prepared under the *Water Act, 1912* using the *Floodplain Development Manual* (NSW Government, 2005). OEH and DPI Water (now DI Water) have developed a Draft FMP pursuant to section 50 of the *Water Management Act, 2000*.

Therefore, the management rules given in the Draft FMP have been used as the basis for assessing the infrastructure proposed as part of the Project.

Since lodgement of the Project EIS, the Draft FMP has been finalised (the FMP). Updates incorporated in the FMP do not affect the outcomes of the Project rail spur flooding impact assessment (i.e. hydraulic assessment criteria remain the same).



LEGEND

- Mining Lease Application (MLA)
- Mining Tenement Boundary (ML and CL)
- Whitehaven-owned Land
- Indicative Rail Spur Alignment

Predicted Change in Water Level
Due to the Project Rail Spur (1% AEP Flood Event)

- 5cm < dWL < 10cm
- 10cm < dWL < 15cm
- 15cm < dWL < 20cm
- 20cm < dWL < 30cm

Project Rail Spur Conceptual Design

- Embankment
- Embankment/Culvert
- Elevated Structure

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); WRM Water and Environment (2019)

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VICKERY EXTENSION PROJECT

Revised Conceptual Project Rail Spur Design
Predicted Flooding Impacts (1% AEP)

Figure 12

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b. Justification of 'extreme' flood event assessment

The Secretary's Environmental Assessment Requirements (SEARs) for the Project required that flood modelling be conducted for the 20% AEP, 5% AEP and 1% AEP flood events (Attachment 1 of the EIS). An 'extreme' flood event equivalent to three times the 1% AEP flood event (assumed to be the Probable Maximum Flood [PMF] event) was also modelled. Assessment of an 'extreme' flood event of a magnitude of 0.1% AEP (as suggested in some public submissions) is not considered to be warranted because the Project mining area is not predicted to be inundated by the 'extreme' flood event (i.e. three times 1% AEP).

Consistent with the rainfall predictions in the Surface Water Assessment (Appendix B of the EIS), the magnitude of any changes in rainfall intensities due to climate change over the Project life (25 years) are not expected to significantly change the 1% AEP and PMF events that have been assessed and therefore the predicted changes in flood levels and velocities due to the Project would not be significantly affected.

Comparison of the differences in flood levels for the 5% and 1% AEP flood events is less than 0.5 m in the Namoi River itself, and accordingly, any minor change in peak discharge above the 1% AEP design event due to climate change over the 25-year Project life would not materially change the modelled 1% AEP flood levels. During detailed design, freeboard considerations for the Project rail spur above the 1% AEP flood level would be sufficient to account for any changes in peak discharge due to climate change.

c. Justification of flood model extent

The flood model extent was designed to assess the relevant aspects of the Project to flooding, in particular:

- the potential impacts of Project infrastructure to flood levels, velocities and distribution; and
- the immunity of the Project from flooding events.

The key flood regime relevant to the Project is the Namoi River, given the Project rail spur crosses the Namoi River floodplain and the model has been developed based on data available to define the Namoi River flood characteristics. The model also considers local creeks such as Collygra Creek, Deadmans Gully, Stratford Creek, South Creek, Driggle Draggle Creek and Bollol Creek.

The flood regime of other watercourses significantly upstream or downstream of the Project, which are tributaries of the Namoi River, does not require specific consideration as they are not directly relevant to the Project and their contributions to Namoi River flooding are accounted for in the data for the Namoi River.

d. Clarification of change in flow distribution for the 1% AEP event

The impact of the Project rail spur on peak flow distribution for the 5% Annual Exceedance Probability (AEP) flood event was assessed in the Flood Assessment (Section 6.4.3 of Appendix C of the EIS). The peak flow distribution impacts for the 5% AEP flood event and the 1% AEP flood event are detailed in Tables 5a and 5b, respectively (see below). The location of each Peak Flow ID is shown on Figure 6.1 of Appendix C of the EIS, reproduced below as Figure 13.

The results show that the distribution of flow across the floodplain is not significantly altered by the Project rail spur for both events and would not result in a consequential effect to neighbouring properties or the environment.

Table 5a
Peak Flow Distribution Impacts for 5% AEP Flood Event

Flow ID	Existing	Proposed	Difference (%)
PA	185.5	185.4	0.0%
PA1	169.6	169.6	0.0%
PA2	159.7	159.8	0.0%
PA3	133.0	132.9	-0.1%
PA4	18.0	18.0	-0.2%
DMG	22.1	22.2	0.2%
DMG1	17.1	17.1	-0.2%
DMG2	12.2	12.1	-0.2%
DMG3	22.4	22.0	-1.8%
DMG4	73.0	73.0	-0.1%
GL	667.9	666.0	-0.3%
GL1	528.9	527.0	-0.4%
GL2	582.8	581.1	-0.3%
GL3	855.1	851.8	-0.4%
NR	1724.8	1718.8	-0.4%
NR1	1858.9	1853.0	-0.3%
NR2	1781.0	1774.4	-0.4%
NR3	1462.2	1458.8	-0.2%
NR4	1033.3	1030.6	-0.3%
NRB4	1236.0	1229.7	-0.5%
CoxsCk US	54.1	54.9	1.4%
Namoi DS	2416.4	2404.1	-0.5%

Table 5b
Peak Flow Distribution Impacts for 1% AEP Flood Event

Flow ID	Existing	Proposed	Difference (%)
PA	819.4	818.6	-0.1%
PA1	853.2	852.8	0.0%
PA2	802.5	802.1	-0.1%
PA3	766.7	766.0	-0.1%
PA4	238.3	237.9	-0.2%
DMG	947.4	951.8	0.5%
DMG1	935.6	940.6	0.5%
DMG2	945.1	949.7	0.5%
DMG3	1277.9	1281.3	0.3%
DMG4	1712.5	1712.5	0.0%
GL	2972.0	2979.4	0.2%
GL1	2619.7	2627.6	0.3%
GL2	2654.8	2661.4	0.2%
GL3	2753.6	2752.9	0.0%
NR	3017.9	2998.9	-0.6%
NR1	3325.8	3305.2	-0.6%
NR2	3254.6	3235.8	-0.6%
NR3	2666.1	2657.3	-0.3%
NR4	2290.1	2289.2	0.0%
NRB4	3280.6	3272.2	-0.3%
CoxsCk US	137.8	137.6	-0.2%
Namoi DS	7488.8	7476.4	-0.2%

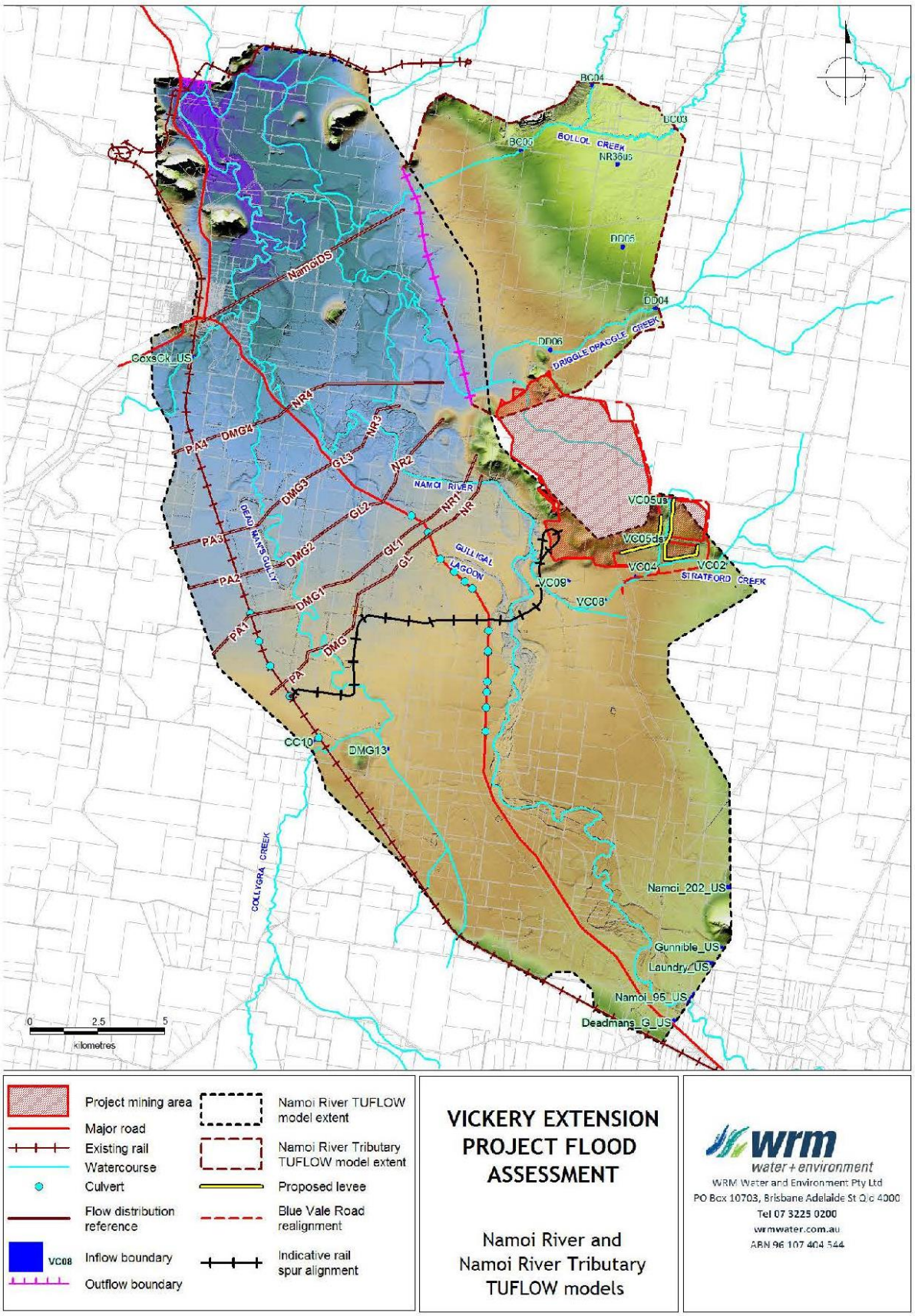


Figure 13: Namoi River and Namoi River Tributary TUFLOW Models (Source: WRM Water & Environment, 2018)

e. Clarification of cumulative flooding assessment

The TUFLOW model has been developed using the best available topography sources. The topography data across the model extent is sourced from an airborne laser survey (ALS) in 2000, and has been supplemented with more detailed data in the vicinity of the Project, including LiDAR survey data and a more detailed ALS, conducted in 2011 and 2015, respectively (Section 5.2.2 of Appendix C of the EIS).

As the flood model has been developed using ALS and LiDAR data, it includes the floodplain infrastructure that was present at the time of the surveys. As the model includes both existing built infrastructure as well as proposed Project infrastructure, it is considered to represent a cumulative impact assessment (Section 6.4.5 of Appendix C of the EIS).

f. Clarification of potential erosion impacts

The flood model results predicted an increase in velocity between 0.2 metres per second (m/s) and 0.5 m/s at the ends of embankment sections of the Project rail spur (Figure 6.13 of Appendix C of the EIS, reproduced as Figure 14). The predicted increases on the western side of the Namoi River would effectively be avoided as Whitehaven now proposes to elevate all sections of the Project rail spur west of the Namoi River on piers and/or pylons.

The predicted increases to flood velocities in localised areas on the eastern side of the Namoi River would comply with the velocity impact requirement set out in the FMP, and would be constrained to Whitehaven-owned land. Appropriate erosion and sediment control measures will be implemented at locations of increased velocity, where required.

g. Justification of predictions at privately-owned residences and properties

Relevant objectives of the Draft FMP were assessed against the predicted 20% AEP, 5% AEP and 1% AEP flood events incorporating the conceptual rail spur design. Changes to flood levels on privately-owned land as a result of the Project rail spur are predicted to comply with the Draft FMP objectives (i.e. significantly less than the FMP objective of 20 centimetres [cm]), which are consistent with those in the FMP.

Consideration of safe wading depths at residences and property access ways is not necessary due to the negligible change in flood depths and velocities predicted for the Project. Detailed design of the rail spur (including locations of openings and bunds on the east side of the Namoi River) would be consistent with the objectives of the Draft FMP.

3. Design flood immunity of Blue Vale Road realignment

The Blue Vale Road realignment is an approved component of the Approved Mine. The approved Blue Vale Road realignment would be designed with the same flood immunity as the existing road (i.e. 20% AEP flood event) (Section 2.12.3 of the EIS).

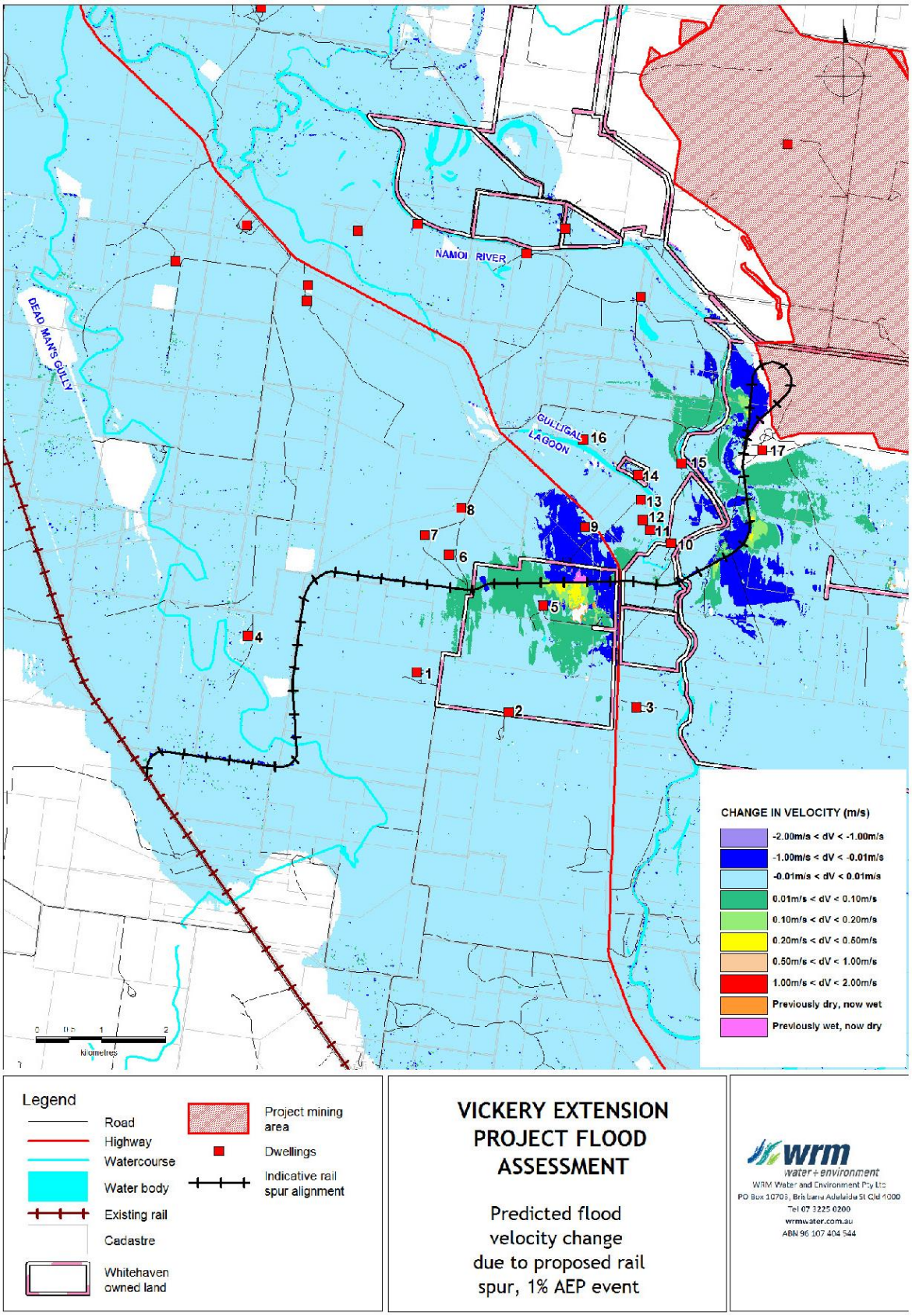


Figure 14: Predicted flood velocity change due to Project Rail Spur (1% AEP event) (Source: WRM Water & Environment, 2018)

4. Clarification of flooding impacts in the Project mining area

The Project mining area is located outside the extent of the 1% AEP Namoi River events. Accordingly, the Project mining area would not alter the flooding characteristics along the Namoi River, and the Project mining area is not at risk of flood impacts from the Namoi River (Appendix C of the EIS).

Potential flooding impacts from Stratford Creek and South Creek in the south-east of the Project mining area have been assessed in Section 4.6.2 of the EIS and the Flood Assessment (Appendix C of the EIS). As part of the Project infrastructure design, bunds/levees would be constructed in this area to prevent inundation of the infrastructure areas and open cut from high-flow events in Stratford Creek and South Creek.

5. Coincident flooding of Namoi River and tributaries

The catchment area of the Namoi River to the Project is approximately 18,000 square kilometres (km^2) with an estimated 1% AEP peak discharge of 9,147 cubic metres per second (m^3/s). By comparison, the catchment area of Stratford Creek that drains to the proposed rail spur is 105 km^2 with an estimated 1% AEP peak discharge of 221 m^3/s. When these peaks coincide, the peak discharge at the Project site would be 9,368 m^3/s, slightly larger than the 1% AEP peak discharge from the Namoi River only.

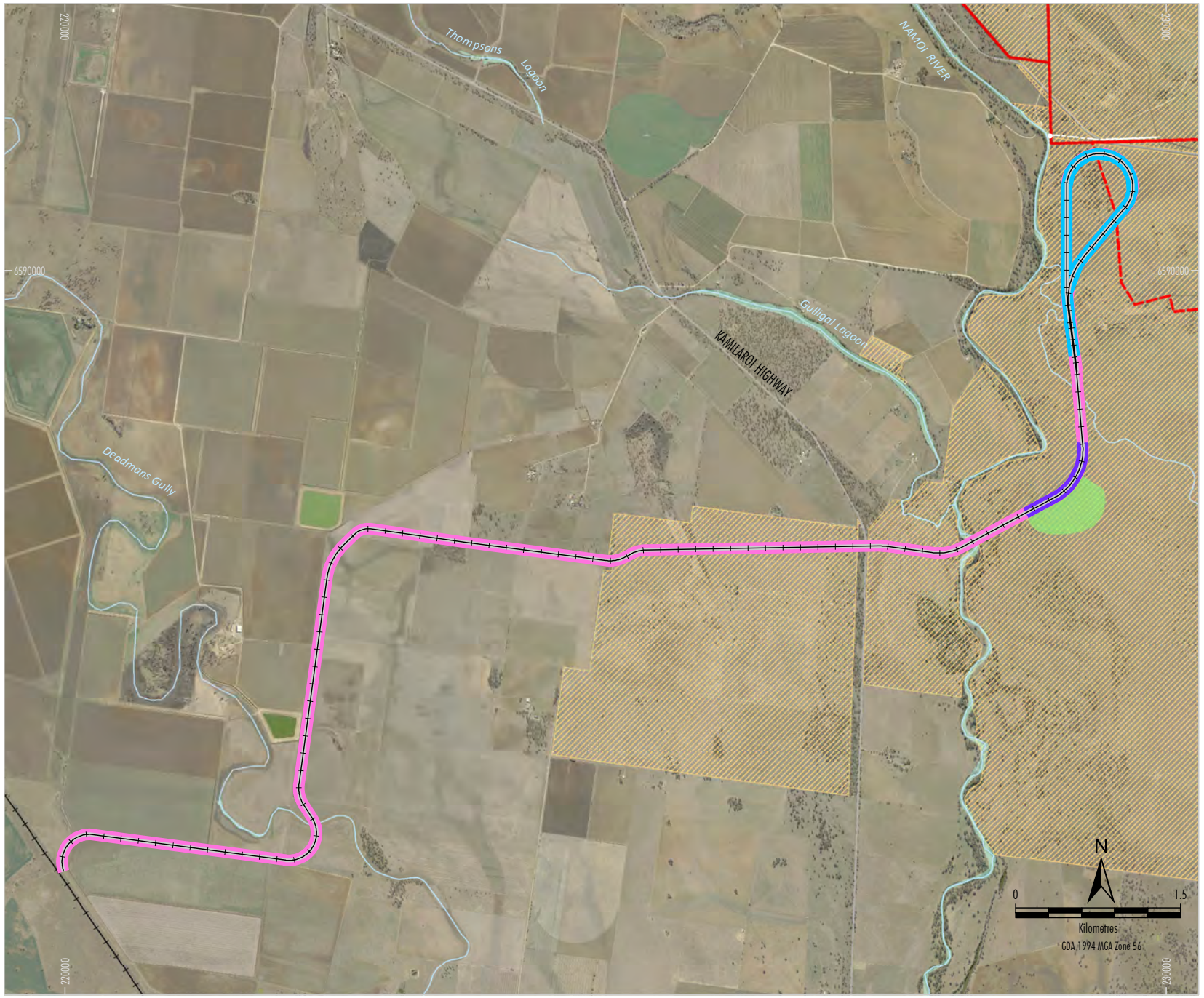
The relative sizes of the catchments mean that different storm mechanisms would produce peak discharges in each catchment. For instance, a long duration, region wide storm event would produce the flood peak from the Namoi and this event would not peak at the Project site for days after the peak rainfall. For the local catchments, an intense short-duration storm would produce the flood peak, which would peak at the Project site within approximately 6 hours of the peak rainfall. In other words, the likelihood of the regional and local flood-producing events with the same AEP peaking at the Project site at the same time is very low.

Notwithstanding, the model was rerun with and without the rail configuration for two scenarios:

- 1% AEP flood peak from the local catchments (Stratford Creek and Collygra Creek) occurring independently of the Namoi River; and
- 1% AEP flood peak from the local catchments (Stratford Creek and Collygra Creek) coinciding with the Namoi River flood peaks by offsetting the local catchment flood peaks by 80 hours.

For both scenarios, the revised rail configuration was adopted, which includes elevated sections of rail on piers (or similar) to the west of the Namoi River and minor sections of embankment to the east of the Namoi River.

Figure 15 shows the 1% AEP flood level impacts of the proposed rail for the scenario where local creeks flood coincident with the Namoi River. The difference in flood level impacts compared to the scenario where the local creeks flood independently from the Namoi River is imperceptible given that the Namoi River flows are significantly larger than the Collygra Creek and Stratford Creek flows.



LEGEND

- Mining Lease Application (MLA)
- Mining Tenement Boundary (ML and CL)
- Whitehaven-owned Land
- Indicative Rail Spur Alignment

Predicted Change in Water Level
Due to the Project Rail Spur (1% AEP Flood Event)

- 5cm < dWL < 10cm
- 10cm < dWL < 15cm
- 15cm < dWL < 20cm
- 20cm < dWL < 30cm

Project Rail Spur Conceptual Design

- Embankment
- Embankment/Culvert
- Elevated Structure

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); WRM Water and Environment (2019)

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Revised Conceptual Project Rail Spur Design
Predicted Flooding Impacts
(Coincident Flooding)

Figure 15

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6. Justification of Probable Maximum Flood assessment methodology.

The PMF defines the extent of flood-prone land, that is, the floodplain. The NSW Floodplain Development Manual (NSW Government, 2005) states *"Generally, it is not physically or economically possible to provide complete protection against this event. The extent, nature and potential consequences of flooding associated with a range of events rarer than the flood used for designing mitigation works and controlling development, up to and including the PMF event should be addressed in a floodplain risk management study."*

The primary focus of a floodplain risk management study for extreme events is emergency management and public safety. Given that the Project site is located on a 'high flood island' with significant warning time available, emergency management measures such as evacuation are suitable to manage the safety of site staff during extreme events.

WRM previously determined the extent of the PMF from the Namoi River at the Project site using a discharge equivalent to three times the 1% AEP flood. This empirical approach was considered "reasonable and appropriate" by the independent peer reviewer appointed by the DPIE (Erin Askew of WMA Water). However, the IPC suggested consideration of the PMF based on estimation using either:

1) the Generalised Short Duration Method (GSDM) developed by the Bureau of Meteorology (2003); or
2) the PMF methodology recommended in Australian Rainfall and Runoff (ARR) (Ball, J et al., 2016).

The methodologies recommended by the IPC are rainfall-based procedures. This requires the development of a rainfall runoff routing model of the entire Namoi River catchment. Given the complexity of the Namoi River catchment (i.e. average annual rainfall varying between 650 mm and 1,300 mm, elevations varying over a range of 800 m, three large water supply dams, substantial differences in topographic and flow characteristics as well over 20 stream gauges) the development of a rainfall runoff routing model would be a substantial task and is not considered reasonable.

The Bureau of Meteorology (2003) states that the GSDM is "*a method that can be used to make consistent and timely estimates of probable maximum precipitation for catchment areas up to 1000 km^2. Estimates are limited to a duration of six hours along the tropical and subtropical coastal areas and three hours in inland and southern Australia"*. The GSDM method was used to derive Probable Maximum Precipitation (PMP) rainfalls in the Project Flood Assessment (WRM, 2018) for the estimation of PMF in the local catchments, including Stratford Creek. However, the GSDM cannot be used for the Namoi River catchment, which is around 18,000 km^2 to the Project. If a rainfall runoff routing model of the Namoi River was developed, the Generalised Tropical Storm Method (Revised) (GTSMR) (Bureau of Meteorology, 2003) would be appropriate to estimate PMP for the catchment.

<u>Alternate Approach</u>

To address the IPC's suggestion, a regression equation developed by Watt et al (2018) was used to derive an alternate PMF discharge estimate for the Namoi River in the vicinity of the Project. The regression equation is based on an analysis of extreme flood estimates for inflows to storages within the Coastal GTSMR region of Queensland and northern NSW, with catchment areas varying from less than 10 km^2 to over 100,000 km^2.

Note that the storages used to derive the regression equation are located in confined valley sections of the catchment with little (or minimal) flood storage to mitigate flood peaks. In contrast, the Project site is located downstream of the broad floodplain of Mooki River and the Namoi River downstream of Keepit Dam. Notwithstanding, it provides an alternate method to define the extent of the floodplain.

The regression equation from Watt et al. (2018) adopted for the analysis is as follows:

$$PMF = 226 \times A^{0.586}$$

where A = catchment area (km^2)

Using a catchment area of 18,000 km^2, the estimated alternate PMF discharge would be approximately 70,400 m^3/s, or roughly 7.5 times the 1% AEP event. Note that the PMF discharge estimated in the Flood Assessment (WRM, 2018) using three times the 1% AEP was 27,246 m^3/s.

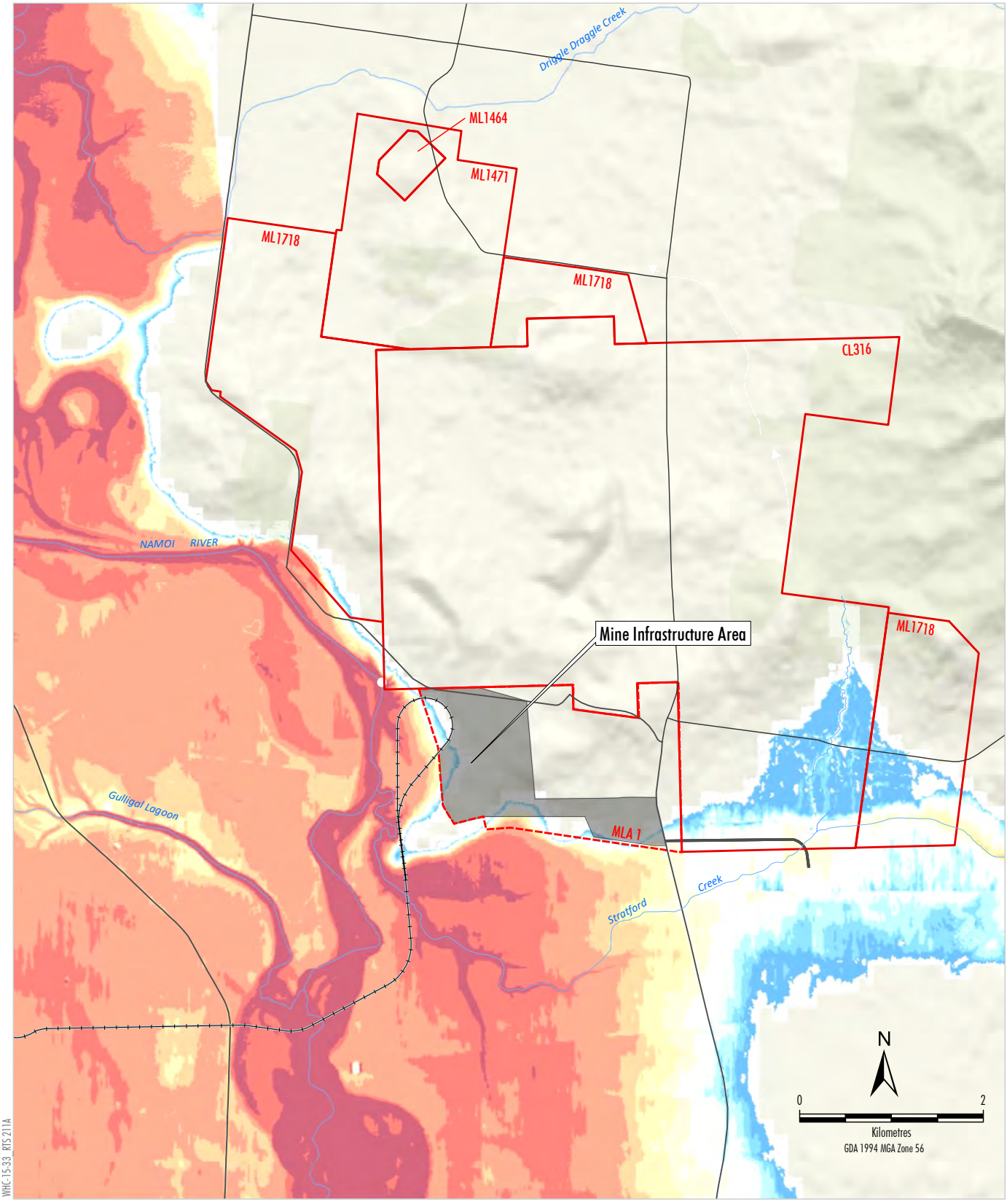
Results

Figure 16 shows the predicted flood depths and extent for the alternate PMF in the vicinity of the Project. The upstream inflows were derived by factoring up the 1984 flood event discharge hydrographs (obtained from the SMEC [2003] Mike 11 model). The methodology used to derive the Stratford Creek PMF discharges is given in the Project Flood Assessment (WRM, 2018).

In comparison to the previous assessment of the extent of floodprone land:

- Peak PMF flood levels are up to 1.5 m higher than previously predicted in the floodplain. The increased PMF level extends an additional 100 m to 150 m into the infrastructure area on the south-western corner of the Project site (to a maximum depth of 1.3 m) but does not extend to the open cut.
- There are no changes in peak flood level and extent along Stratford Creek to the east of Bluevale Road or South Creek as these peak flood levels are dominated by local catchment peak flood levels.

Overall, the difference in the extent of flood-prone land between the two methods is negligible and does not impact on the flood risk assessment for the site.



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LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- Major Roads
- Indicative Project Rail Spur
- Indicative Extent of Infrastructure Area

Flood Depth (m)

- 0.0 > 0.1
- 0.1 > 0.2
- 0.2 > 0.3
- 0.3 > 0.4
- 0.4 > 0.5
- 0.5 > 1.0
- 1.0 > 1.5
- 1.5 > 2.0
- 2.0 > 3.0
- 3.0 > 4.0
- 4.0 > 5.0
- > 5.0

Source: LPMA - Topographic Base (2010); NSW Department of Industry (2015); WRM Water & Environment (2018)

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Alternate PMF Depths and Extents for Stratford Creek and Namoi River

Figure 16

6.5 WATER BALANCE

6.5.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to the site water balance included:

- current drought conditions;
- depletion of regional surface water and groundwater resources due to Project water requirements;
- accuracy of site water balance modelling;
- licensing of water collected on-site under harvestable rights; and
- allocation of Whitehaven-owned water licences to the Project.

Agency Submissions

Agencies and local councils that provided comments on the Project relevant to the site water balance included EPA, DI Crown Lands and Water, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- clarification of reuse of mine water (e.g. for irrigation);
- consideration of worst-case conditions in site water balance modelling;
- justification that Whitehaven holds sufficient licences;
- clarification of harvestable rights allocation;
- accuracy of site water balance modelling; and
- clarification of contingency measures in event water requirement cannot be met.

Independent Planning Commission Issues Report

Regarding the site water balance, paragraph 149 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraphs 131 to 138 and Additional Material now available, the Commission considers that the Department should give detailed consideration to:*
>
> - *the water balance for the Project site while operational and whether the Applicant holds sufficient water extraction licences in the event of restrictions on extraction during drought, as has occurred in the Zone 4 alluvial aquifers and Namoi River in the past, and methods for addressing any water shortfall; and*
> - *a water balance model for the two final void lakes, which should include an assessment of the uncertainties in inflow rates, infiltration, evaporation, and sensitivity studies of the long-term trajectory to equilibrium (i.e. duration of recovery, salinity trends, rate of lake rise relative to groundwater recovery rates).*

6.5.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Site water balance modelling methodology.
    a. Justification of consideration of worst-case climatic conditions.
    b. Calculation of harvestable rights allocation.
    c. Clarification of reuse of mine water.
2. Justification that Whitehaven holds sufficient water access licences for the Project.
3. Proposed monitoring and management measures.

The responses in this section relate to on-site surface water management, the site water balance and licensing requirements for water demands. Responses relating to groundwater (including final void analysis) and surface water quality are provided in Sections 6.2 and 6.3, respectively.

6.5.3 Responses

1. Site water balance modelling methodology

a. Justification of consideration of worst-case climatic conditions

The site water modelling is based on 124 years of daily rainfall records, and as such, considers the full range of climatic conditions (i.e. rainfall and evaporation) that have been experienced over this period including the Federation drought and the major droughts in 1935 to 1948, 1979 to 1983 and 1992 to 1996.

If the worst-case climatic condition is considered to be the lowest rainfall conditions (“dry conditions”), there would be no discharge from the site.

If the worst-case climatic condition is considered to be the highest rainfall conditions (“wet conditions”), this would lead to a high dilution of any sediment dam overflows in the receiving environment. No releases of mine water or coal contact water are predicted based on the worst-case climate sequence modelled.

b. Calculation of harvestable rights allocation

Dams totalling 138 ML (in addition to coal contact water dams and mine water dams) and sediment dams could be constructed on first or second order streams without the requirement for a license under harvestable rights (Section 11.2 of Appendix B of the EIS).

Mine and coal contact water dams and sediment dams developed over the life of the Project would be designed to satisfy relevant harvestable rights exclusions. Alternatively, Whitehaven would confirm that any water held is within its harvestable rights, or suitable water access licences would be held to account for any take.

Water licensing requirements for the as-constructed Project would be described in the Water Management Plan for the Project.

c. Clarification of reuse of mine water

To minimise licensed extraction from the Namoi River and alluvium, the Project will maximise the reuse of water collected on-site to meet operational water demands. As such, there would be limited periods when there is surplus water stored on-site.

Irrigation of mine catchments as a means of surplus mine water disposal would not be required during typical operations. If irrigation of mine water to mine catchments is required as a contingency measure (i.e. in very wet periods) this would:

- not result in erosion impacts causing increased sediment, as runoff would report internally to mine water dams or the open cut; and
- not result in impact to soils, as mine catchments by definition have not had topsoil reapplication.

2. Justification that Whitehaven holds sufficient water access licences for the Project

Attachment 6 of the EIS details water licensing for the Project.

Whitehaven holds sufficient surface water and groundwater access licences (net of licences required for groundwater inflows) to account for predicted operational water supply requirements. Whitehaven also holds sufficient water access licences to account for groundwater inflows to the open cut and induced loses from the Namoi River and associated alluvium. These licences are dedicated for use for the Project.

The site water balance modelling for the Project has included restrictions on extraction from the Namoi River, as it has included consideration of changes in Available Water Determinations (AWDs) of general security river licences due to changes in climatic conditions. This has been based on AWDs reported in the NSW Department of Primary Industry's (2013) document "*Water availability in NSW Murray-Darling Basin regulated rivers, Appendix of annual data*" and contemporary AWD data (from 2013 onwards) (Plate 7) (Section 7.10 of Appendix B of the EIS).

Based on all available data since the commencement of *the Water Sharing Plan for the Upper and Lower Groundwater Source, 2003*, there has not been any restrictions on AWDs for Zone 4 alluvium.

DPIE's peer reviewer for surface water stated in regard to the site water balance modelling:

> *Based on the review, it is considered that the parameters and methodology adopted for the modelling of surface water are appropriate. The results obtained from the modelling can be used to consider the water balance of the mine…*

The Surface Water Assessment was peer reviewed by Emeritus Professor Tom McMahon (University of Melbourne) (see Attachment 4 of the EIS). The peer review states:

> *…in Section 2 the Secretary's Environmental Assessment Requirements are discussed. As far as I can ascertain, all the requirements have been dealt with.*

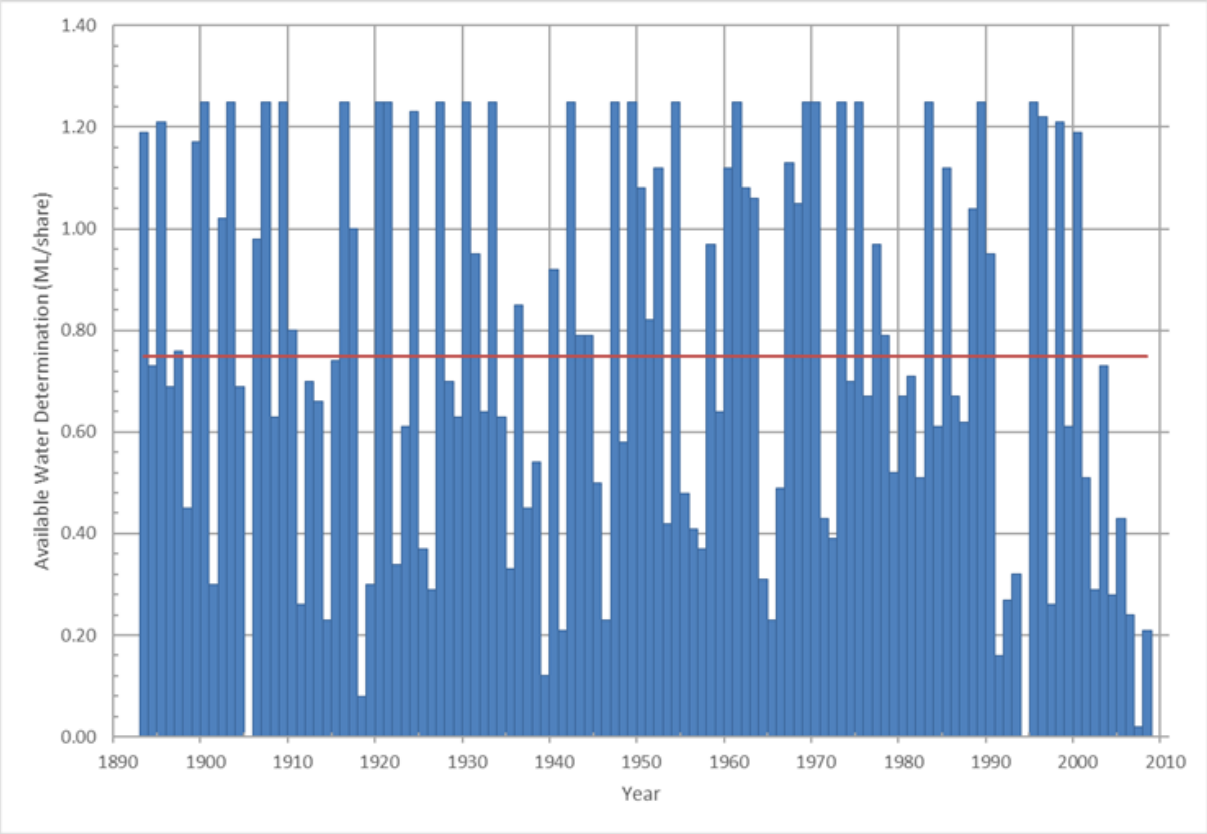

Plate 7: Modelled Annual General Security Available Water Determination - Lower Namoi River (Source: Advisian, 2018)

As stated above, the peer review undertaken by Professor Tom McMahon also states:

> *… overall, the study detailed in the Vickery Extension Project Surface Water Assessment Report was completed in a professional and detailed manner, and the conclusions in the Report are appropriately supplemented by suitable modelling studies carried out by the consultant.*

Whitehaven also holds sufficient additional water access licences to account for groundwater inflows to the open cut and induced losses from the Namoi River and associated alluvium. These licences are dedicated for use for the Project.

Post-mining groundwater licensing requirements would be less than the requirements during operations, and are well within Whitehaven's existing water access licence entitlements. Relevant entitlements under these licences could be retired at the completion of the Project to account for predicted groundwater losses to the final void.

Whitehaven commits to holding sufficient water licences to meet operational water demands for the Project.

3. Proposed monitoring and management measures

A Water Management Plan will be prepared for the Project in consideration of the requirements of any relevant Development Consent and EPL conditions. Monitoring and management measures relevant to the site water balance are described in Section 4.5.3 of the EIS, and reproduced below for reference.

Periodic review and revision of the site water balance would be undertaken over the life of the Project to record and document the status of inflows (water capture), storage and consumption (e.g. dust suppression and CHPP water supply) and to optimise water management performance. The reviews would also evaluate actual external make-up water requirements, climatic conditions and long-term predictions (including consideration of AWDs for the Lower Namoi Regulated River Water Source of the *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016*).

Monitoring would be undertaken over the life of the Project to provide data for refinement of the site water balance, including:

- records of pumped water volumes;
- storage levels in mine water dams and other containment storages;
- dust suppression water usage rates; and
- CHPP water usage rates.

6.6 NOISE AND BLASTING

6.6.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to noise and blasting included:

- cumulative noise and blasting impacts;
- accuracy of noise modelling and predictions;
- 'worst-case' noise modelling scenarios;
- potential amenity impacts (i.e. sleep disturbance);
- reduced noise levels predicted compared to the Approved Mine;
- potential impacts to privately-owned residences along the Project rail spur alignment;
- predicted noise exceedances at privately-owned residences; and
- adequacy of proposed monitoring and mitigation measures.

Agency Submissions

Agencies and local councils that provided comments on the Project relevant to noise and blasting included EPA, NSW Health, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- clarification of the adopted equipment sound power levels (SWLs);
- justification for the approach to low-frequency noise;
- clarification of the cumulative noise assessment;
- potential impacts to sleep disturbance (specifically from equipment horns);
- justification of proposed construction hours;
- clarification of rail noise impacts along the Main Line;
- implementation of a Noise Management Plan;
- accuracy of predicted noise, airblast and vibration levels;
- predicted noise exceedances at privately-owned residences; and
- adequacy of proposed mitigation measures.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report referred to comments made in EPA's submission and by the public, specifically justification of the equipment SWLs and reductions in predicted noise levels compared to the Approved Mine. DPIE requested that Whitehaven provides additional information to address these comments in the RTS.

Independent Planning Commission Issues Report

Regarding noise and blasting, paragraph 180 of the IPC's Issues Report states:

> *Accordingly, the Commission considers that the Department should give detailed consideration to:*
>
> - *the Applicant's demonstration of which years are the 'worst case' years for operations and any articulation of what impacts are predicted for nearby residents. Predicted noise emissions and impacts at sensitive receptors for all years of operation may be of assistance in this regard;*
> - *the Applicant's justification for the construction hours being beyond what is set out in the ICNG;*
> - *the Applicant's monitoring data of trains, both loaded and empty, travelling across the Maules Creek viaduct, which will provide the stakeholders with a sense of the noise level that could be expected from the project's viaduct. The Department should also give detailed consideration to noise modelling across the floodplain based on this monitoring data and other appropriate data for resonance emissions of the viaduct superstructure;*
> - *details on the investigation of noise and blast exceedances at Maules Creek, Rocglen and Tarrawonga Coal Mines in the past 5 years, including the findings of the investigations by the regulatory authorities; and*
> - *whether any of the recommendations made in the report summarising Whitehaven's 2016 Mandatory Noise Management Audit will be implemented on this Project; and*
> - *whether the blasting criteria determined for the Kurrumbede Homestead will protect the Homestead from damage due to blasting.*

6.6.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Noise modelling predictions.
    a. Clarification of adopted equipment SWLs.
    b. Justification of the approach to low-frequency noise.
    c. Clarification of the cumulative noise assessment.
    d. Clarification of potential impacts to sleep disturbance (specifically equipment hours).
    e. Justification of proposed construction hours.
    f. Clarification of rail noise impacts.
    g. Justification of Project noise levels compared to Approved Mine.
    h. Justification of 'worst-case' modelling scenarios.
    i. Justification of Kurrumbede Homestead blasting criteria.
2. Clarification of noise and blasting levels at other Whitehaven operations.
3. Proposed noise monitoring and mitigation measures.
4. Proposed airblast and vibration monitoring and management measures.
5. Noise exceedances at privately-owned residences.

6.6.3 Responses

1. Noise modelling predictions

a. Clarification of adopted equipment SWLs

References for each indicative SWL used in the modelling are included in Table 5-4 of the Noise and Blasting Assessment in accordance with Section 3.3.1 of the *Noise Policy for Industry* (EPA, 2017) (NPfI), either to industry (i.e. manufacturer) or measurements conducted at other mine sites (e.g. Maules Creek Coal Mine).

Additionally, recent advances have been made by mining equipment manufacturers such as Hitachi to reduce SWLs. These SWL reductions have been achieved through implementation of a range of measures such as acoustic scanning of equipment (Plate 8) to identify and mitigate noise sources, re-engineered mufflers, variations to fan speed and modification of louvres to improve air flow.

Accordingly, while the Noise and Blasting Assessment adopted current best practice mining equipment SWLs (consistent with the requirement for the Project to implement reasonable and feasible noise mitigation measures) it is likely that at the time Project equipment is procured, equipment SWLs will be lower than those modelled.

Ongoing maintenance of equipment would be conducted over the life of the Project along with SWL monitoring to confirm the ongoing acoustic performance of mining equipment.

Plate 8: Acoustic Noise Scanning of Machinery (Source: Hitachi Construction Machinery Australia)

b. Justification of the approach to low-frequency noise

The low-frequency spectrum shape determined as part of a noise audit in Bulga Village has been assumed to be representative for the Project in the absence of on-site measurements (i.e. as the Project has not yet commenced). The analysis of the low-frequency noise for the Project used the Bulga Village low-frequency spectrum and normalised that spectrum to the Project-specific levels predicted from the noise model (Section 5.6 of Appendix D of the EIS).

It is acknowledged the Bulga noise audit did result in some measured data being corrected by +2 A-weighted decibel (dBA) low-frequency correction. Upon review of noise monitoring reports for the Bulga Coal Mine, it appears that, since adoption of the methodology for low-frequency noise described in the NPfI in Q4 2017, there have been approximately 76 measurements at 10 locations in the vicinity of the Bulga Coal Mine. Of these measurements, only one resulted in the application of a 2 dBA penalty, however a subsequent re-measure at the same location did not result in the application of a penalty.

With regard to the Project, the low-frequency spectrum shape has been assessed for each receiver individually (e.g. considering SWL and propagation paths), and it was determined that it would be unlikely that any of the receivers surrounding the Project would be subject to dominant low-frequency noise. As such, a low-frequency modifying factor was not found to be applicable in this assessment.

Based on the above, no further assessment of potential low-frequency noise is considered necessary for the Project. It is noted that the peer review of the Noise and Blasting Assessment conducted by Glenn Thomas of SLR Consulting (refer to letter in the EIS) considered the approach to assessing low-frequency noise to be appropriate.

If a 2 dBA low-frequency modifying factor were to apply to the maximum predicted noise levels (Table 6), no additional properties would be 'significantly' noise affected (as per the definition in the NSW Government [2014] *Voluntary Land Acquisition and Mitigation Policy - For State Significant Mining, Petroleum and Extractive Industry Developments* [Voluntary Land Acquisition and Mitigation Policy]).

c. Clarification of the cumulative noise assessment

For the purposes of cumulative noise assessment, noise levels from the Rocglen Coal Mine were converted to $L_{Aeq,9hr}$ levels by subtracting 3 dBA, consistent with the recommended procedure in the NPfI.

The noise levels presented in Table 5-11 of Appendix D of the EIS for receivers 94 and 98 ($L_{Aeq,9hr}$ of 32 dBA and 36 dBA) are consistent with those stated in the Spectrum Acoustics report for the Rocglen Coal Mine Expansion (i.e. $L_{Aeq,15min}$ of 35 dBA and 39 dBA).

Given the above, no revisions to the cumulative assessment of noise levels are necessary.

d. Clarification of potential impacts to sleep disturbance (specifically equipment horns)

It is common practice for mobile equipment at mines to use horns to communicate between each other. However, radio communication would be progressed at the Project in place of horns, where safe to do so.

A sleep disturbance assessment was undertaken as a component of the Noise and Blasting Assessment, which assessed a maximum instantaneous noise of 125 dBA L_{AFmax}. Note that noise levels from the Project due to night operations are predicted to be below the Project's 52 dBA L_{AFmax} trigger level at all privately-owned residences.

Table 6
Maximum Night-time $L_{Aeq,15min}$ Noise Levels at Closest Private Receivers

Private Receiver ID	Location with Respect to the Project Mining Area	Maximum Night-time $L_{Aeq,15min}$ Noise Level (dBA)	
		NPfI	P10
127c	South-west	42	40
131a		37	34
131b		36	33
132		36	33
133a		35	34
141		33	30
125	West	31	30
127a		35	33
127b		40	38
334		29	28
87a	North-west	27	26
87b		28	27
122		26	25
108a	South-east	30	28
310		29	27

Typical maximum noise levels for vehicle horns or alarms are in the range of 115 to 120 dBA (Bridges Acoustics, 2011).

Such noise levels would be less than the maximum case noise levels modelled in the Noise and Blasting Assessment (i.e. excavator dumping in empty truck bodies and infrastructure area impact noise was modelled at 125 dBA). Therefore, noise levels from horns, would also be lower than the Project's 52 dBA L_{AFmax} trigger level at all privately-owned residences.

Given the above, no additional quantitative assessment of potential sleep disturbance due to equipment horns is considered to be necessary for the Project.

e. Justification of proposed construction hours

Whitehaven would generally limit construction/development activities to between 7.00 am and 6.00 pm Monday to Sunday (inclusive) (Section 2.2.1 of Appendix D of the EIS).

Construction activities outside standard hours (e.g. Saturday afternoon and Sunday) are considered justified as it would allow continuity of work for construction crews, reducing the length of the construction period and therefore the overall duration of potential impacts from construction noise at receivers. In addition, as the construction workforce requires specialised skills, a majority of the construction workforce would be non-local, and experience has shown that the typical roster is 10 days on, 4 days off.

Construction activities at the Project CHPP would occur proximal to Mining operations, which would occur 24 hours per day. It is likely only the Project rail spur construction would be distinguishable at receivers to mining operations. Activities associated with the construction of the rail spur would by nature progressively move along the rail spur corridor. Therefore, the likelihood of the construction activities occurring in the vicinity of these receivers while outside of recommended standard construction hours and during adverse conditions is low.

Whitehaven would maintain construction noise levels such that they would comply with the 'Noise Affected' noise management level in accordance with the *Interim Construction Noise Guideline* (Department of Environment and Climate Change, 2009) (ICNG) outside of recommended standard construction hours, unless a negotiated agreement is entered into with the owners of the relevant properties. Where possible, Whitehaven would schedule low intensity construction activities outside standard hours (i.e. Saturday afternoon and Sunday).

If no construction activities were permitted on Saturday afternoon or Sundays, it is estimated productivity would be reduced by 20% to 25% and the construction period would increase by 2 to 3 months (i.e. extending the overall duration of construction noise).

Whitehaven would consult with nearby landowners in regard to construction activities and associated noise management measures.

Whitehaven commits to maintaining construction noise levels such that they would comply with the 'Noise Affected' noise management level in accordance with the Interim Construction Noise Guideline outside of recommended standard construction hours, unless a negotiated agreement is entered into with the owners of the relevant properties.

f. Clarification of rail noise impacts

The conceptual design of the Project rail spur involved elevating the Project rail spur above predicted flood levels (i.e. a superstructure supported on either pylon-like structures, or in-filled embankment sections with culverts/openings).

Proceeding with a conceptual design involved an iterative approach during flood modelling, whereby the distribution of openings under the superstructure of the Project rail spur was adjusted to achieve consistency with the Draft FMP. The Project rail spur construction materials would be determined during detailed design.

Further design development of the conceptual rail spur alignment following submission of the Project EIS determined that the Project rail spur would be completely elevated on pylon-like structures west of the Namoi River, with the superstructure of the rail spur elevated above the 1 in 100 year flood level. An example of such an elevated structure is the existing Maules Creek and Boggabri Coal Mine Rail Spur viaduct where it crosses the Namoi River floodplain (refer to Plate 9a). The Maules Creek and Boggabri Coal Mine Rail Spur viaduct is constructed of steel pylons with the superstructure constructed of steel girders and timber transoms. As a result of the topography at the floodplain crossing site the Boggabri Maules Creek Rail Spur viaduct is considerably higher than the proposed Project rail spur (at its closest point to any privately-owned receiver [refer to the simulation provided in Plate 9b]).

Noise monitoring of the viaduct was conducted along the Maules Creek Coal Mine and Boggabri Coal Mine Rail Spur. Noise data loggers were at offset distances of 100 m, 200 m and 400 m. The logger locations are shown in Figure 17. The noise loggers were used to conduct the measurements so that a significant quantity of train movement data for a wide range of meteorological conditions could be gathered.

Plate 9a Maules Creek and Boggabri Coal Mine Rail Spur Viaduct Structure

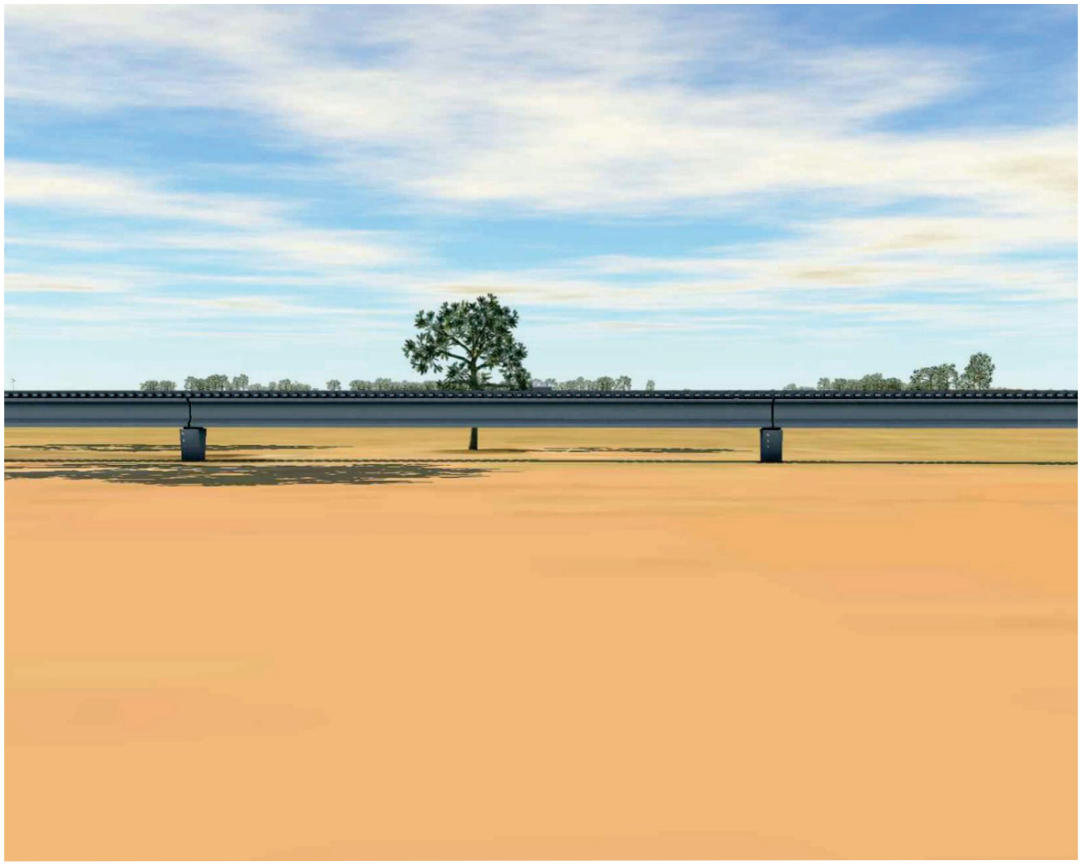

Plate 9b Simulation of the Project Rail Spur Indicating Relatively Low Profile

Source: Whitehaven (2019)

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WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Maules Creek and Boggabri Coal Mine Rail Spur Compared to Project Rail Spur Simulation

Plate 9a and 9b

The results of the noise monitoring are shown in Table 7, using the Sound Exposure Level (SEL), which is a measure of the total noise energy of an event normalised to a one-second period. This allows comparison of noise events of different duration and calculation of $L_{Aeq, period}$ levels (e.g. the relevant assessment period for noise from the Project rail spur).

The results of the Maules Creek and Boggabri viaduct were used by Wilkinson Murray to recalibrate the modelling for the Project rail spur. Revised predictions using the Maules Creek and Boggabri viaduct data are presented in Table 8.

The noise modelling presented in the EIS was calibrated based on data from a rail line constructed on an embankment.

Based on the monitoring data from the Maules Creek and Boggabri viaduct, the revised rail spur modelling would indicate that maximum predicted $L_{Aeq,period}$ noise levels are within 1 to 2 dBA of those predicted in the EIS.

Review of Table 8 indicates that all predicted levels (as revised) comply with the *Rail Infrastructure Noise Guideline* (EPA, 2013) (RING) night-time noise criterion for non-network rail lines apart from receiver 144b where a 2 dBA exceedance has been predicted. Voluntary Land Acquisition and Mitigation Policy suggests that a 1-2 dBA exceedance is considered negligible, which would not be discernible by an average listener.

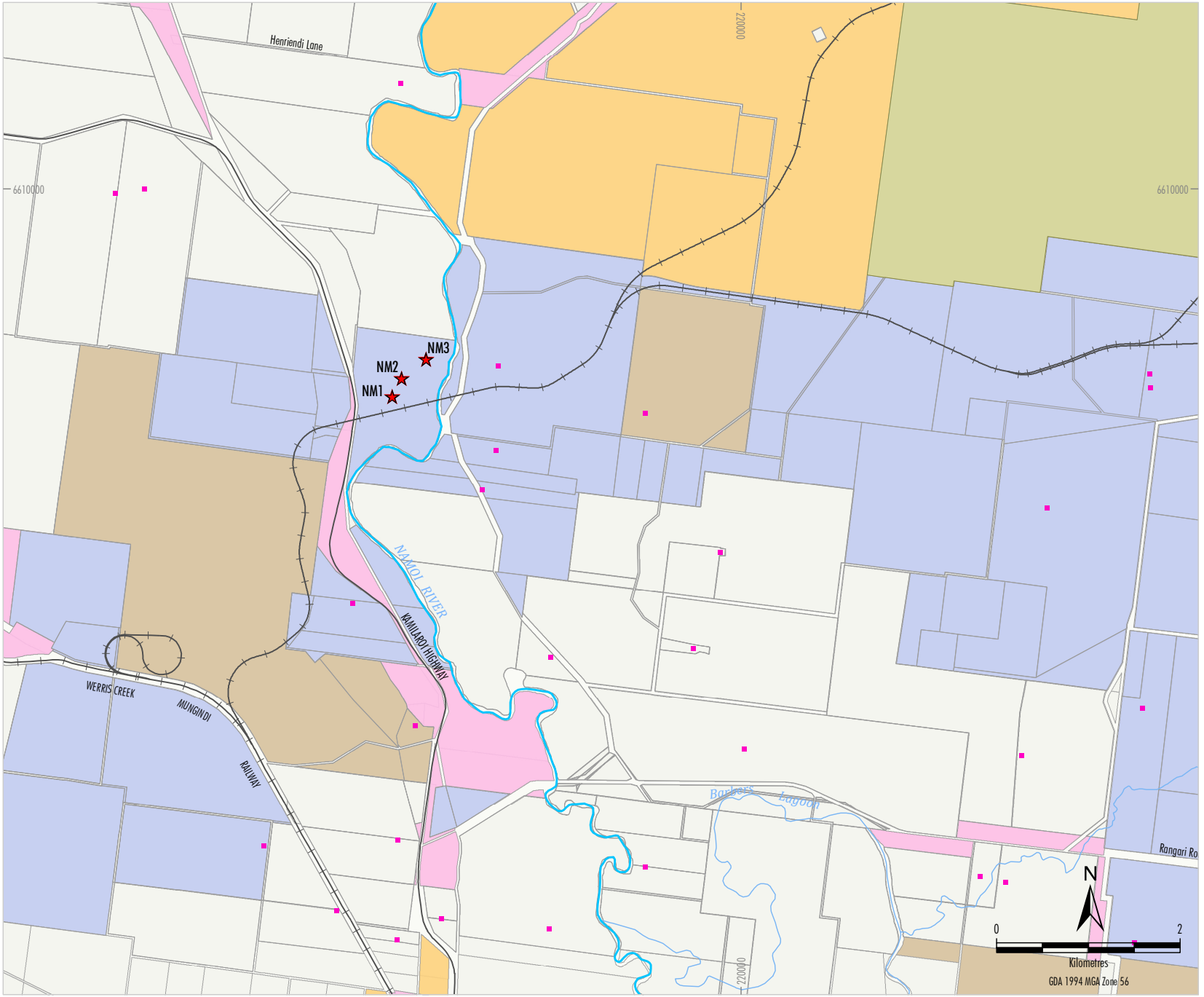
As such, the analysis of actual noise measurements taken at the Maules Creek and Boggabri viaduct and extending them to the Project rail spur (which are within 1 – 2 dBA of the EIS predictions despite the Project having a lower profile elevated structure) confirmed the noise assessment conducted by Wilkinson Murray (2018) for the EIS within the limits of accuracy of the acoustic modelling methodology or differences in noise levels discernible to an average listener.

It is noted the noise monitoring is based on the design of the Maules Creek and Boggabri Coal Mine viaduct. During the detailed design process for the Project rail spur there may be opportunities to mitigate noise by incorporating the noise mitigation measures not incorporated in the existing Maules Creek and Boggabri viaduct, such as:

- vibration isolators below the rails (up to 4 dBA reduction achievable [Kostli, 2008]); or
- vibration isolation below the sleeper (up to 4 dBA reduction achievable); or
- side screens on viaduct (up to 2 dBA reduction achievable [SLR, 2015]); or
- providing a ballasted track design (up to 4 dBA reduction achievable [SLR, 2015]).

When considering the above mitigation options could provide 4 dBA reduction in noise levels, Whitehaven considers it will be reasonable and feasible to comply with the RING night-time noise criterion for non-network rail lines at all existing privately-owned receivers (unless an alternative agreement is in place with the landowner).

Whitehaven commits to incorporating all reasonable and feasible noise mitigation measures in the detailed rail spur design, commission a suitably qualified and experienced person to review the detailed rail spur design and undertake commissioning trials to determine optimum train speeds to minimise noise impacts.



LEGEND

- State Forest
- Crown Land
- Whitehaven Coal Owned Land
- Whitehaven Coal/Boggabri Coal Joint Owned Land
- Boggabri Coal Owned Land
- Privately Owned Land and Other Land
- Railway
- Dwelling
- Approximate Noise Logger Location

Source: Whitehaven Coal Limited (2016); NSW Department of Land and Property Information (2016); NSW Department of Industry (2016); Office of Environment and Heritage NSW (2016)

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VICKERY EXTENSION PROJECT

Maules Creek and Boggabri Coal Mine
Rail Spur Noise Logger Locations

Figure 17

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Table 7
Maules Creek and Boggabri Coal Mine Rail Spur Viaduct Sound Exposure Level, Train Speed and Meteorological Data

Date	Time	ID	Direction of Travel	Sound Exposure Level (dBA)			Train Speed		Meteorological Conditions					Comments
				100 m	200 m	400 m	Entering Viaduct (km/h)	Exiting Viaduct (km/h)	Temp at 10 m (°C)	Sigma Theta	Stability Class	Wind Direction (°)	Wind (m/s)	
01/11/2016	17:51:50	BE915	Up line	93.6	83.8	71.1	54	53	22.8	10.32	A-D	329	3.3	
01/11/2016	21:27:31	BE916	Down line	93.1	89.2	81.5	46	51	16.8	4.02	F	217	2.9	
02/11/2016	7:38:34	MB945	Up line	95.9	85.4	78.9	62	59	12.5	34.83	A-D	34	0.5	
02/11/2016	11:55:26	MB946	Down line	93.3	89.1	78.6	45	46	21.2	16.50	A-D	223	2.6	
02/11/2016	17:57:32	BE908	Down line	88.5	87.1	72.6	43	38	24.8	20.55	A-D	306	2.4	
03/11/2016	2:22:10	MB528	Down line	91.4	81.3	79.9	48	49	10.0	10.83	F	117	0.5	
03/11/2016	19:36:05	BE917	Up line	92.2	87.9	75.0	54	49	21.5	87.22	F	171	0.6	
03/11/2016	23:57:03	BE918	Down line	91.5	86.5	79.5	43	46	13.2	44.22	F	205	0.4	
04/11/2016	0:37:40	BE529	Up line	93.7	89.2	86.6	57	53	12.9	41.30	F	199	0.4	
04/11/2016	5:51:19	BE933	Up line	93.4	85.7		61	57	9.0	27.42	A-D	103	0.8	400 m measurement excluded due to truck pass by in middle of train
04/11/2016	9:28:00	BE934	Down line				37	27	22.1	28.65	A-D	304	0.8	EXCLUDE train comes to a stop - does not complete pass by
04/11/2016	10:21:48	MB536	Down line	91.3	81.8	71.2	51	49	24.1	35.84	A-D	174	2.4	
05/11/2016	7:52:32	BE943	Up line	92.5	85.4		48	43	21	58.45	A-D	250	0.6	400 m measurement excluded due to high backgrounds
05/11/2016	11:12:32	BE944	Down line	87.9	84.6		51	49	27.3	15.09	A-D	277	7.3	400 m measurement excluded due to high backgrounds
06/11/2016	1:43:36	MB533	Up line	95.3	83.3	82.0	56	56	10.1	19.64	F	220	0.4	
06/11/2016	7:13:24	MB534	Down line	91.9	80.5		45	48	11.8	16.50	A-D	239	0.3	400 m measurement excluded due to high backgrounds
06/11/2016	8:36:19	BE938	Down line	92.9	79.3		49	49	16.5	30.81	A-D	65	2.0	400 m measurement excluded due to high backgrounds
06/11/2016	9:33:59	BE901	Up line	95.7	84.4	75.8	64	59	18.7	18.03	A-D	182	2.9	

Table 7 (Continued)
Maules Creek and Boggabri Coal Mine Rail Spur Viaduct Sound Exposure Level, Train Speed and Meteorological Data

Date	Time	ID	Direction of Travel	Sound Exposure Level (dBA)			Train Speed		Meteorological Conditions					Comments
				100 m	200 m	400 m	Entering Viaduct (km/h)	Exiting Viaduct (km/h)	Temp at 10 m (°C)	Sigma Theta	Stability Class	Wind Direction (°)	Wind (m/s)	
06/11/2016	12:44:12	BE902	Down line	89.6	84.7		41	43	23.3	56.11	A-D	219	3.0	
07/11/2016	4:23:26	BE941	Up line	96.2	81.1	83.4	62	57	10.5	54.64	F	84	0.6	
Average Night				**93.5**	**85.1**	**82.1**	**52.0**	**52.0**						
Average Day				**92.9**	**85.6**	**74.7**	**53.3**	**50.4**						

Source: Global Acoustics (2017)

km/h = kilometres per hour

Table 8
Predicted Night-time Rail Spur Noise Levels

Receiver ID	SEL (dBA)		Adjustments					Night Time $L_{Aeq,9hr}$ (dBA)	
	With Local Meteorology	Calm	SEL to $L_{Aeq,9hr}$ Adjustment	6 Trains	Façade Adjustment	Speed	Total Adjustment	With Local Meteorology	Calm
Privately-owned Dwellings									
147b	49.5	49.0	-45.1	7.8	2.5	-2.3	-37.1	12.4	11.9
160	55.0	54.2	-45.1	7.8	2.5	-2.3	-37.1	17.9	17.1
127c	68.8	67.6	-45.1	7.8	2.5	-2.3	-37.1	31.7	30.5
131a	69.0	67.9	-45.1	7.8	2.5	-2.3	-37.1	31.9	30.8
131b	73.1	72.0	-45.1	7.8	2.5	-2.3	-37.1	36.0	34.9
132	75.2	74.1	-45.1	7.8	2.5	-2.3	-37.1	38.1	37.0
133a	59.1	58.0	-45.1	7.8	2.5	-2.3	-37.1	22.0	21.1
141	73.7	72.6	-45.1	7.8	2.5	-2.3	-37.1	36.6	35.5
143	66.3	65.5	-45.1	7.8	2.5	-2.3	-37.1	29.2	28.4
144a	73.5	72.4	-45.1	7.8	2.5	-2.3	-37.1	36.4	35.3
144b	78.7	77.9	-45.1	7.8	2.5	-2.3	-37.1	41.6	40.8
146a	73.0	71.8	-45.1	7.8	2.5	-2.3	-37.1	35.9	34.7
146b	73.2	72.0	-45.1	7.8	2.5	-2.3	-37.1	36.1	34.9
147	64.8	64.0	-45.1	7.8	2.5	-2.3	-37.1	27.7	26.9
153	61.1	60.1	-45.1	7.8	2.5	-2.3	-37.1	24.0	23.0
Mine-owned Dwellings									
1 af	59.6	58.6	-45.1	7.8	2.5	-2.3	-37.1	22.5	21.5
1 v	80.5	79.3	-45.1	7.8	2.5	-2.3	-37.1	43.4	42.2
1 w	78.6	77.5	-45.1	7.8	2.5	-2.3	-37.1	41.5	40.4
1 y	82.2	81.5	-45.1	7.8	2.5	-2.3	-37.1	45.3	44.4
1 z	65.0	64.0	-45.1	7.8	2.5	-2.3	-37.1	27.9	26.9

Werris Creek Mungindi Railway (Main Line)

It is noted the comment raised by the EPA in regard to rail noise relates to noise along the Werris Creek Mungindi Railway (the Main Line) (i.e. not the Project rail spur). The rail noise assessment undertaken for the Project (Section 7 of Appendix D of the EIS) considers the increase in rail noise along five sections of the main line by comparing the number of rail movements with and without the Project. The number of "other" movements (i.e. not Project-related) increases along the Main Line as it gets closer towards Newcastle.

The sections of the Main Line considered in the rail noise assessment were:

- Section 1 – Junction of Main Line and Project Rail Spur to Whitehaven CHPP.
- Section 2 – Whitehaven CHPP to Junction with Watermark Spur.
- Section 3 – Junction of Watermark Spur to Junction with Werris Creek Mungindi Railway.
- Section 4 – Werris Creek Mungindi Railway to Main Northern Railway.
- Section 5 – Main Northern Railway to Muswellbrook Junction.

The compliance offset distance for Rail Section 5 may increase during the night from approximately 410 m (existing/approved plus other proposed projects) to 441 m (existing/approved/other proposed plus the Project) (refer Table 7-5 of Appendix D of the EIS reproduced as Table 9 below).

The 345 m value highlighted by the EPA includes existing/approved movements only (i.e. does not include other proposed projects) and comparing this to the 441 m value is not a representative indication of the potential increase in noise due to the Project.

Table 9
Offset Distances to Achieve ARTC and RING Criteria – Sections 1-5 (Table 7-5 of Appendix D)

Section	ARTC/RING Criteria (dBA)	Distance from Track (m)		
		Existing/Approved Movements	Existing/Approved Plus Other Proposed Movements	Existing/Approved/Proposed plus Project Movements
1	65 (15 hr/day) 60 (9 hr/night)	86 222	86 222	116 294
2	65 (15 hr/day) 60 (9 hr/night)	98 259	98 259	116 294
3	65 (15 hr/day) 60 (9 hr/night)	121 312	121 312	138 345
4	65 (15 hr/day) 60 (9 hr/night)	121 312	146 378	162 410
5	65 (15 hr/day) 60 (9 hr/night)	138 345	162 410	177 441
All	L_{Amax} – 85 dBA with wheel defects Without wheel defects (based on loco)	130 55	130 55	130 55

g. Justification of Project noise levels compared to Approved Mine

The Project Noise and Blasting Assessment (Wilkinson Murray, 2018) was prepared in accordance with the NPfI, which requires an assessment of potential noise impacts following implementation of all reasonable and feasible mitigation measures.

While key aspects of the Project may appear likely to increase noise levels at sensitive receivers in comparison to the Approved Mine (e.g. the mining rate and number of mobile equipment have increased and an on-site CHPP and train loading facility is proposed), the Project includes a number of improvements with regard to acoustic design.

In addition to design of the waste rock emplacement area, haul roads and mine progression direction to minimise noise impacts to key sensitive receivers, the Project Noise and Blasting Assessment (Wilkinson Murray, 2018) adopts SWLs consistent with current leading practice mining equipment for noise performance, as evidenced by noise performance monitoring from the Maules Creek Coal Mine and other mines in the region (refer to the response above).

Table 10 provides a comparison of the total SWLs adopted for the Approved Mine and the Project in Year 7. Generally, the total number of equipment required for the Project has increased, however the total SWL has reduced in comparison to those adopted for the Approved Mine (Table 10).

Table 10
Predicted Total SWLs for Approved Mine and Project (Year 7)

Equipment	Approved Mine (Year 7)			Project (Year 7)		
	Number	SWL Per Item (dBA)	Total SWL (dBA)	Number	SWL Per Item (dBA)	Total SWL (dBA)
Trucks	33	114 – 118	132	50	107 – 113	130
Dozers	13	114 – 116	127	14	107 – 113	123
Excavators	7	115 – 117	125	9	113 – 114	123
Loaders	2	113	116	1	110	110
Drills	4	114	120	7	113	121
Graders	4	108	114	5	106	113
Scrapers	4	115	121	-	-	-
Water Carts	4	111	117	4	112	118
Ancillary	-	-	117.7	-	-	107
Infrastructure Area*	-	-	115.3	-	-	116.9
Rail	-	-	-	-	-	108
TOTAL	**-**	-	**135**	**-**	**-**	**132**

Source: Wilkinson Murray (2013; 2018)

* For the Project this includes noise sources at the CHPP and rail loop

References for each indicative SWL used in the modelling are included in Table 5-4 of the Project Noise and Blasting Assessment (Appendix D of the EIS) in accordance with Section 3.3.1 of the NPfI, either to industry (i.e. manufacturer) or measurements conducted at other mine sites (e.g. Maules Creek Coal Mine).

There are numerous differences in the proposed operations of the Approved Mine and the Project that would affect predicted noise levels at receiver locations in any given year, including:

- The Approved Mine included the haulage and dumping of waste at the Eastern Emplacement, which is not required for the Project.
- The Project includes the CHPP and rail loop.
- Differences in mine progression, for example, the Approved Mine involves two open cut faces progressing simultaneously, whereas the Project involves a single open cut face.

As a result of the changes in modelled SWLs and operations, a comparison of noise impacts between the Approved Mine and the Project is summarised as follows:

- At the closest property to the Project (ID 127) 'significant' exceedances of operational noise limits are predicted for the Project and the Approved Mine under the most adverse assessable meteorological conditions. Note, the owners of the property have the right to acquisition upon request under the Development Consent for the Approved Mine.
- For receivers to the south-west of the Project, maximum predicted noise levels are greater at receivers on Property IDs 131 and 132 for the Project than the Approved Mine (i.e. 'negligible' exceedances are predicted at these receivers for the Project, which are located to the south-west of the Project CHPP and rail loop).

- For receivers to the south of the Project, the maximum predicted noise levels are lower at the closest property (ID 108) for the Project, due to the removal of the requirement for haulage and dumping at the Eastern Emplacement.
- For receivers to the west of the Project, noise levels are similar for the Project and the Approved Mine (i.e. compliance with noise levels is predicted for all privately-owned receivers except those on Property IDs 127, 131 and 132 as listed above).

h. Justification of 'worst-case' modelling scenarios.

Providing predicted noise levels for each year of Project operation is not considered to be required as the three operational scenarios which were modelled (i.e. Project Years 3, 7 and 21) encompass the maximum likely conditions for nearby private receivers.

Three operational scenarios of the Project were assessed for potential noise impacts (Section 2.1 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]):

- Project Year 3 – representative of initial operations (i.e. mining operations in the north-west and central portions of the open cut and waste rock emplacement at the Western Emplacement) (Figure 18);
- Project Year 7 – representative of ongoing operations (i.e. mining operations in the eastern portion of the open cut and waste rock emplacement at the Western Emplacement) (Figure 19); and
- Project Year 21 – representative of ongoing operations (i.e. mining operations in the southern portion of the open cut) (Figure 20).

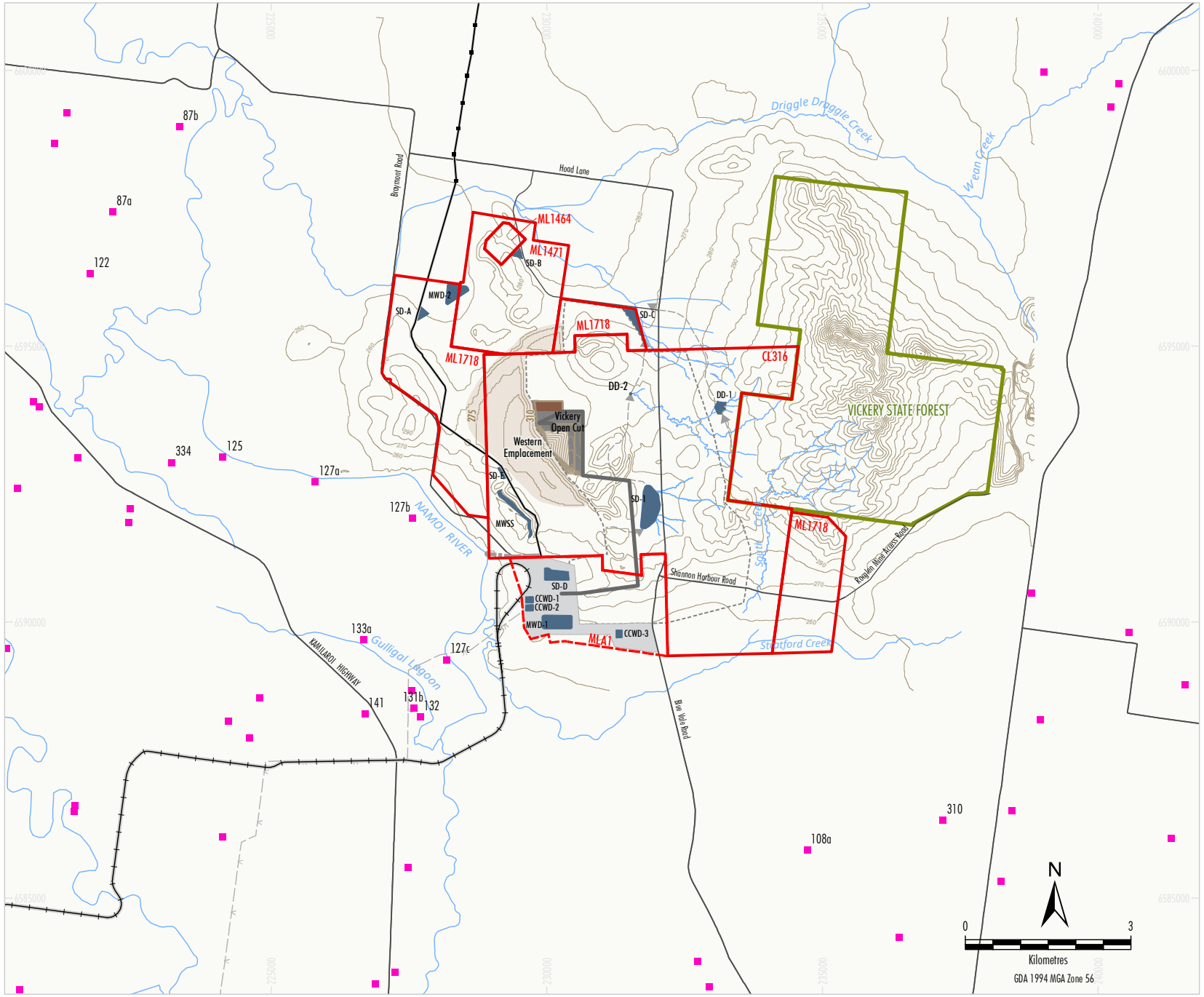
These worst-case scenarios were determined in consideration of maximum potential noise emissions (e.g. to account for the maximum mobile equipment fleet, maximum elevations at which equipment would be working and proximity to receivers) to evaluate the potential impacts at the nearest privately-owned receivers for the life of the Project.

Each assessment scenario was modelled using consistent meteorological conditions. Therefore the only variants between Project years are the intensity of operations (i.e. fleet numbers, processing rates), elevation of mine topography and the proximity of operations to receivers. Changes in these variants over the life of the Project with respect to the modelled scenarios are described below.

Note Project operations would be required to comply with the same operational noise criteria throughout the Project life (i.e. across every year of operation), as specified in any relevant Development Consent or EPL conditions. That is, noise criteria would not vary year-by-year to account for variations in intensity and location of operations.

Table 11 (Table 2-2 of the EIS) provides the indicative mine schedule for the Project. Project Years 3, 7 and 21 are highlighted to indicate the rate of mining during each of the modelled scenarios.

The assessment scenario for Project Year 21 encompasses the highest intensity of operations over the life of the Project and therefore maximum potential noise level from the Project (i.e. as the maximum fleet would be required).



Source: Department of Land and Property Information (2014); Department of Industry (2015)

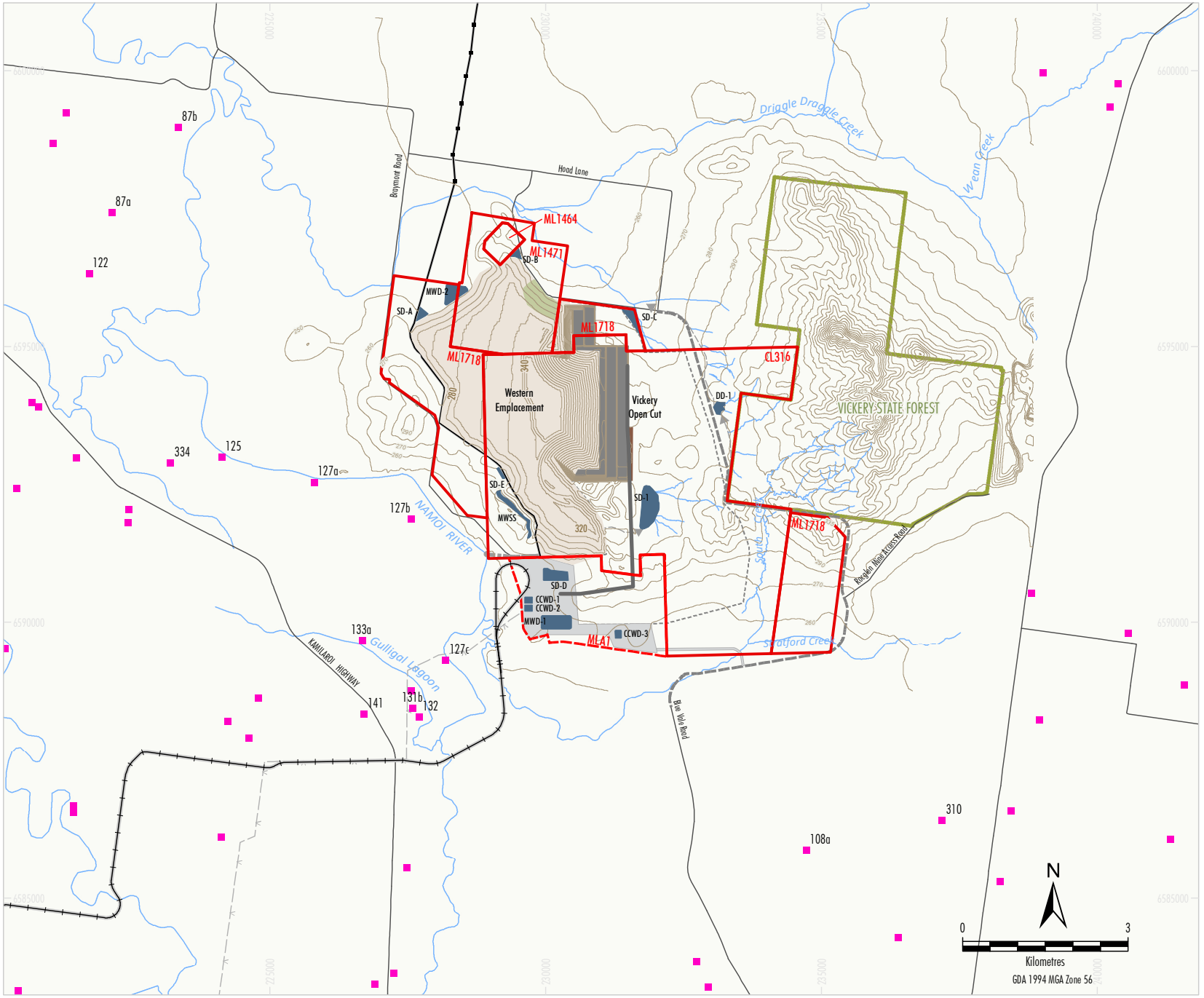
WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Proximity of Receivers to Operations - Project Year 3

Figure 18

WHC-15-33_RTS 212A


LEGEND
Mining Tenement Boundary (ML & CL)
Mining Lease Application (MLA)
State Forest
Existing 66kV Powerline
Indicative Road Realignment
Indicative Namoi River Pump Station and Pipeline
Indicative Up-catchment Diversion
Indicative Active Mining
Indicative Active Waste Rock Emplacement
Indicative Soil Stripped
Indicative Initial Rehabilitation
Indicative Infrastructure Area
Indicative Extent of Water Storage
Indicative Mine Access Road
Indicative Main ROM Coal Haul Road
Indicative Rail Spur Alignment
Indicative Location of Groundwater Bores and Pipeline
Indicative Maximum Extent of Open Cut
Private Receiver
Source: Department of Land and Property Information (2014); Department of Industry (2015)
ML1464
ML1471
ML1718
CL316
MLA1
Western Emplacement
Vickery Open Cut
VICKERY STATE FOREST
SD-A
SD-B
SD-C
SD-D
SD-E
MWD-1
MWD-2
MWSS
DD-1
CCWD-1
CCWD-2
CCWD-3
Braymont Road
Hoad Lane
Driggle Driggle Creek
Wean Creek
NAMOI RIVER
Gulligal Lagoon
Stratford Creek
Boggy Creek
Blue Vale Road
Rocglen Mine Access Road
KAMILAROI HIGHWAY
87b
87a
122
334
125
127a
127b
133a
127c
141
131b
132
310
108a
0
3
Kilometres
GDA 1994 MGA Zone 56
N
WHITEHAVEN COAL
VICKERY EXTENSION PROJECT
Proximity of Receivers to Operations - Project Year 7
Figure 19
WHC-15-33_RTS 213A

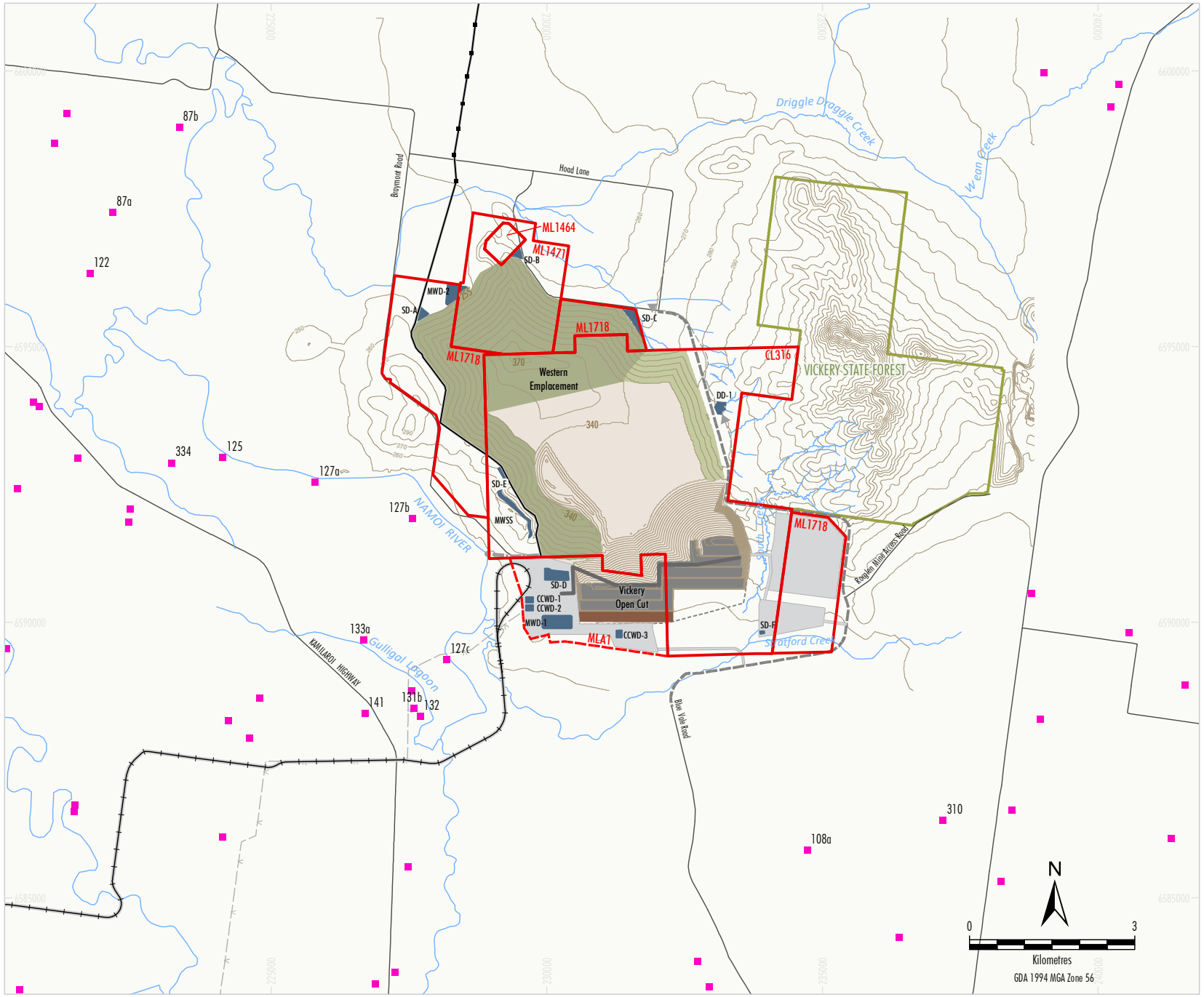

LEGEND
Mining Tenement Boundary (ML & CL)
Mining Lease Application (MLA)
State Forest
Existing 66kV Powerline
Indicative Road Realignment
Indicative Namoi River Pump Station and Pipeline
Indicative Up-catchment Diversion
Indicative Active Mining
Indicative Active Waste Rock Emplacement
Indicative Soil Stripped
Indicative Initial Rehabilitation
Indicative Established Rehabilitation
Indicative Infrastructure Area
Indicative Extent of Water Storage
Indicative Mine Access Road
Indicative Main ROM Coal Haul Road
Indicative Rail Spur Alignment
Indicative Location of Groundwater Bores and Pipeline
Indicative Maximum Extent of Open Cut
Private Receiver
Source: Department of Land and Property Information (2014); Department of Industry (2015)
Driggle Draggle Creek
Wean Creek
Braymont Road
Hood Lane
ML1464
ML1471
ML1718
SD-A
SD-B
SD-C
MWD-2
Western Emplacement
CL316
VICKERY STATE FOREST
DD-1
SD-E
MWSS
NAMOI RIVER
Vickery Open Cut
SD-D
CCWD-1
CCWD-2
MWD-1
CCWD-3
MLA1
SD-F
Spattord Creek
Rogden Mine Access Road
Blue Vale Road
KAMILAROI HIGHWAY
Gulligal Lagoon
87b
87a
122
334
125
127a
127b
133a
127c
141
131b
132
108a
310
N
0
3
Kilometres
GDA 1994 MGA Zone 56
WHITEHAVEN COAL
VICKERY EXTENSION PROJECT
Proximity of Receivers to Operations - Project Year 21
Figure 20
WHC-15-33_RTS 214A

Table 11
Indicative Project Mine Schedule (Table 2-2 of the EIS)

Year	Open Cut Waste Rock (Mbcm)	Open Cut ROM Coal (Mt)
1	-	-
2	12.2	1.0
3	34.0	2.7
4	54.0	4.3
5	74.0	5.5
6	89.0	7.2
7	89.0	8.4
8	89.0	8.5
9	89.0	9.8
10	89.0	9.3
11	89.0	8.8
12	91.9	8.6
13	95.0	8.6
14	95.0	8.3
15	95.0	9.1
16	95.0	9.9
17	95.0	9.6
18	95.0	9.7
19	95.0	9.5
20	90.0	8.9
21	95.0	9.9
22	70.0	7.8
23	55.0	6.5
24	35.0	4.0
25	15.0	2.1
26	5.4	1.1
Total	**1,830**	**179***

Mbcm = million bank cubic metres

Mt = million tonnes

* Refer to Section 2.1 in regard to Amendment Report and associated reduction in total ROM coal.

Year 3 represents the first year of significant mining operations (i.e. ramp up) and when operations are located on the western side of the Project area. By Year 7, operations are effectively at full production, with waste emplacement still occurring on the western side of the Project. All scenarios modelled included the operation of the Project CHPP, rail loop and rail spur, as well as receipt of ROM coal from other Whitehaven operations where relevant (i.e. this would not occur in Year 21 as this is beyond the life of the Tarrawonga and Rocglen Coal Mines).

Proximity to Privately-owned Receivers

Given the modelling of Years 3, 7 and 21 has captured the maximum intensity of operations and elevation of mining landforms, the only factor that could result in increased modelled noise levels in other years would be if operations in other years (not modelled) were significantly closer to receivers.

Figures 18 to 20 show private receivers with respect to Project operations in Years 3, 7 and 21.

Mine snapshots for all Project years have been analysed to establish the minimum distance of operations to the closest receivers to the Project.

The minimum distance of operations to all privately-owned receivers (all Project years) occurs during either Project Year 7 or 21 for all receivers except those to the south-east of the Project. This demonstrates that other scenarios not modelled were no closer to receivers except those to the south-east of the Project, and modelling these other years would result in the same or lower noise levels.

Open cut operations would progress towards receivers located to the south-east of the Project mining area after Year 21. The modelled scenarios are still considered to be worst-case for these receivers to the south-east as:

- the open cut extent only progresses approximately 500 m further towards receivers (and the closest receivers to the south-east are at least 4 km from operations);
- the intensity of operations significantly reduces following Project Year 21 (Table 11), and therefore fleet numbers are also reduced; and
- predicted noise levels for south-east receivers are significantly below relevant impact assessment criteria for the modelled years which have higher intensity operations (Table 12).

Table 12
Predicted Noise Levels for South-east Receiver IDs 108a and 310

Receiver ID	Assessment Scenario	Predicted Maximum $L_{Aeq,15min}$ Operational Noise Levels (dBA)		
		Day	Evening	Night
108a	Year 3	18	24	24
	Year 7	21	27	27
	Year 21	22	30	30
310	Year 3	17	21	22
	Year 7	19	24	25
	Year 21	20	28	29
Criteria		**40**	**35**	**35**

Whitehaven commits to implementing all reasonable and feasible measures in meeting Development Consent and EPL noise limits at all relevant receiver locations in all years of the Project life.

i. Justification of Kurrumbede Homestead blasting criteria

Wilkinson Murray (2018) nominated a vibration limit of 10 millimetres per second (mm/s) and airblast limit of 133 dBA for the Kurrumbede Homestead based on potential for structural damage as prescribed in relevant standards and guidelines.

Blast modelling predicts there would be no exceedance of blast vibration and overpressure criteria for building damage at the Kurrumbede Homestead.

To avoid physical damage to the Kurrumbede Homestead, Whitehaven commits to meeting building damage blast criteria (10 mm/s [vibration] and 133 dBA [air blast], or alternative limits if determined to be suitable via engineering inspection).

2. Clarification of noise and blasting levels at other Whitehaven operations

Results of Noise and Blast Investigations at Other Whitehaven Operations

The majority of noise and blasting monitoring results recorded during the past 5 years across the Maules Creek, Tarrawonga and Rocglen Coal Mines are below the relevant compliance criteria.

Noise monitoring is undertaken by an independent acoustic consultant at each of the operations. In addition, Independent Environmental Audits are prepared by independent consultants as specified in relevant Development Consent conditions for each operation. Key conclusions from Independent Environmental Audits relevant to noise and blasting at the Maules Creek, Tarrawonga and Rocglen Coal Mines are provided below.

Maules Creek Coal Mine

- The Maules Creek Coal Mine Conditions of Approval Independent Environmental Audit Report (ERM, 2018) was conducted for the period July 2015 to June 2018 and concluded:

  On behalf of MCCM [Maules Creek Coal Mine]*, an acoustic consulting firm (Global Acoustics) conducts attended noise monitoring on a monthly basis in accordance with the Noise Management Plan and the NSW Industrial Noise Policy. The results of this monitoring generally demonstrated compliance with the noise impact assessment criteria at each of the monitoring locations for the audit period, with each exceedance as a result of the application of the NSW Industrial Noise Policy 2000 low frequency modifying factor, such exceedances are considered to be 'technical exceedances'* [i.e. an exceedance where the noise measurement itself does not exceed criteria, only the measurement plus modifying factor].

  Blast monitoring is undertaken at monitoring locations BM 1 to BM 4 as per the requirements of the EPL and the Blast Management Plan. … While there have also been a very limited number of blasts that have exceeded the 115dBL criteria, they have been insufficient to go above the 5% of allowable exceedances as authorised under the CoA and EPL.

Rocglen Coal Mine

- The *Rocglen Mine Independent Environmental Audit* (ERM, 2019) was conducted for the period March 2016 to February 2019 and concluded:

  Rocglen Coal Mine Annual Reviews for 2016 and 2017 identified one noise exceedance during the 2016 reporting period (1st August 2016 to 31st December 2016), and three exceedances during the 2017 reporting period (1st January 2017 to 31st December 2017). All exceedances were recorded at the Surrey property.

  The blasting criteria was not exceeded for any blast during the 2016 or 2017 reporting period.

  Note the three noise exceedances during the 2017 reporting period were 'technical' exceedances following application of a low-frequency modifying factor.

- The *Rocglen Mine Conditions of Approval Independent Environmental Audit* (ERM, 2016) was conducted for the period April 2013 to May 2016 and concluded:

  … no non-compliance was noted for the noise criteria during the reporting period…

  The maximum recorded overpressure was also within the criteria of 115dBL for not more than 5% of the total number with the exception of two blasts in September 2014. Both of these results were recorded at "Roseberry", and made up 6.7% of all blasts undertaken for the period.

Tarrawonga Coal Mine

- The Tarrawonga Mine Conditions of Approval Independent Environmental and Independent Biodiversity Audit (ERM, 2017) was conducted for the period August 2014 to July 2017 and concluded:

  During the audit period, there was an exceedance of noise criteria at an adjacent privately owned residence. The exceedance was 2dB above the 35dB criteria. As this is an isolated exceedance it was not considered to be sustained or systematic, as such this was not reported as non-compliance.

  …

  Review of evidence identified that no exceedances of ground vibration criteria of the most stringent criteria of 5 mm/s occurred during the reporting period. Exceedances of airblast overpressure were recorded in 2015 and 2016 at Tarrawonga and Matong however these locations are owned by the mine and are not private residences.

Note, some exceedances of relevant compliance criteria reported occurred either on Whitehaven-owned land or at privately-owned residences with an agreement in place with Whitehaven. In these cases, the elevated blast overpressure or noise levels are not actually exceedances of the relevant criteria (i.e. the criteria only apply at privately-owned residences where the owner does not have an agreement in place with Whitehaven).

In some instances, Whitehaven has been asked to provide information in relation to such 'non-exceedances' by regulatory authorities. As an outcome of these information requests/investigations, Whitehaven has altered operations or implemented further management measures, including relocating monitoring equipment to locations more representative of privately-owned residences where the relevant criteria apply, restricting scraping activities at times where there are likely to be temperature inversions and additional blast management measures.

For the very small number of occasions where noise criteria have been exceeded, subsequent investigations have generally found compliance with the relevant criteria (i.e. any potential non-compliances have generally not been sustained).

It is noted that most reported exceedances of noise criteria have included the application of a modifying factor for dominant low-frequency noise. However, a number of these occurrences would not require the application of a modifying factor in accordance with the revised low-frequency noise methodology described in the NPfI, which superseded the *Industrial Noise Policy* (EPA, 2000) in October 2017.

Maules Creek Coal Mine 2016 Mandatory Noise Management Audit

It is noted the findings of the *Mandatory Environmental Audit of Noise Management at Maules Creek Coal Mine (MCCM)* (EMM Consulting, 2016) were that:

> *The adequacy of systems, procedures and general measures and its activities are considered appropriate, and consistent with good practice and satisfy the Act and condition L3 of the licence.*

Recommendations of the audit were generally specific to the Maules Creek Coal Mine Noise Management Plan, which would inform the preparation of the Noise Management Plan for the Project.

Some recommendations of the audit have already been incorporated into the Project, including consideration of low SWL equipment during procurement, enclosure/shrouding of the CPP and consideration of low-frequency noise in selection and/or design of equipment and mitigation measures.

3. Proposed noise monitoring and mitigation measures

The Noise and Blasting Assessment (Appendix D of the EIS) was prepared in accordance with the NPfI, which requires an assessment of potential noise impacts following the implementation of all reasonable and feasible mitigation measures. In addition, the Noise and Blasting Assessment adopted indicative SWLs consistent with current leading practice mining equipment for noise performance.

Reasonable and feasible mitigation measures that were considered for the Project and incorporated in the modelling include (Wilkinson Murray, 2018):

- Redesign of the waste rock emplacement area, haul road alignments and mine progression direction to provide opportunities for shielding of operations during adverse meteorological conditions.
- Enclosure and/or acoustic shrouding of selected infrastructure items in the mine infrastructure area.
- Noise controls on mobile equipment.

The Project pro-active noise management system (as described in Section 5.3 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]) was not included in the noise modelling and therefore provides opportunity for further noise attenuation as required during periods of adverse meteorological conditions.

Pro-active noise management is successfully used throughout the mining industry to manage noise levels within compliance limits.

Rail activities with the potential to cause instantaneous noise (e.g. shunting) would be unlikely to occur on the rail spur, but may occur at the rail loop, immediately adjacent to the mine infrastructure area.

The Noise and Blasting Assessment conducted for the Project included consideration of potential instantaneous noise impacts (Section 5.12 of Appendix D of the EIS). This instantaneous noise assessment included a maximum noise level of 125 dBA associated with impact noise at the mine infrastructure area. It is noted the *Mount Pleasant Operation Rail Modification Noise Assessment* (Wilkinson Murray, 2017) describes that rail activities such as bunching and stretching could potentially produce noise levels of up to 119 dBA. This is within the range of instantaneous noise levels assessed for the Project.

Whitehaven notes that potential noise impacts from the Project rail spur are predicted to comply with the RING at all privately-owned residences when considering local noise-enhancing meteorology (Section 4.13.1 of the EIS).

4. Proposed airblast and vibration monitoring and management measures

Approvals would be sought from the Gunnedah Shire Council and/or Narrabri Shire Council to temporarily close sections of local roads to allow blasting to occur. Local emergency service providers and potentially affected local residents would be notified of blasting-related road closures in advance.

Blast fume management measures that would be implemented for the Project include:

- The use of risk assessments prior to blasting, in order to review factors, such as:
  - geological conditions;
  - ground conditions (e.g. presence of clay or loose/broken ground or heavy rain affected ground);
  - location of the blast relative to previous blasts which may have triggered fume events;
  - blasting product selection; and
  - presence of groundwater;
- The use of the outcomes of the risk assessment to alter the blasting method where necessary by:
  - minimising the time between drilling, loading and shooting of the blast;
  - formulation of explosive products to an appropriate oxygen balance to reduce the likelihood of fumes; and
  - adjusting the blast scheduling to avoid unfavourable meteorological conditions.

These management measures would be detailed in the Project Blast Management Plan.

5. Noise exceedances at privately-owned residences

The Noise and Blasting Assessment also gave consideration to the Voluntary Land Acquisition and Mitigation Policy. The Voluntary Land Acquisition and Mitigation Policy provides that in those cases where the NPfI Project-specific noise criteria are exceeded, it does not automatically follow that all people exposed to the noise would find the noise noticeable or unacceptable.

One receiver on Property ID 127 is predicted to experience noise levels within the 'Noise Acquisition Zone' (i.e. > 5 dBA exceedance of the project-specific noise criteria) under noise-enhancing meteorological conditions during the evening and night-time, which would occur infrequently. It is noted that at this same property none of the P10 noise predictions are at a level consistent with the Noise Acquisition Zone and this property has the right to acquisition upon request in accordance with the Development Consent conditions for the Approved Mine (SSD-5000). A separate receiver on the same property is predicted to experience noise levels within the 'Noise Management Zone' (i.e. 3-5 dBA exceedance of the project-specific noise criteria).

All other noise level exceedances under noise enhancing meteorological conditions during the evening and night-time (three dwellings on Property IDs 131 and 132) are considered negligible (i.e. exceedance is within 1-2 dBA of the project-specific noise criteria) and would not be discernible by the average listener.

It is noted noise level exceedances were predicted during particularly adverse meteorological conditions, which the noise modelling predicts would occur infrequently.

It should be noted that under P10 noise levels (i.e. the level that is exceeded 10% of the time), receivers on private Property IDs 131 and 132 comply with the operational noise criteria and predicted exceedances at the receiver on Property ID 127 are considered 'moderate' (according to the Voluntary Land Acquisition and Mitigation Policy).

The real-time noise monitoring and management system will be used to maintain noise levels consistent with EIS predictions and any Development Consent and EPL noise limits.

6.7 AIR QUALITY

6.7.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to air quality included:

- cumulative dust levels;
- regional air quality monitoring (specifically for Boggabri);
- dust deposition at privately-owned residences and agricultural enterprises;
- accuracy of air quality modelling and predictions;
- reduced dust levels predicted compared to Approved Mine; and
- blast fume monitoring and management.

Agency Submissions

Agencies and local councils that provided comments on the Project relevant to air quality included EPA, NSW Health, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- clarification of the emissions inventory;
- best practice emission control factors;
- implementation of an Air Quality Management Plan; and
- regional air quality monitoring (specifically for Boggabri and Curlewis).

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report referred to comments made in EPA's submission and by the public, specifically justification of adopted emission control factors and reductions in predicted dust levels compared to the Approved Mine. DPIE requested Whitehaven provide additional information to address these comments in the RTS.

Independent Planning Commission Issues Report

Regarding air quality, paragraph 222 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 221, the Commission considers that the Department should give detailed consideration to:*
>
> - *why the dust levels of the Project are predicted to be lower than those for the Approved Project, even though the Project will be extracting and handling more coal, will have a higher production rate and includes operating a CHPP and rail load out facility;*
> - *any comparison of modelling assumptions used for the Approved Project and the Project provided by the Applicant to demonstrate how the changes in technology and practices impact the results; and*

- *which years are the 'worst case' years for operations from the perspective of air quality emissions and identify what are the impacts predicted for nearby residents. The Department may be assisted in this regard by the Applicant providing annual predicted air quality emissions and impacts at sensitive receptors for each year of operation.*

6.7.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided in the sections below:

1. Accuracy of modelling predictions.
    a. Clarification of emissions inventory assumptions.
    b. Justification of best practice emissions control factors.
    c. Justification of Project dust levels compared to Approved Mine.
2. Justification of worst-case modelling scenarios.
3. Potential impacts of dust to agriculture.
4. Proposed air quality monitoring and management.

6.7.3 Responses

1. Accuracy of modelling predictions

a. Clarification of emissions inventory assumptions

Detailed emission inventories for each assessment scenario (i.e. Project Years 3, 7 and 21) are included in Attachment 4. These emission inventories include all assumptions made with regard to air quality modelling, such as wind erosion, haul lengths/loads and indicative fleet numbers consistent with the indicative general arrangements and mining schedule provided in Section 2 of the EIS.

The detailed emission inventories also clarify that crushing and screening emissions (including handling) associated with ROM coal from the Tarrawonga and Rocglen Coal Mines have been modelled at the Project CHPP.

Haulage of ROM coal from the Tarrawonga and Rocglen Coal Mines to the Project CHPP is included in the cumulative modelling on the basis that this activity (i.e. on-road haulage of coal from the Tarrawonga and Rocglen Coal Mines) is approved and would occur regardless of the Project, as described in Appendix 1 of the Air Quality and Greenhouse Gas Assessment (Appendix E of the EIS).

Note that hauling from the Tarrawonga and Rocglen Coal Mines would occur along sealed roads (including the on-site access road to the mine infrastructure area). Wheel-generated dust emissions along sealed roads are very low (e.g. by comparison to wheel-generated dust from unsealed roads).

Notwithstanding, the Project would reduce dust emissions from on-road haulage as it would reduce the distance travelled by trucks transporting coal to and from the Tarrawonga and Rocglen Coal Mines.

b. Justification of best practice emission control factors

The EPA's submission commented on the use of ACARP 22027 and ACARP 20023 as references for some control factors used in the Air Quality and Greenhouse Gas Assessment (Appendix E of the EIS), and stated their preference for other emissions factors (summarised in Katestone Environmental [Katestone], 2011).

ACARP 22027

The Air Quality and Greenhouse Gas Assessment for the Project only references surface stabilisation control factors for wind erosion from ACARP 22027.

Katestone (2017) prepared a benchmarking study for the EPA to determine appropriate dust controls to be implemented at the Maules Creek Coal Mine (*Best Practice Dust Management Benchmarking Study – Maules Creek Coal Mine* [Katestone, 2017]). This study updated the best practice control factors described in Katestone's 2011 report *NSW Coal Mine Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, which is referenced by the EPA in its submission.

The Katestone (2017) study includes the specific surface stabilisation control factors used in the Air Quality and Greenhouse Gas Assessment for the Project (i.e. Katestone considers the surface stabilisation control factors documented in ACARP 22027 represent best practice management of wind erosion emissions).

Therefore the surface stabilisation control factors used, which are consistent with ACARP C22027 and the Katestone (2017) study, are considered representative of best practice management and appropriate for the Project Air Quality and Greenhouse Gas Assessment.

ACARP 20023

The Air Quality and Greenhouse Gas Assessment for the Project only references surface treatment control factors (specifically watering of haul roads) from ACARP 20023. The EPA's submission stated the "90% control factor used for watering of roads is considered high and not achievable".

Subsequent to the NSW Coal Benchmarking Study (Katestone, 2011) and the National Pollutant Inventory (2012), the EPA's Dust Stop Pollution Reduction Program required all open cut coal mines in NSW to implement best practice measures to significantly reduce their dust emissions.

The Dust Stop Pollution Reduction Program included a requirement for all mines to demonstrate at least 80% dust control was being achieved on active haul roads (i.e. greater than the EPA's recommendation for a 75% control factor).

As a result of the Dust Stop Pollution Reduction Program, all NSW open cut coal mines successfully demonstrated control efficiencies of 80% or more. Results with greater than or equal to 90% control efficiency were reported by many mines, including:

- Maules Creek Coal Mine (92%). Maules Creek Coal Mine PRP E1: Monitoring Results – Wheel Generated Dust, Pacific Environment Limited, 2016.
- Werris Creek Coal Mine (96%). Werris Creek Coal PRP U1: Monitoring Results – Wheel Generated Dust, Pacific Environment Limited, 2014.

- Bulga Coal Mine (90%). Report for U1 Particulate Matter Control Best Practice Implementation – Wheel Generated Dust, Glencore, 2014.

As Whitehaven has demonstrated it can achieve greater than 90% control efficiency on unsealed haul roads at a number of its existing operations (e.g. Werris Creek and Maules Creek Coal Mines), it is reasonable to expect that at least a 90% level of control can be achieved for the Project.

The Air Quality and Greenhouse Gas Assessment (Appendix E of the EIS) was peer reviewed by Todoroski Air Sciences (Aleks Todoroski, Director) (see Attachment 4 of the EIS). The peer review undertaken by Todoroski Air Sciences stated:

> *… The controls proposed appear to be sufficient and consistent with general best practice, especially in light of the relatively low predicted dust contributions.*
>
> *…*
>
> *The scale of the impacts appears to be consistent with the reviewer's expectations given the estimated dust emissions levels and the distance of sources to receptors. The Report indicates low levels of dust contribution due to the project.*

This level of control would be achieved during operations by:

- restricting speeds on haul roads;
- haul road watering; and
- where sufficient water is not available, or is being used for other purposes, use of chemical dust suppressants.

c. Justification of Project dust levels compared to Approved Mine

Compared to the emissions inventory for the Approved Mine, the Project would no longer require certain high-intensity emissions activities, including on-site gravel crushing and scraping for rehabilitation.

The Project air quality modelling also adopted improved control factors:

- Wheel-generated dust control on haul roads has improved since the Approved Mine modelling (i.e. 90% control has been assumed for the Project compared to 75% for the Approved Mine) (refer to response to Issue 1b above).
- The ROM hopper would be enclosed for the Project, therefore a 70% control factor has been applied to emissions associated with ROM rehandling (compared to no control applied for the Approved Mine).
- The emissions factor for overburden removal and dumping by dozers was improved based on site-specific measurements at nearby Whitehaven operations.
- Dozer emissions in the open cut also experience a reduction due to a decrease in intensity of operations for the Project (i.e. the Approved Mine had two open cuts advancing simultaneously, whereas the Project has one).

The measures outlined above compensate for additional emissions sources associated with the Project, such as higher material handling and processing rates and operation of the on-site CHPP and rail load-out facility.

In particular, wheel-generated dust from haul roads is predicted to be the dominant uncontrolled PM_{10} emission source for both the Project (62% to 81% of total emissions) and the Approved Mine (66% to 74% of total emissions).

As described above, the control factor for surface treatment of haul roads has improved from those modelled for the Approved Mine (i.e. 90% control has been assumed for the Project compared to 75% for the Approved Mine).

Chart 5 provides a comparison of predicted Year 7 PM_{10} emissions for the Approved Mine and the Project.

To allow like-for-like comparison, a 90% surface treatment control factor has been applied to the Approved Mine predictions (Chart 5). This demonstrates that, when 90% haul road control is applied to both the Approved Mine and the Project the predicted emissions for the Project are reasonable.

Chart 5
Approved Mine and Project PM_{10} Emissions (Year 7) - Haulage and Total Emissions

Whitehaven commits to implementing all reasonable and feasible dust management measures to meet Development Consent and EPL air quality criteria at relevant receivers.

2. *Justification of worst-case modelling scenarios*

Similar to the justification of noise modelling scenarios (Section 6.6), the three operation scenarios modelled for air quality (Years 3, 7 and 21) are considered representative of maximum emissions from the Project (i.e. on the basis of intensity of operations and proximity of operations to receivers). The analysis of minimum distance of operations in all Project years to the closest privately-owned receivers (Section 6.6) indicates the minimum distance is captured by Year 7 or 21 for all receivers except 108a and 310.

Receiver IDs 108a and 310 are located to the south-east of the Project mining area and therefore the open cut would progress towards them after Year 21. The modelled scenarios are still considered worst-case for these receivers to the south-east as:

- the open cut extent only progresses approximately 500 m further towards receivers (and the closest receivers to the south-east are at least 4 km from operations);
- the intensity of operations reduces following Project Year 21 (Table 11), and therefore amount of material handled and fleet numbers are also reduced; and
- predicted Project air quality emissions for south-east receivers are significantly below relevant impact assessment criteria for the modelled years that have higher intensity operations (Table 13).

Table 13
Predicted Air Quality Emissions for South-east Receivers 108a and 310

Receiver	Assessment Scenario	Predicted Project-only Air Quality Emissions					
		Annual Average PM_{10} ($\mu g/m^3$)	24-hour PM_{10} ($\mu g/m^3$)	Annual Average $PM_{2.5}$ ($\mu g/m^3$)	24-hour $PM_{2.5}$ ($\mu g/m^3$)	Annual Average TSP ($\mu g/m^3$)	Dust Deposition (g/m^2/month)
108a	Year 3	0.3	7.9	0.1	1.7	0.5	0.0
	Year 7	0.8	8.2	0.2	1.8	1.4	0.0
	Year 21	0.9	13.3	0.2	2.8	2.0	0.1
310	Year 3	0.3	3.6	0.1	0.8	0.5	0.0
	Year 7	0.6	4.0	0.2	0.9	1.2	0.0
	Year 21	0.7	7.5	0.1	1.5	1.5	0.1
Criteria		**25**	**50**	**8**	**25**	**90**	**4**

Whitehaven commits to implementing all reasonable and feasible measures in meeting Development Consent and EPL air quality criteria at all relevant receiver locations in all years of the Project life.

3. *Potential impacts of dust to agriculture*

The effects of Project-related dust on agricultural activity are expected to be minimal.

Impacts of the Project (e.g. air quality) on surrounding agricultural enterprises have been considered in the Project Agricultural Impact Statement based on the predictions of the Project Air Quality and Greenhouse Gas Assessment (Ramboll, 2018). It should be noted that the relevant air quality consideration with respect to agriculture is dust deposition (measured as grams per square metre per month [g/m^2/month]), as opposed to concentrations of dust in the atmosphere (measured as micrograms per cubic metre [$\mu g/m^3$])

The potential effects of coal dust on agricultural production have been the subject of previous study (Andrews and Skriskandarajah, 1992; in Connell Hatch, 2008), which found that:

- Cattle did not find feed unpalatable if coal mine dust was present at a dust deposition level of approximately 120 g/m^2/month.
- The presence of coal mine dust in feed did not affect the amount of feed that the cattle ate or the amount of milk that the cattle produced at a level equivalent to a dust deposition level of approximately 120 g/m^2/month.
- Cattle did not preferentially eat feed that did not contain coal mine dust. The cattle were able to choose between feed that was free of coal mine dust, feed that contained 120 g/m^2/month of coal mine dust and feed that contained 240 g/m^2/month of coal mine dust.

A review by Farmer (1993) found that the lowest rate of application of inert dusts to commercial crops observed to cause an effect was approximately 15 g/m^2/month.

It is noted that some submissions at the public hearing raised the potential for discolouration of cotton crops due to coal dust from the Project.

The annual average background dust deposition rate (e.g. from existing agricultural activities) recorded across all eight baseline monitoring sites in the vicinity of the Project (Figure 21) is 2.8 g/m^2/month for the period 2012 to 2016 (with the highest annual average at any of the monitors being approximately 8.7 g/m^2/month at 'DDG2', representative of air quality at privately-owned receiver 127b [Figure 21]) (Ramboll, 2018).

The maximum predicted incremental increase in dust deposition due to the Project is 1 g/m^2/month (at receiver 127b). Therefore the maximum predicted cumulative dust deposition rate, based on the annual average background and maximum predicted incremental Project dust deposition rate, is predicted to be 3.8 g/m^2/month (Ramboll, 2018).

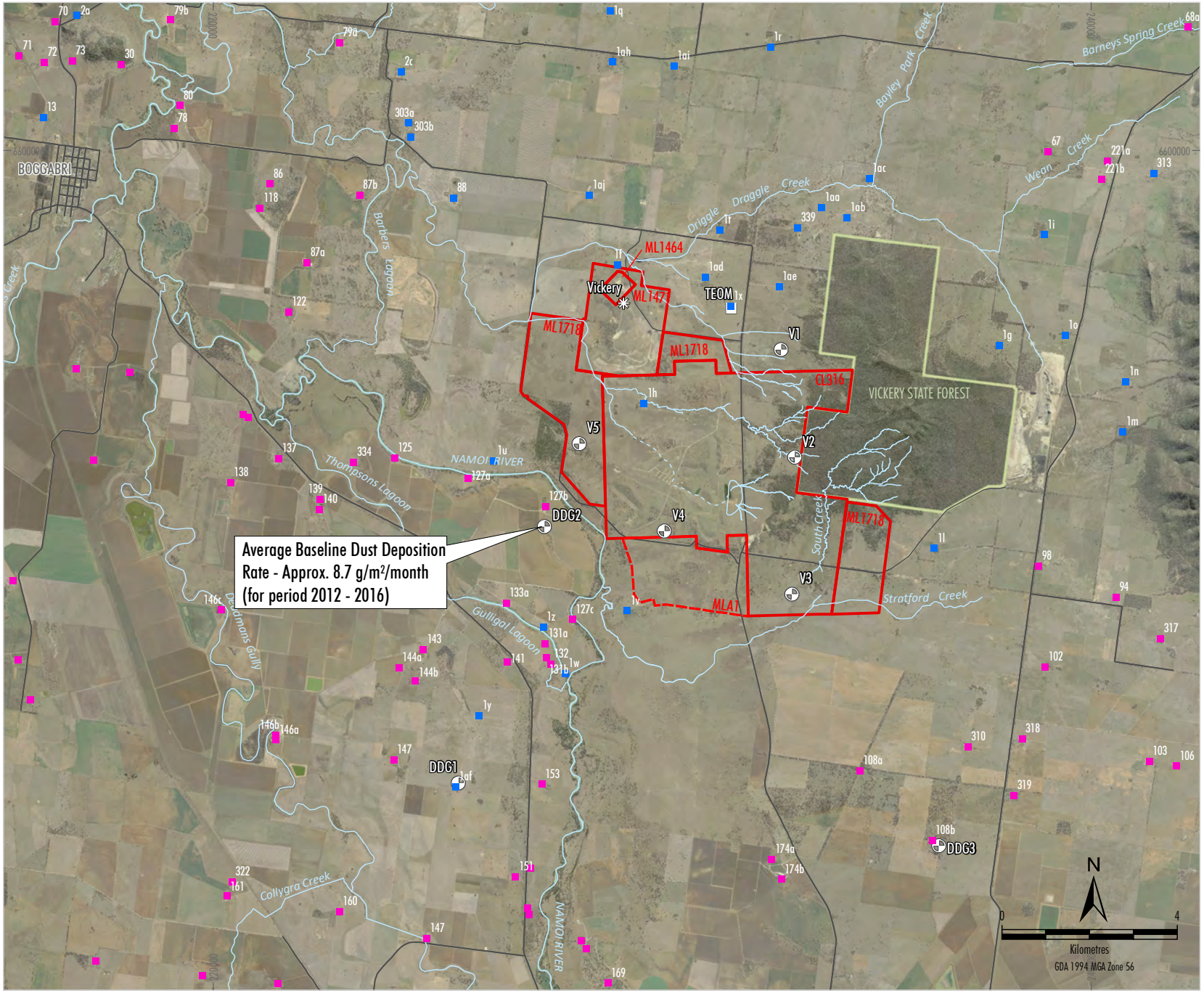
The maximum predicted cumulative dust deposition rate due to the Project is far lower than those detailed in Andrews and Skriskandarajah (1992; in Connell Hatch, 2008) and Farmer (1993), therefore effects of Project-related dust on agricultural production are expected to be minimal.

4. Proposed Air Quality Monitoring and Management

Potential impacts related to human health and amenity have been assessed in the Air Quality and Greenhouse Gas Assessment, which conclude there are no modelled exceedances of air quality criteria designed to protect human health (e.g. TSP, PM_{10} and $PM_{2.5}$) at any existing private dwelling locations.

In addition, no privately-owned receivers are predicted to experience dust deposition levels above the EPA maximum total deposited dust level criterion (4 g/m²/month [annual average]) due to the cumulative contributions from the Project, the Tarrawonga, Boggabri, Rocglen and Maules Creek Coal Mines and background sources (Appendix E of the EIS).

A number of public and local council submitters specifically requested expansion of independent regional monitoring networks to include the towns of Boggabri and Curlewis. As dust from the Project is predicted to be undetectable in Boggabri and Curlewis, Project-specific air quality monitoring in these towns is not considered to be warranted. Monitoring would be conducted closer to the Project, which would be more effective in establishing any contribution of the Project to air quality.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- State Forest
- Mine-owned Dwelling
- Private Dwelling

Whitehaven Monitoring

- Dust Deposition Gauge
- TEOM
- Meteorological Station

Source: LPMA - Topographic Base (2010) and Orthophoto (Boggabri 2011); Department of Industry (2015); Whitehaven (2016)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project Air Quality Monitoring Sites

Figure 21

WHC-15-33_RTS 226A

The Namoi Regional Air Quality Monitoring Program (NRAQMP) is managed by the EPA and the NSW air quality monitoring network, which includes monitoring stations in Gunnedah, Narrabri and Tamworth, is managed by OEH. As such, installation of any new monitoring stations would be subject to the discretion of the EPA and/or OEH.

An existing NRAQMP tapered element oscillating microbalance (TEOM) monitoring location ('Wil gai'), located within the Project mining area, is considered by the EPA to be representative of the ambient air quality in the region.

An Air Quality Management Plan will be developed for the Project in consideration of the requirements of any relevant Development Consent and EPL conditions. Whitehaven would also prepare a Blast Management Plan for the Project in accordance with the requirements of any relevant Development Consent and EPL conditions.

Measures to minimise or avoid imperfect blasts, which may result in oxides of nitrogen (NOx) fumes being emitted, would be implemented in accordance with the *Code of Practice: Prevention and Management of Blast Generated NOx Gases in Surface Blasting* (Australian Explosives Industry and Safety Group Inc., 2011) and these measures would be incorporated into the Blast Management Plan.

6.8 PROJECT INFRASTRUCTURE AREA

6.8.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to the project infrastructure area included the adequacy of proposed noise shielding at the Project CHPP.

Independent Planning Commission Issues Report

Regarding the location of the project infrastructure area, paragraph 242 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 241, the Commission considers that the Department should give detailed consideration to:*
>
> - *any noise modelling results provided by the Applicant for alternative rail spur and CHPP locations. Specifically, the Department should consider noise modelling results for the siting of the CHPP approximately 400 m east to enable a noise bund to be located on the western side of the plant, and quantifying any impacts from a loss of reserves. In addition, the Department should consider noise modelling of an alternative site for the CHPP and rail spur located within the infrastructure area allocated for the Approved Project in the south east;*
> - *any details of the comparative noise impacts from the construction of an alternative rail spur in the south east, including but not limited to the intensity and duration of construction of the rail spur;*
> - *any assessment provided by the Applicant as to the potential for locating the CHPP and rail spur in the south-eastern portion of the Project provided by the Applicant including, in particular, a comparison of the impacts of the CHPP and rail spur in the proposed location and the south-eastern location, including flooding, noise, air quality and economic impacts; and*
> - *the Applicant's justification as to why the CHPP cannot be fitted with acoustic cladding to reduce the noise of the CHPP, given the apparent constraints on bunding the CHPP.*

6.8.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Analysis of alternate Project infrastructure area locations.
    a. Noise mitigation bund.
    b. Relocation to the secondary infrastructure area.
    c. Proposed noise shielding at the Project CHPP.

6.8.3 Responses

1. Analysis of alternate Project infrastructure area locations

The location of the Project CHPP was developed in consideration of the following legal, economic and environmental considerations:

- It must be located outside the extent of the open cut to avoid resource sterilisation.
- It must be located outside the predicted extent of flooding from the Namoi River.
- It must be located within existing Whitehaven mining tenements and the Mining Lease Application area (MLA 1).
- It should provide the shortest coal haulage distance for the majority of the Project life to minimise potential impacts from noise and dust emissions as far as practicable and minimise construction and operational costs.
- It should provide the shortest practicable rail spur (i.e. be located on the western side of the project) to minimise potential noise impacts from rail movements and minimise construction and operational costs associated with a further extension of the rail spur around the Project.
- It should allow for the rail spur alignment to avoid direct disturbance of the Kurrumbede Homestead.

Modelling of the CHPP in its proposed location has been undertaken for the EIS, which indicates there would be:

- Compliance with air quality criteria at all private receivers.
- Compliance with operational noise criteria at all private receivers, except:
  - During the evening and night-time, 'negligible' exceedances of the operational noise criteria are predicted at receivers on private Property IDs 131 and 132 during adverse meteorological conditions.
  - During the evening and night-time, 'significant' exceedances are predicted at a receiver on private Property ID 127 during adverse meteorological conditions (noting that this property has the right to acquisition upon request under the Development Consent for the Approved Mine due to predicted 'significant' exceedances).
  - It should be noted that under P10 noise levels (i.e. the level that is exceeded 10% of the time), receivers on private Property IDs 131 and 132 comply with the operational noise criteria and predicted exceedances at the receiver on Property ID 127 are considered 'moderate' (according to the Voluntary Land Acquisition and Mitigation Policy).

In consideration of the above, the CHPP is proposed to be located as presented in the EIS. Notwithstanding, a comparative analysis of the following alternate locations of the mine infrastructure area has been undertaken:

- two arrangements of the mine infrastructure area offset by 400 m to incorporate a noise mitigation bund (i.e. Scenarios 1a and 1b); and
- relocation of the mine infrastructure area to the secondary infrastructure area to the south-east (i.e. Scenario 2).

a. Noise mitigation bund

If the Western Emplacement were to extend to the south to surround the CHPP (or the western side of the CHPP) this additional section of the emplacement would need to be long-term safe and stable (to avoid the cost and environmental impacts associated with rehandling the waste rock material).

The slope of the outer batter of the Western Emplacement was determined from the NSW Mineral Council's (2007) *Rehabilitation by Design Practice Notes* and the NSW Department of Environment, Climate Change and Water's (DECCW's) (2008) *Managing Urban Stormwater Soils and Construction Volume 2E Mines and Quarries*, which state that benches are not expected to be required to control the velocity of runoff from batters where waste emplacement slopes are less than 10% (i.e. 1 in 10) (refer to Section 5.3.3 of the EIS).

An extension of the waste rock emplacement to provide a 'bund' for the Project CHPP at a height of 20 m would be approximately 400 m wide (i.e. 200 m either side of the crest of the emplacement at a slope of 1 in 10) to remain a long-term stable landform.

Relocation of the Project CHPP (i.e. CPP, train load-out facility, stockpiles and dams) and associated rail loop at least 400 m from the location proposed in the Project EIS is not considered feasible given the constraints on the location of the CHPP remain (i.e. Whitehaven mining tenure and avoiding the extent of the open cut).

A comparative analysis was undertaken of the proposed mine infrastructure area location with two potential alternative arrangements offset by approximately 400 m (i.e. to incorporate a noise mitigation bund) within the constraints listed about (e.g. remaining within MLA 1) (Figures 22 and 23).

Table 14 provides a breakdown of the additional cost associated with the two scenarios. Although the cost of earthworks and construction of additional length of rail spur is not insignificant, the potential resource sterilisation is the majority of the economic impact associated with incorporation of a noise mitigation bund (by an order of magnitude). These costs are considered unreasonable for the Project.

Table 14
Breakdown of Associated Costs for Alternate Mine Infrastructure Area Scenarios 1a and 1b

	Scenario 1a	Scenario 1b
Resource Sterilisation*	$1.4 billion (approximately 10 Mt coal sterilised)	$2.1 billion (approximately 15 Mt coal sterilised)
Additional length of rail spur	$0.6 million (approximately 0.06 km of additional spur length)	$5.9 million (approximately 0.58 km of additional spur length)
Earthworks	$1 million	$1.2 million

* Based on coal price of US$100/tonne and exchange rate of 0.7.

It is noted the IPC acknowledged in their Issues Report that "bunding of the CHPP appears to be problematic due to the required width of the bund to ensure the stability of the bund and potential to sterilise coal resources".

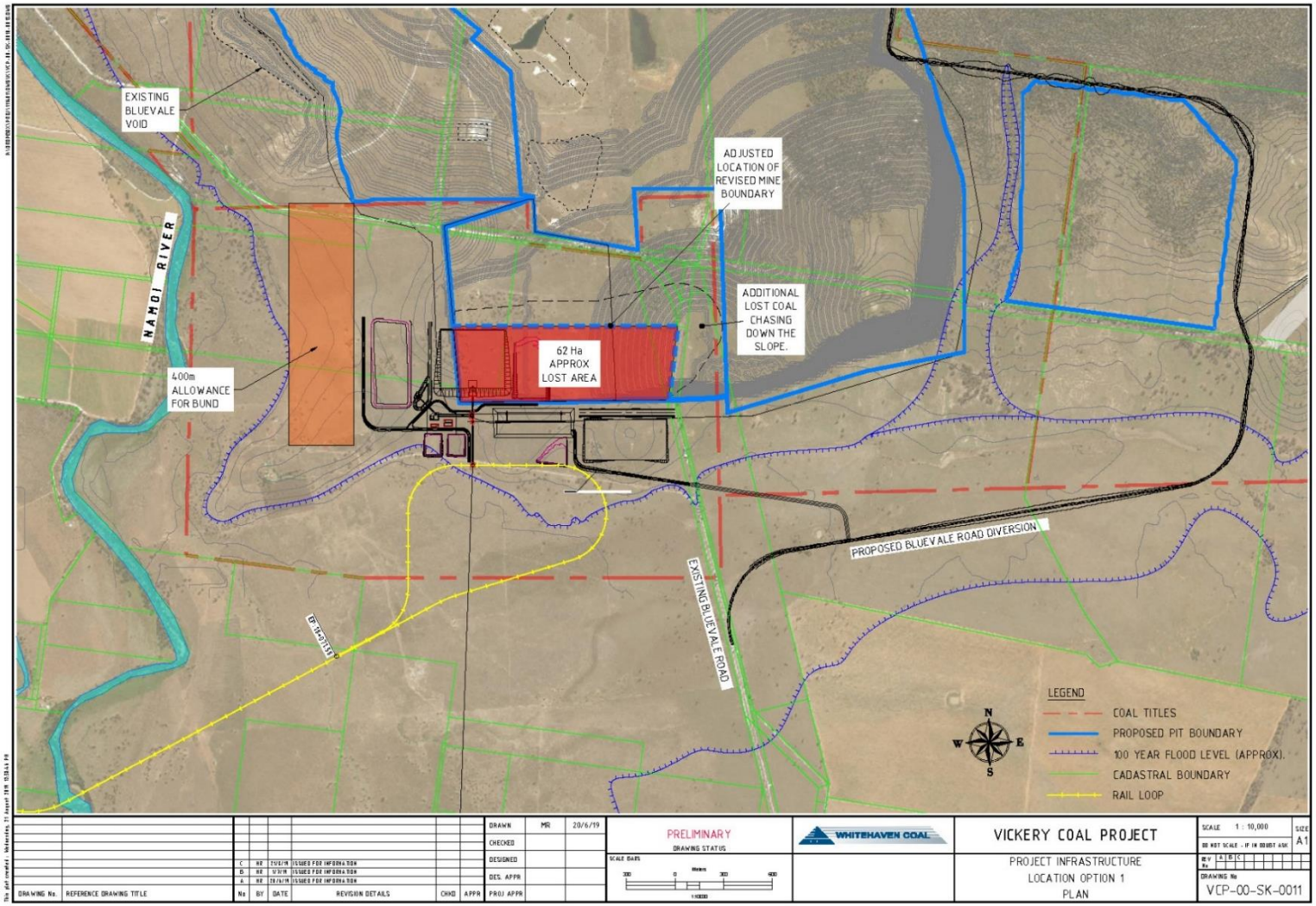


Figure 22: Mine Infrastructure Area Relocation – Scenario 1a (Source: Whitehaven)

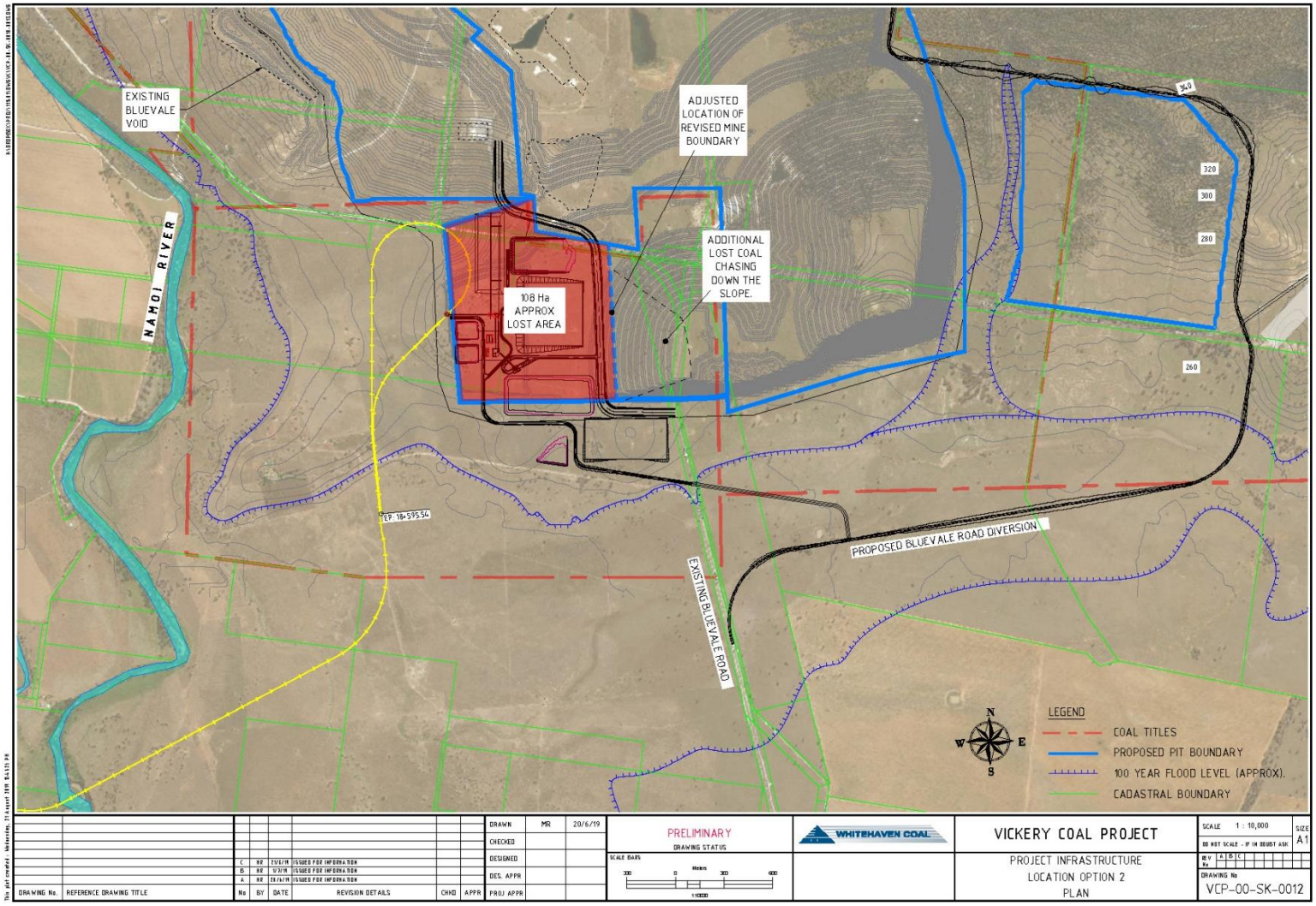


Figure 23: Mine Infrastructure Area Relocation – Scenario 1b (Source: Whitehaven)

b. Relocation to the secondary infrastructure area

A comparative analysis was undertaken of the proposed mine infrastructure area with the alternate scenario of the infrastructure relocated to the south-east (i.e. within the secondary infrastructure area) (Figure 24).

The secondary infrastructure area is not considered to be a superior alternative for the location of the Project CHPP, rail loop and associated infrastructure as:

- increased costs and emissions associated with increased haulage distances from the active mining area (note the cost of re-designing the mine plan has not been considered in this analysis);
- potential sterilisation of additional coal resources within Coal Lease (CL) 316 or ML 1719 (which are not part of the Project); and
- additional economic impacts which are considered unreasonable for the Project, including:
  - construction of additional 3.7 km of rail spur ($60 million);
  - construction of required rail over passes of Blue Vale Road (prior to realignment) and the mine access road, as well as additional waterway crossing of ephemeral creeks ($10 million); and
  - additional earthworks ($15 million).

Further survey and assessment required to determine potential additional environmental impacts which could arise from relocation of the mine infrastructure area and associated realignment of the Project rail spur would include Aboriginal cultural heritage, native vegetation and fauna habitat, flood immunity and additional noise, air quality and visual impacts for receivers to the south-east of the Project.

c. Proposed noise shielding at the Project CHPP.

In response to the IPC's comment in regard to cladding of the CHPP, Whitehaven would implement the following noise attenuation for the Project:

- partial cladding of the CPP using HushClad acoustic lining or equivalent (e.g. openings for personnel to be retained);
- partial cladding of the ROM bin using HushClad acoustic lining or equivalent (e.g. openings for ROM coal transfer to be retained); and
- covers and/or cladding of conveyors.

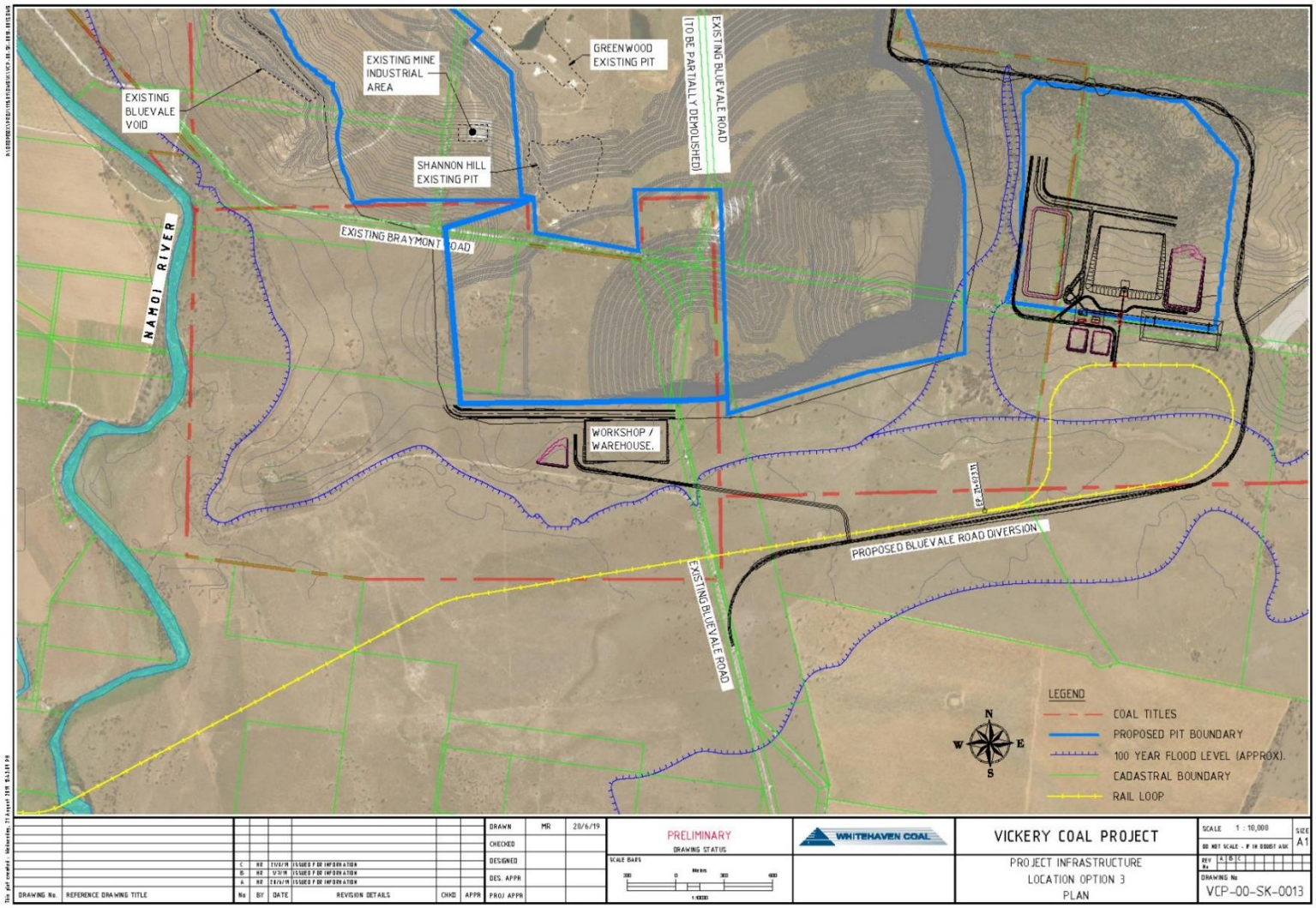


Figure 24: Mine Infrastructure Area Relocation – Scenario 2 (Source: Whitehaven)

Summary

Relocating the Project CHPP, rail loop and rail spur is not considered to be reasonable, given that:

- the limited noise impacts predicted under the most adverse assessable meteorological conditions (i.e. predicted noise exceedances at dwellings on three privately-owned properties, which would reduce to exceedances on one property only under P10 meteorological conditions [with the owners of this property having the right to acquisition upon request for the Approved Mine]);
- even if the CHPP, rail loop and rail spur were relocated, there would be residual noise emissions associated with the mining operations (i.e. reductions in total noise levels would be limited);
- the potential for resource sterilisation; and
- the costs associated with relocation would be prohibitive and/or unreasonable.

Notwithstanding, cladding of the CHPP would mitigate potential noise impacts from this infrastructure.

To minimise noise emissions from the CHPP, Whitehaven commits to implement cladding of the CHPP including the use of HushClad (or equivalent) acoustic lining.

6.9 BIODIVERSITY

6.9.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to biodiversity included:

- assessment of impacts to koala habitat and barriers to movement;
- inconsistent assessment of Winged Peppercress compared to the Approved Mine;
- inconsistent assessment of Weeping Myall Woodland compared to a previous draft of the Project Biodiversity Assessment Report and Biodiversity Offset Strategy (BARBOS);
- impacts to aquatic ecology, including GDEs;
- adequacy of the proposed Biodiversity Offset Strategy;
- value of credits calculated for mine rehabilitation;
- cumulative impacts of vegetation clearing with other operations in the region, including riparian vegetation;
- implementation of avoidance measures; and
- potential impacts to endangered species and communities.

Agency Submissions

Agencies and local government which provided comments on the Project relevant to biodiversity included OEH, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- justification of the koala species polygon and associated credit liability;
- preparation of a Koala Plan of Management prior to determination of the Project;
- justification of Squirrel Glider habitat;
- clarification of potential habitat for Commonwealth-listed fauna species;
- provision of further information on mine rehabilitation to be used as an offset, in accordance with Section 12.2 of the *Framework for Biodiversity Assessment* (OEH, 2014b) (FBA); and
- review of species and ecosystem credits to be generated in the proposed offset areas in accordance with the FBA.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report reinforces comments made in agency and public submissions, specifically ongoing consultation with OEH to confirm the offset liability and requirement for a Koala Plan of Management. DPIE requested that Whitehaven provide the Koala Plan of Management with the RTS.

Independent Planning Commission Issues Report

Regarding biodiversity, paragraph 261 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 268, the Commission considers that the Department should give detailed consideration to:*
>
> - *the Commonwealth Matters;*
> - *any quantification of the potential impact to the local Koala population and measures to avoid impacts and offset to any impacts to Koalas, within the Koala Plan of Management;*
> - *any evidence-based feasibility assessment provided by the Applicant for establishing self-sustaining woodland communities to a standard to satisfy the biodiversity offset requirements;*
> - *any offsetting approach provided by the Applicant, which may include, if necessary, details of how its approach will be staged, the timing, offset value and how it could be successfully undertaken, as well as alternative measures to meet the credit requirements if rehabilitation is not considered achievable; and*
> - *the Applicant's BARBOS and, in particular, whether its BARBOS addresses the information requirements set out by OEH, including agreed upon credit calculations, and provides adequate supporting information in relation to the use of mine rehabilitation.*

6.9.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Biodiversity habitat assessment.
    a. Justification of Koala species polygon and associated credit liability.
    b. Justification of Squirrel Glider species polygon.
    c. Clarification of Commonwealth-listed species habitat.
    d. Justification of cumulative impact of vegetation clearing.
    e. Clarification of impacts to endangered species and communities.
    f. Clarification of impacts to aquatic ecology and aquatic ecosystems.
2. Proposed biodiversity management and mitigation measures.
3. Biodiversity Offset Strategy.
    a. Review of credits generated in proposed offset areas in accordance with the FBA.
    b. Justification of proposed mine rehabilitation consistent with the requirements of the FBA.
    c. Justification of mine site rehabilitation as an offset.
    d. Clarification of timing for proposed rehabilitation as offset.
4. Koala Plan of Management.

6.9.3 Responses

1. Biodiversity habitat assessment

a. Justification of Koala species polygon and associated credit liability

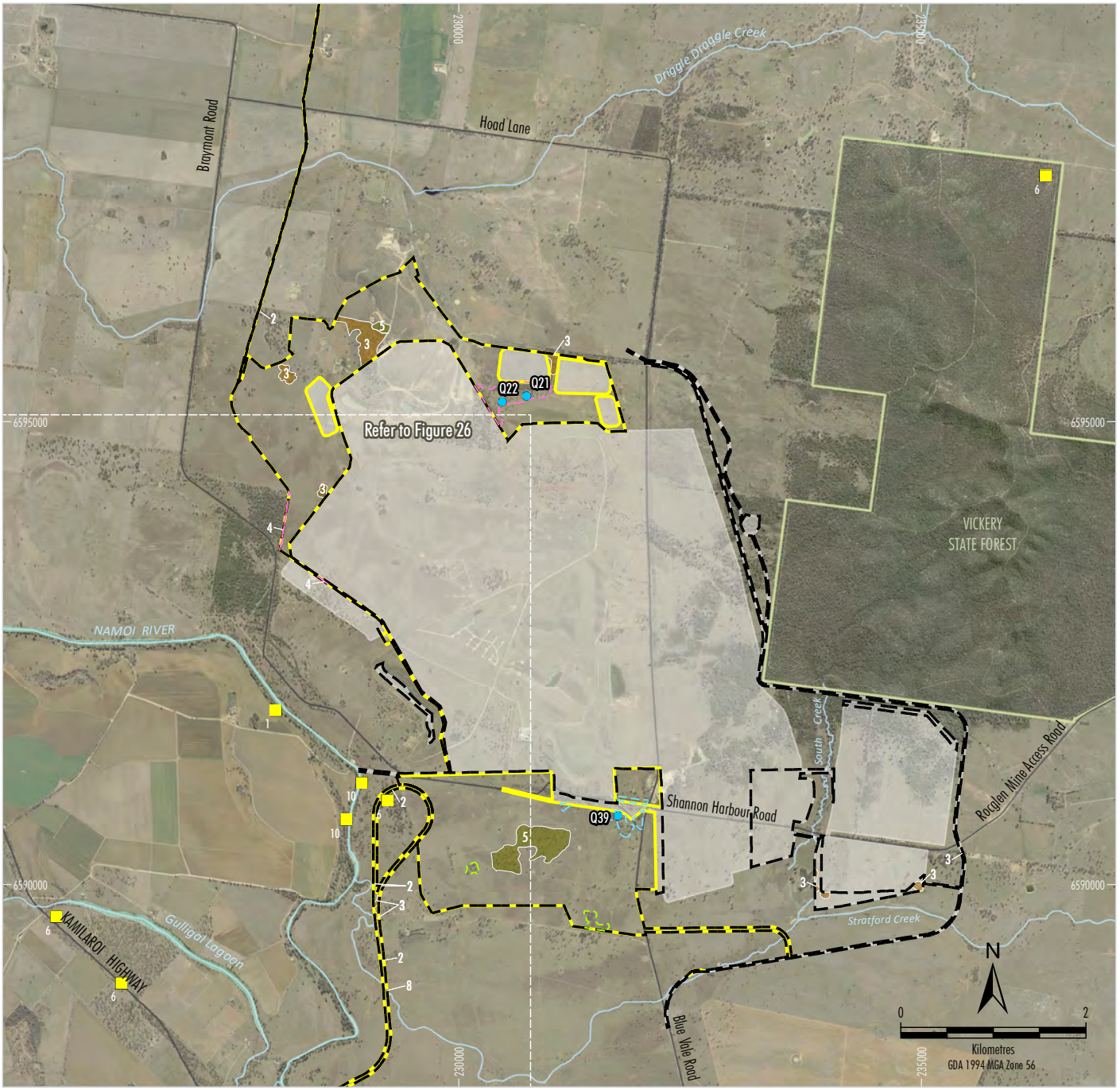
Increasing the Koala species credit polygon to 72.6 hectares (ha) in the NSW Assessment Footprint and 108.9 ha in the Commonwealth Assessment Footprint is not considered to be justified. The species credit polygon mapped for the Koala (Figures 13 and 23 of Appendix F of the EIS, reproduced as Figures 25 and 26 below):

- is based on on-ground survey data collected by Dr Colin Bower;
- covers all potential habitat in the vicinity of records of the Koala near the Namoi River;
- is consistent with the preferred Koala feed tree species in the *State Environmental Planning Policy 44 – Koala Habitat Protection* (SEPP 44);
- is consistent with the preferred Koala feed tree species in the NSW Recovery Plan for the Koala (DECC, 2008);
- is consistent with the preferred Koala tree species in the *Explanation of Intended Effect: State Environmental Planning Policy 44 – Koala Habitat Protection* (NSW Government, 2016).
- is consistent with the definition of Koala habitat in the *EPBC Act Referral Guidelines for the Vulnerable Koala* (Department of the Environment [DoE], 2014).

OEH requested the Koala species credit polygon be expanded to also include other tree species (which are not listed in SEPP 44 or the NSW *Recovery Plan for the Koala*) further away from the Namoi River. The species credit polygon mapped for the Koala does not include these as:

- The Koala has not been recorded in the patches and scattered trees, either historically or during surveys undertaken for the Project by Dr Colin Bower (Figures 25 and 26, below). The Koala is a species credit species and cannot be predicted to be present based on habitat assessment (i.e. PCT, distribution and habitat criteria).
- Including the additional area would be inconsistent with SEPP 44, the NSW *Recovery Plan for the Koala* (DECC, 2008), *Explanation of Intended Effect: State Environmental Planning Policy 44 – Koala Habitat Protection* (NSW Government, 2016) and *EPBC Act Referral Guidelines for the Vulnerable Koala* (DoE, 2014) as no preferred Koala feed tree species are present (refer to Plates 10a, 10b and 10c from survey quadrats 21, 22 and 39 within these excluded patches). Note that Quadrat 10 is not in NA324 (as mentioned by OEH) but is in NA185, outside the development footprint. Therefore it is not relevant to the Koala species credit polygon.
- The species within the identified patches and scattered trees (i.e. Narrow-leaved Ironbark, Silver-leaved Ironbark) are not used by Koalas as preferred feed trees. The references provided by OEH in their submission on the Project EIS support this:
  - Kavanagh et al., 2007:

    ***The two ironbarks (narrow-leaved and silver-leaved)**, although preferred in two home-ranges, were generally used in proportion to their availability and **were more likely to be avoided by koalas** (in the presence of piliga box and/or the red gums) than preferred (Table 2). Compared with most other tree species, the white cypress pine was avoided by koalas.*



LEGEND

- State Forest
- Approximate Extent of Approved Mine
- Approximate Extent of Vickery Extension Project (EPBC 2016/7649) Footprint
- Biodiversity Assessment Report Development Site Footprint
- Koala

Potential Habitat

- 2 Poplar Box Woodland on Alluvial Clay Soils (NA185)
- 3 Pilliga Box – Poplar Box Shrubby Woodland (NA324)
- 4 White Box – Silver-leaved Ironbark Shrubby Open Forest (NA349)
- 5 Narrow-leaved Ironbark – White Box Shrubby Forest (NA311)
- NA311 that does not Provide Habitat for Koala
- NA324 that does not Provide Habitat for Koala
- NA349 that does not Provide Habitat for Koala
- FBA Plot

Source: (1) Future Ecology (2018)
(6) OEH (2017)
(10) Kendall&Kendall Ecological Services (2011)

Note: Sources 2 to 5 and 7 to 9 are not shown on this figure.

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); Flora Search (2018)

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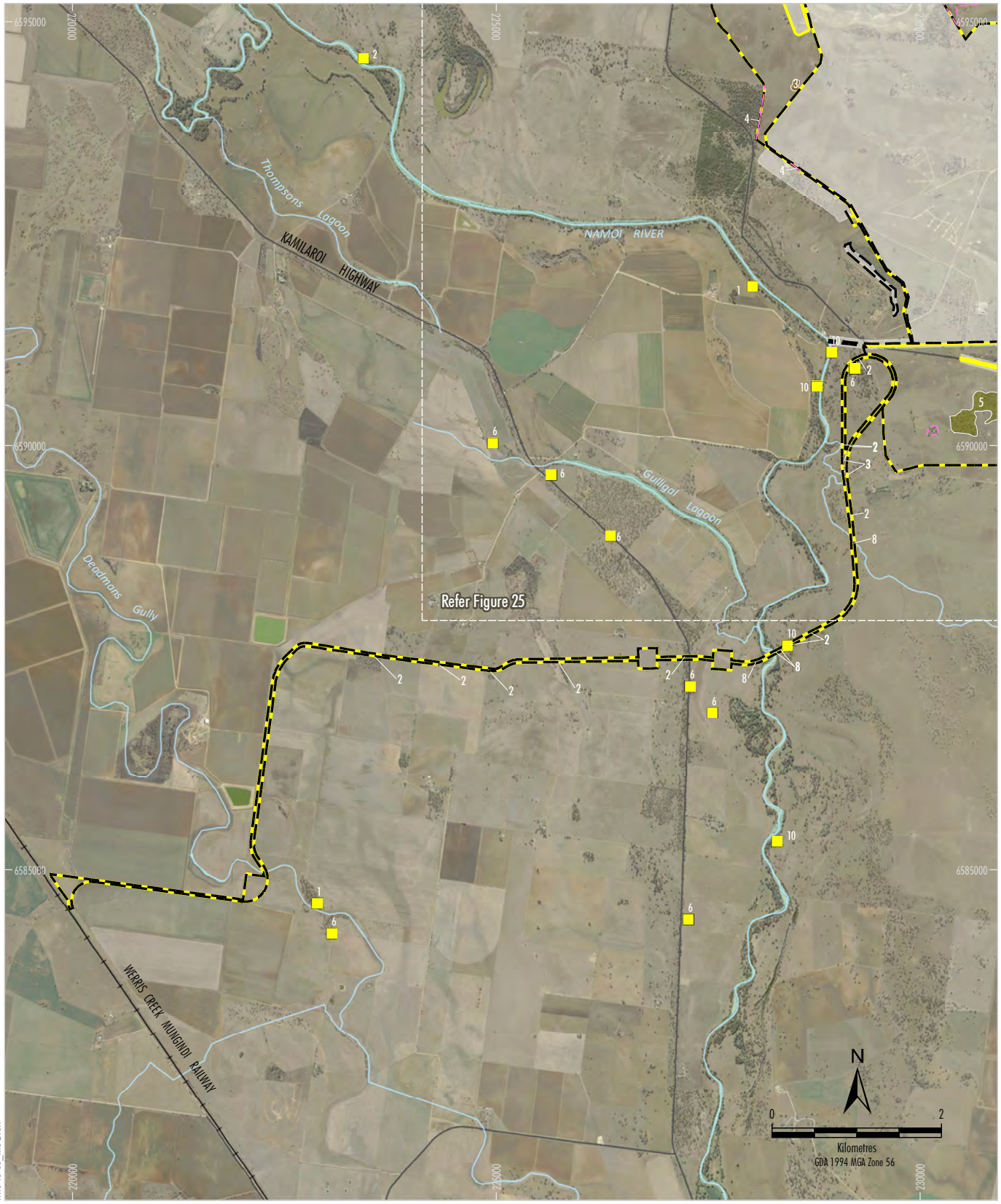
VICKERY EXTENSION PROJECT

Koala Potential Habitat - Mining Area

Figure 25

WHC-15-33_RTS 215A



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LEGEND

- Approximate Extent of Approved Mine
- Approximate Extent of Vickery Extension Project (EPBC 2016/7649) Footprint
- Biodiversity Assessment Report Development Site Footprint
- Koala

Potential Habitat

- 2 Poplar Box Woodland on Alluvial Clay Soils (NA185)
- 3 Pilliga Box – Poplar Box Shrubby Woodland (NA324)
- 4 White Box – Silver-leaved Ironbark Shrubby Open Forest (NA349)
- 5 Narrow-leaved Ironbark – White Box Shrubby Forest (NA311)
- 8 River Red Gum Riparian Tall Woodland (NA193)
- NA349 that does not Provide Habitat for Koala

* Provisional vegetation mapping west of the Kamilaroi Highway based on airphoto interpretation

Source:
(1) Future Ecology (2018)
(6) OEH (2017)
(10) Kendall&Kendall Ecological Services (2011)

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); FloraSearch (2018)

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VICKERY EXTENSION PROJECT

Koala Potential Habitat - Project Rail Spur

Figure 26

Plate 10a Survey Quadrat 21

Plate 10b Survey Quadrat 22

Plate 10c Survey Quadrat 39

WHC-15-33_RTS_002A

Source: FloraSearch (2018)

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VICKERY EXTENSION PROJECT

Survey Photos from Quadrats within vegetation that is not considered to provide Koala habitat

Plate 10a to 10c

- White, 1999:

  In most cases where a preference was shown (16/19) this was for E. tereticornis [Forest Red Gum]. *Conversely,* ***in 12/16 cases where there was avoidance this was against E. crebra*** **[Narrow-leaved Ironbark].**

  …

  Areas 1 and 2 were floristically and structurally dominated by E. crebra but ***koalas showed a consistent preference for E. tereticornis*** **[Forest Red Gum]*, suggesting that E. crebra*** **[Narrow-leaved Ironbark]** ***was insufficient as a food source.***

- The patches are located further from known Koala habitat along the Namoi River (Figure 25), do not contain feed trees and therefore it is less likely that the Koala would use the trees for shade.

b. Justification of Squirrel Glider species polygon

Whitehaven does not consider that NA185 should be incorporated into the Squirrel Glider species polygon as:

- The Squirrel Glider was not recorded within NA185 (PCT101) during past or present surveys. The Squirrel Glider is a species credit species and cannot be predicted to be present based on habitat assessment (i.e. PCT, distribution and habitat criteria).
- OEH databases used by the NSW Biodiversity Assessment Method Credit Calculator do not recognise NA185 as Squirrel Glider habitat (i.e. Archived BioMetric and Threatened Species Profiles Datasets [June 2019] or the Threatened Biodiversity Data Collection [June 2019]).
- A search identified that relevant literature does not reference the Squirrel Glider using NA185 as habitat.

Note Figures 20 and 24 the BARBOS (Appendix F of the EIS) (reproduced as Figures 27 and 28 below) show that the records of the Squirrel Glider are within NA324 and NA193, both recognised in the OEH's *Archived BioMetric and Threatened Species Profiles Datasets.*

c. Clarification of Commonwealth-listed species habitat

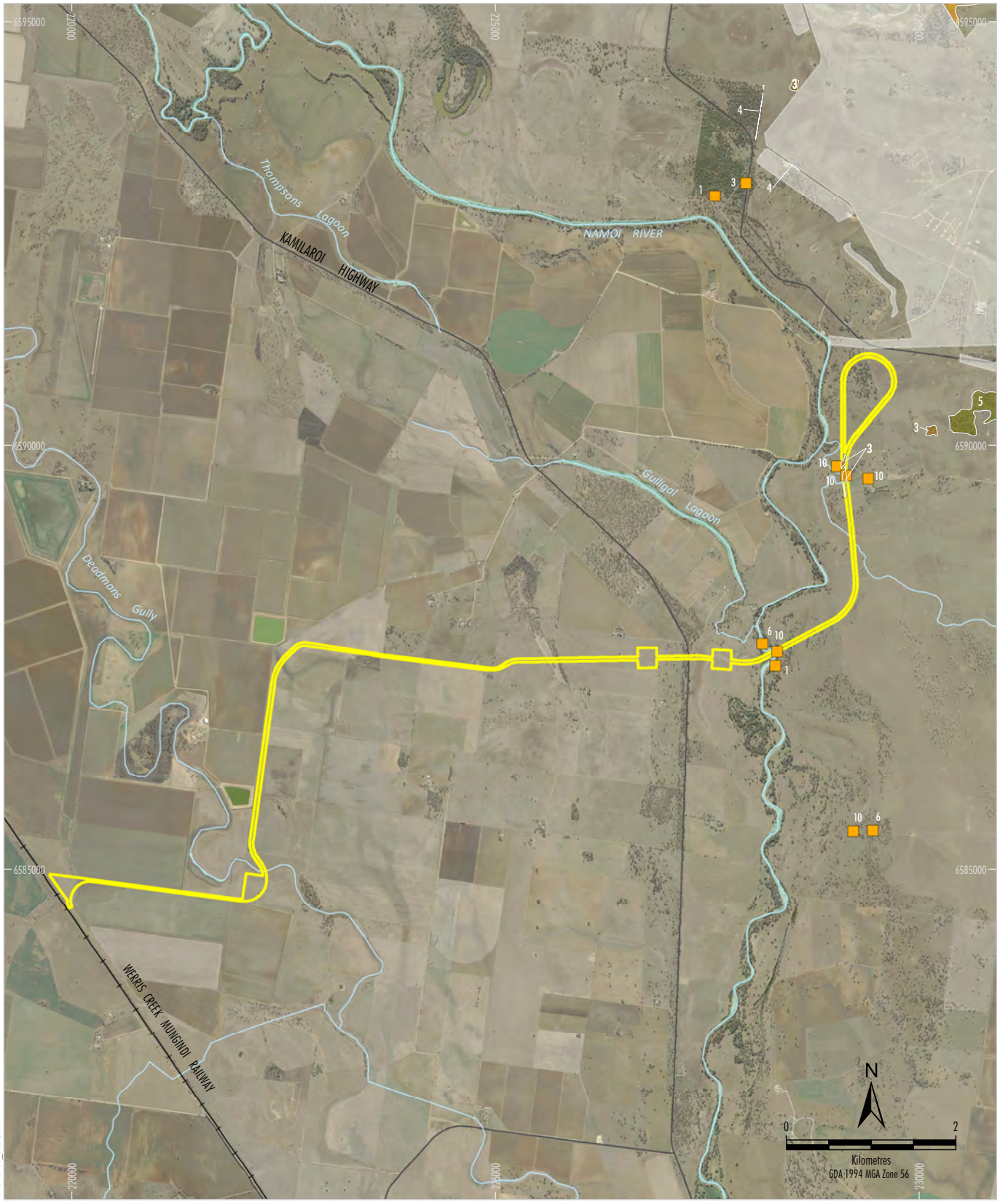
Commonwealth-listed species habitat information is provided in Table 36 of the BARBOS (Appendix F of the EIS) (reproduced as Table 15 below). The assignment of vegetation types to habitat is consistent with OEH's data (i.e. the *Archived BioMetric and Threatened Species Profiles Datasets*).

d. Justification of cumulative impact of vegetation clearing

Cumulative impacts due to disturbance have been assessed in Section 5.1.4 of the BARBOS (Appendix F of the EIS). This included the areas of vegetation clearance, rehabilitation and proposed offsets from the Rocglen Coal Mine as well as the Boggabri, Tarrawonga and Maules Creek Coal Mines (the subjects of the *Leard Forest Regional Biodiversity Strategy*).

Cumulative impacts on threatened species and communities have been considered in Attachments A and B of the BARBOS (Appendix F of the EIS).

The Project would not involve any clearance within the Vickery State Forest. The Project mining area is approximately 1.5 km away from the Vickery State Forest at its closest point.



WHC-15-33 RTS 218A

LEGEND

- Approximate Extent of Approved Mine
- Biodiversity Assessment Report Development Site Footprint
- Squirrel Glider

Potential Habitat

- 3 Pilliga Box – Poplar Box Shrubby Woodland (NA324)
- 4 White Box – Silver-leaved Ironbark Shrubby Open Forest (NA349)
- 5 Narrow-leaved Ironbark – White Box Shrubby Forest (NA311)

Source:
(1) Future Ecology (2018)
(3) Cenwest (2011)
(6) OEH (2017)
(10) Kendall&Kendall Ecological Services (2011)

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); FloraSearch (2018)

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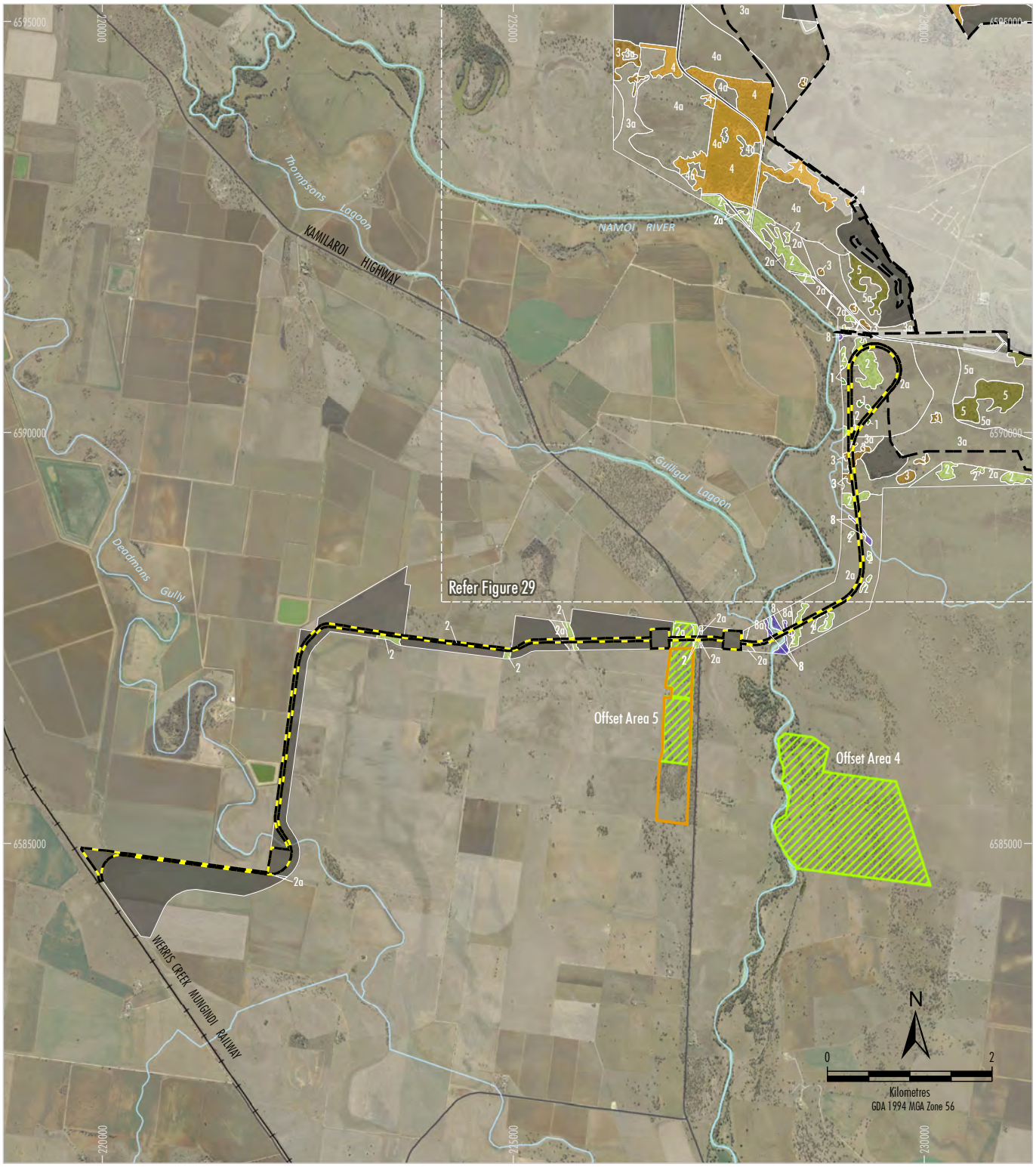
VICKERY EXTENSION PROJECT

Squirrel Glider Potential Habitat - Project Rail Spur

Figure 27



WHC-15-33_RTS 217A

LEGEND

- Approximate Extent of Approved Mine
- Biodiversity Assessment Report Development Site Footprint
- Approximate Extent of Vickery Extension Project (EPBC 2016/7649) Footprint
- Existing Approved Offset Area for the Vickery Coal Mine
- Modified Offset Area 5

Vegetation Communities

Semi-arid Woodlands (Grassy Sub-formation)

- 1 Weeping Myall Woodland (NA219)
- 2 Poplar Box Woodland on Alluvial Clay Soils (NA185)
- 2a Poplar Box Woodland on Alluvial Clay Soils (Secondary/derived grassland) (NA185)

Dry Sclerophyll Forests (Shrub/Grass Sub-formation)

- 3 Pilliga Box – Poplar Box Shrubby Woodland (NA324)
- 3a Pilliga Box – Poplar Box Shrubby Woodland (Secondary/derived grassland) (NA324)

Dry Sclerophyll Forests (Shrub/Grass Sub-formation)

- 4 White Box – Silver-leaved Ironbark Shrubby Open Forest (NA349)
- 4a White Box – Silver-leaved Ironbark Shrubby Open Forest (Secondary/derived grassland) (NA349)

Dry Sclerophyll Forests (Shrubby Sub-formation)

- 5 Narrow-leaved Ironbark – White Box Shrubby Forest (NA311)
- 5a Narrow-leaved Ironbark – White Box Shrubby Forest | (Secondary/derived grassland) (NA311)

Forested Wetlands

- 8 River Red Gum Riparian Tall Woodland (NA193)
- 8a River Red Gum Riparian Tall Woodland (Secondary/derived grassland) (NA193)

Cleared Land

- DL Disturbed Land

Note: Vegetation communities 1, 5, 6 and 7 are not present in the Project Rail Spur

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); FloraSearch (2018)

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VICKERY EXTENSION PROJECT

Vegetation Communities - Project Rail Spur

Figure 28

Table 15
Relevant Matters of National Environmental Significance - Potential Habitat Clearance
(Table 36 of Appendix F of the EIS)

Vegetation Community		Potential Habitat Clearance (ha)					
		Swift Parrot	Regent Honeyeater	Painted Honeyeater	Koala	Corben's Long-eared Bat	Large-eared Pied Bat
Semi-arid Woodlands (Grassy Sub-formation)							
2	Poplar Box Woodland on Alluvial Clay Soils	0	3.7	3.7	3.7	3.7	3.7
2a	Poplar Box Woodland on Alluvial Clay Soils (secondary/derived grassland)	0	0	0	0	88.5	0
Dry Sclerophyll Forests (Shrub/Grass Sub-formation)							
3	Pilliga Box – Poplar Box Shrubby Woodland	26.7	0	26.7	22.7	26.7	26.7
3a	Pilliga Box – Poplar Box Shrubby Woodland (secondary/derived grassland)	0	0	0	0	339.3	0
4	White Box – Silver-leaved Ironbark Shrubby Open Forest	17	17	17	0.5	17	17
4a	White Box – Silver-leaved Ironbark Shrubby Open Forest (secondary/derived grassland)	0	0	0	0	38	0
Dry Sclerophyll Forests (Shrubby Sub-formation)							
5	Narrow-leaved Ironbark – White Box Shrubby Forest	60	53	60	53	60	60
5a	Narrow-leaved Ironbark – White Box Shrubby Forest (secondary/derived grassland)	0	0	0	0	148.5	0
Freshwater Wetlands							
7	Mixed Marsh Sedgeland	0	0	0	0	4	0
Forested Wetlands							
8	River Red Gum Riparian Tall Woodland	1	1	1	1	1	1
8a	River Red Gum Riparian Tall Woodland (secondary/derived grassland)	0	0	0	0	1.7	0
	Scattered paddock trees in secondary derived grassland	0	0.5	0	0	0	0
Habitat in the Commonwealth Assessment Footprint		**104.7**	**75.2^**	**108.4^**	**80.9^**	**728.4>**	**108.4^**

^ Potential foraging habitat.

> Potential foraging and breeding habitat

e. Clarification of impacts to endangered species and communities

Threatened flora and communities

No threatened flora species have been recorded within the additional disturbance area associated with the Project.

Winged Peppercress

The Winged Peppercress has only been recorded within the Approved Mine disturbance footprint. The Winged Peppercress plants within the Approved Mine disturbance footprint would be translocated to a fenced protection area in accordance with the Controlled Action decision (EPBC 2012/6263) and the Development Consent (SSD-5000).

The Approved Mine disturbance footprint was not the subject of the BARBOS (Appendix F of the EIS). No records of the Winged Peppercress were identified within the additional Project disturbance footprint.

Weeping Myall Woodland

Prior to June 2016, only preliminary vegetation surveys had been undertaken of the area where the Weeping Myall Woodland was recorded. The figure provided at the Vickery Community Consultative Committee meeting in June 2016, which demonstrated the results of these preliminary surveys as a working drawing, was marked as a draft and included in the presentation for reference only.

Following additional detailed design of the Project rail spur alignment and the mine infrastructure area, detailed vegetation surveys were undertaken to further define the area of Weeping Myall Woodland. The results of these detailed surveys are presented on Figure 20 of Appendix F of the EIS (reproduced as Figure 27).

Threatened fauna

The Project requires a Biodiversity Offset Strategy that accounts for species credits for the Regent Honeyeater, Squirrel Glider and Koala. The Biodiversity Offset Strategy for the Project, including offset requirements for disturbance of potential threatened fauna habitat, is outlined in Appendix F of the EIS.

f. Clarification of impacts to aquatic ecology and aquatic ecosystems

The Aquatic Ecology Assessment (Appendix N of the EIS) assessed the potential impacts of the Project on aquatic ecology values (including stygofauna, aquatic threatened species and communities).

The Project rail spur would be constructed in accordance with DPI Fisheries (2013) *Policy and Guidelines for Fish Habitat Conservation and Management (Update 2013)* and would not restrict fish passage or significantly impact aquatic ecology values (Appendix N of the EIS).

Potential indirect impacts to aquatic ecology associated with adverse changes in water quality and flow would therefore not result in any significant impact to aquatic ecology (Appendix N of the EIS).

There are no high-priority GDEs identified in the Upper Namoi Groundwater Sources or Porous Rock Groundwater Sources in the vicinity of the Project (Appendix A of the EIS). Recent flora surveys have identified no woodland/forest vegetation communities in the Project locality that exhibit characteristics of groundwater dependency (Appendix F of the EIS).

2. Proposed biodiversity management and mitigation measures

Although the location of the Project is determined by the presence of coal seams, avoidance of potential biodiversity impacts has been considered in the Project design where possible based on the outcomes of baseline survey work.

The majority of the Project mining area is currently cleared and is dominated by grassland areas with occasional regrowth trees. Scattered remnants of woodland, semi-cleared woodland and White Cypress Pine (*Callitris glaucophylla*) re-growth occur in the Project mining area. In addition, the Project mining area includes small areas of land that have been previously disturbed by mining activities and are now rehabilitated.

Whitehaven will prepare and implement a Biodiversity Management Plan for the Project, in consideration of the requirements of any relevant Development Consent conditions.

The overall rehabilitation goal for the Project is to enhance the cover and connectivity of native woodland on the final landform between the Vickery State Forest and the Namoi River, maximising the ability to meet Federal and State biodiversity offset requirements, while returning some areas of the final landform to agricultural land capable of supporting grazing.

Rehabilitation of areas of the Project mining area to woodland/forest has been strategically selected consistent with the surrounding existing land uses (e.g. vegetation and fauna habitat in the Vickery State Forest and along the Namoi River) and to provide a biodiversity corridor linking the Vickery State Forest and the Namoi River. This biodiversity corridor would also be extended by proposed rehabilitation of the Rocglen Coal Mine to the immediate east of the Vickery State Forest.

Rehabilitation of the Project landforms would be undertaken progressively over the Project life and include the establishment of native vegetation and fauna habitat.

The Project is located partially on land mapped as Bush Fire Prone by the NSW Rural Fire Service (Section 4.3.1 of the EIS).

Bushfire management measures would be developed and implemented in accordance with the 'plan and prepare' materials available on the NSW RFS website and the aims and objectives of *Planning for Bushfire Protection* (NSW RFS, 2006) (Section 4.3.3 of the EIS).

Whitehaven would continue to consult with the NSW RFS and provide assistance as required.

3. Biodiversity Offset Strategy

a. Review of credits generated in proposed offset areas in accordance with the FBA

A review of the species and ecosystem credits able to be generated from the offset areas will be undertaken when Whitehaven apply to secure offset areas under the *Biodiversity Conservation Act, 2016* (BC Act) in accordance with the NSW Biodiversity Assessment Method.

Whitehaven may choose to substitute proposed Offset Areas 6, 7, 8 or the Mt Somner Property with alternative offset areas that produce the type and number of species credits required.

Regent Honeyeater

The OEH stated that the *"regent honeyeater was not recorded on Offset Areas 6, 7, 8 or Mt Somner."*

However, it is noted that:

- Regent Honeyeater species credits can only be generated within 'important' habitat mapped by OEH under the BC Act.
- Whitehaven is aware that biodiversity credits generated under the BC Act are not equivalent to those generated under the (superseded) *Threatened Species Conservation Act, 1995*. It is understood that OEH considers the 'reasonable equivalence' of biodiversity credits on a case by case basis.
- The Regent Honeyeater was not recorded in the Project area and no 'important' habitat for the Regent Honeyeater has been mapped by OEH in the Project area.

As such, it is considered that offsetting the impact from the Project within only 'important' habitat mapped by OEH (i.e. elsewhere in NSW) would not be 'reasonable equivalent'.

Squirrel Glider

The OEH stated that the *"squirrel glider was not recorded on Offset Area 7, 8 or Mt Somner. Figure 35 in the BAR indicates that the squirrel glider was recorded in Offset Area 6 in 2018. However, no details regarding this record have been provided."*

It is noted:

- The Squirrel Glider was recorded in proposed Offset Area 6 by Future Ecology (2018) (Attachment D of Appendix F of the EIS) and Cenwest (2011).
- The review of the species credits able to be generated from the offset areas will be undertaken when Whitehaven applies to secure offset areas under the BC Act in accordance with the NSW Biodiversity Assessment Method.

Koala

The OEH stated that the *"koala was not recorded on Offset Areas 6, 7 or 8. The koala was recorded on Mt Somner in 2012. No details of this survey have been provided. Given that this survey occurred more than 5 years ago, its results can inform the credit generation process, but it cannot be used in place of a targeted threatened species survey. No koalas were recorded during the surveys undertaken for this project."*

It is noted:

- The review of the species credits able to be generated from the offset areas will be undertaken when Whitehaven applies to secure offset areas under the BC Act in accordance with the NSW Biodiversity Assessment Method.
- The FBA does not specify that fauna records need to be less than 5 years old.

Whitehaven commits to satisfying the Project offset requirement through retiring the number and type of offset credits applicable to the Project (as determined by the OEH *Credit Calculator for Major Projects and BioBanking*).

b. Justification of proposed mine rehabilitation consistent with the requirements of the FBA

Table 16 below provides a reconciliation of the requirements of Sections 12.2.1.5 and 12.2.1.6 of the FBA. Additional information in support of the conclusions in Table 16 is provided below.

Rehabilitation Completion Criteria

It is reasonable that the initial Mining Operations Plan (MOP) (or equivalent) required under the *Mining Act, 1992* would identify:

- the vegetation types proposed to be targeted in the Project mining area (that occur in the surrounding sub-region and are the same vegetation class as the vegetation types listed in Table 37 of Appendix F of the EIS);
- a list of suitable native plant species to be used in the revegetation of the post-mining landforms; and
- completion/relinquishment criteria.

The MOP would be prepared in accordance with relevant NSW Government rehabilitation and mine closure guidelines.

Whitehaven would develop criteria within a certain timeframe of Project commencement. This is consistent with the approach adopted for the Wilpinjong Extension Project and the Moolarben Coal Project.

Target Vegetation Types

Under the *NSW Offset Policy* (OEH, 2014a) (and associated FBA), the number of ecosystem credits produced for mine rehabilitation does not vary according to the vegetation type proposed to be established (Section 6.2.2.1 of Appendix F of the EIS). Notwithstanding, OEH requested Whitehaven provide further details on potential Biometric Vegetation Types (BVTs) suitable for rehabilitation of the final landform.

There are six BVTs which require offset for the Project, as listed in Table 46 of Appendix F of the EIS (reproduced below as Table 16 for reference). Three of those listed (i.e. NA185, NA201 and NA193) are likely to be unsuitable for rehabilitation of the final landform as they are associated with the vegetation along the Namoi River, on flats and along drainage areas associated with Stratford Creek (refer to Figure 7 of Appendix F of the EIS, reproduced below as Figure 29 for reference).

Table 16
FBA Rehabilitation Offset Information Requirements

Relevant Section of the FBA		Addressed in BARBOS?	Further Justification
12.2.1.5	*For each PCT that is the target of the proposed ecological rehabilitation works the assessor must set out in the BOS completion/relinquishment criteria that:* *(a) are specific, measureable, achievable and realistic, and* *(b) specify the level of increase in the site attribute condition score and the completion/relinquishment standard to be achieved for each site attribute, according to Table 6, and* *(c) demonstrate that vegetation on the rehabilitation site is a recognisable PCT or strongly trending towards becoming a recognisable PCT, and* *(d) demonstrate that the vegetation or other habitat features on the rehabilitation site are providing habitat for the fauna species for which species credits are proposed to be created, and* (e) *demonstrate that the flora species for which species credits are proposed to be created are present on the rehabilitation site.*		Section 6.2.2.1 of the Project BARBOS provides that detailed completion/relinquishment criteria would be included in a MOP prior to the commencement of construction. An example of conditions relating to rehabilitation offsets for the draft Moolarben Coal Project modified Development Consent (Conditions 35B, 35C and 35B) and the Wilpinjong Extension Project Development Consent (Conditions 37 and 38) are provided as Enclosures A and B, respectively.
12.2.1.6	*Where biodiversity credits created from proposed ecological rehabilitation works are proposed to offset the biodiversity impacts of the Major Project, the BOS must set out all of the following:* *(a) the rehabilitation objectives for the rehabilitation site*		The Project BARBOS provides reference to Section 5.3.3 of the Project EIS, which outlines rehabilitation objectives for the Project.
	(b) the PCTs that are the target of the proposed ecological rehabilitation works		Under the *NSW Offset Policy* (OEH, 2014b) (and associated FBA [OEH, 2014a]), the number of ecosystem credits produced for mine rehabilitation does not vary according to the vegetation type proposed to be established. The Project rehabilitation could target the offset credit requirements for *Pilliga Box – Poplar Box Shrubby Woodland* (NA324), or related BVTs (Section 6.2.2.1 of the BARBOS) (Section 6.2.2.1 of the Project BARBOS). Vegetation types would be detailed in a MOP prior to commencement of construction, considering final Offset Areas and outstanding ecosystem credit requirements.
	(c) evidence that the target PCTs occur naturally within the IBRA subregion that the Major Project occurs in or the adjacent IBRA subregions		It is proposed mine rehabilitation areas would be revegetated to one or more woodland/forest vegetation types that occur in the surrounding sub-region and are the same vegetation class as required to be provided (Section 6.2.2.1 of the Project BARBOS).

Legend:

Detailed information provided in Project BARBOS.

Overview provided in Project BARBOS, further detail to be provided post determination similar to other approved Projects.

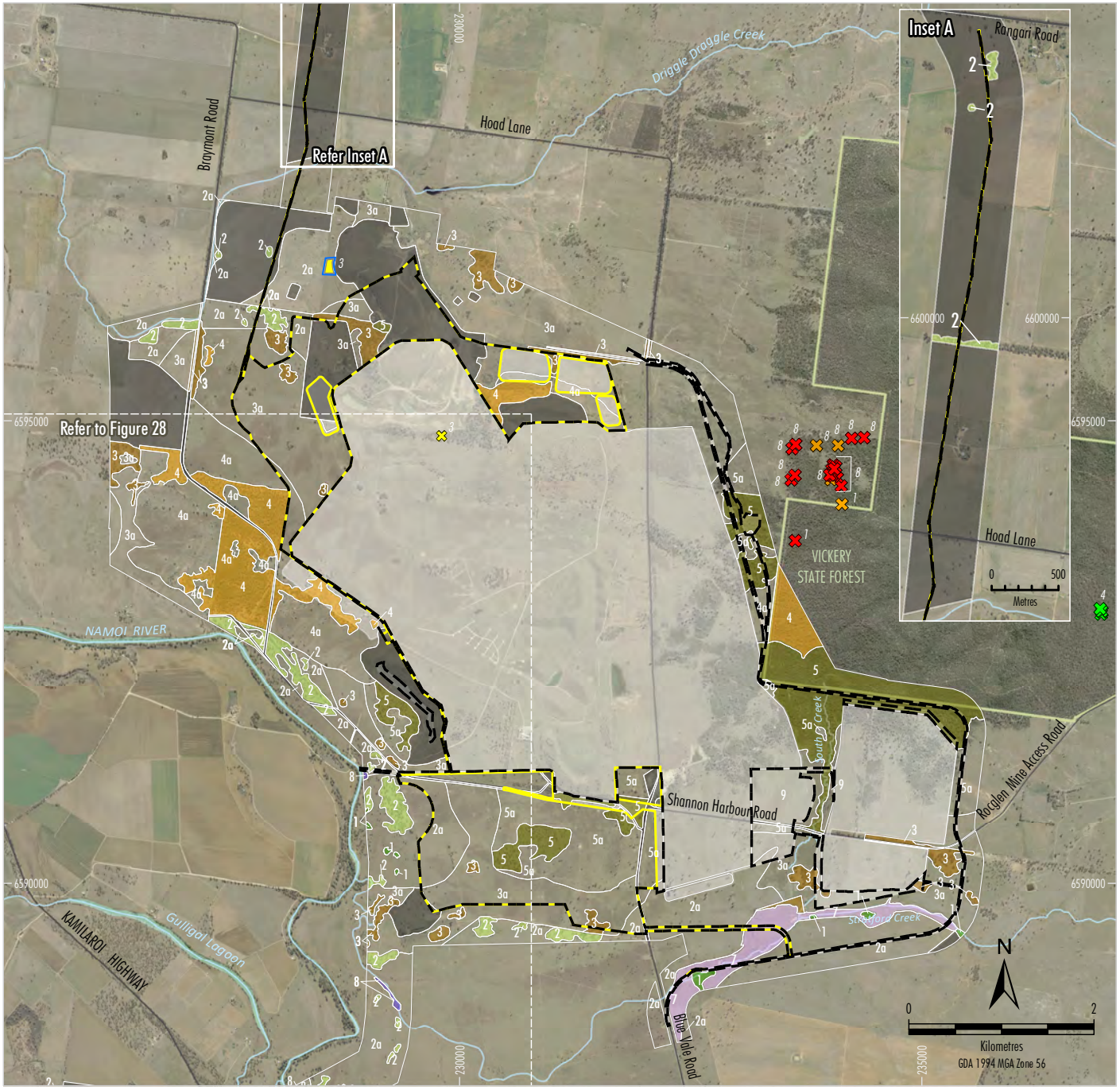
Table 16 (continued)
FBA Rehabilitation Offset Information Requirements

Relevant Section of the FBA		Addressed in BARBOS?	Further Justification
	(d) the completion/relinquishment criteria for each PCT as specified in Paragraph 12.2.1.5		Section 6.2.2.1 of the Project BARBOS provides that detailed completion/relinquishment criteria would be included in a MOP prior to the commencement of construction. An example of conditions relating to rehabilitation offsets for the draft Moolarben Coal Project modified Development Consent (Conditions 35B, 35C and 35B) and the Wilpinjong Extension Project Development Consent (Conditions 37 and 38) are provided as Enclosures A and B, respectively.
	(e) for each site attribute for each PCT, the increase in the site attribute condition score calculated as set out in Table 6, based on the completion/relinquishment criteria in the BOS		Mine rehabilitation credits are capped based on site value increase limits. For the purposes of the mine rehabilitation credit calculations the maximum increases in site values were applied, as outlined in Table 41 of the Project BARBOS.
	(f) the area of land that will be rehabilitated to each PCT		A total of 2,365 ha of the post-mine landform is proposed to be woodland/forest domain, including 482 ha of rehabilitation within the Project BAR footprint and 523 ha of rehabilitation on additional areas of the Approved Mine footprint. The remainder (1,360 ha) is associated with the Approved Mine woodland/forest rehabilitation commitment (refer to Table 42 of the Project BARBOS).
	(g) the total number of ecosystem credits proposed to be created for the ecological rehabilitation for each PCT that is the target of the rehabilitation, calculated in accordance with Subsection 12.2.2		As described above, mine rehabilitation ecosystem credits are capped and the maximum increases in site value scores were assumed for the Project. Ecosystem credits generated from the Project rehabilitation are provided in Table 42 of the Project BARBOS.
	(h) the total number of species credits proposed to be created for each species, calculated in accordance with Subsection 12.2.2	N/A	Not applicable for the Project.
	(i) justification that the proposed ecological rehabilitation works and the achievement of the relinquishment/completion criteria will contribute to the restoration of habitat for the fauna species for which species credits are proposed to be created, or are likely to result in the presence on the rehabilitation site of the flora species for which species credits are proposed to be created	N/A	Not applicable for the Project.
	(j) the biodiversity credits required for the Major Project that will be met through rehabilitation.		It is proposed that approximately 24% of the Project ecosystem credit requirements (3,991 credits) would be offset using mine rehabilitation (refer to Section 6.2.2.5 and Table 46 of the Project BARBOS).

Legend:

Detailed information provided in Project BARBOS.

Overview provided in Project BARBOS, further detail to be provided post determination similar to other approved Projects.



LEGEND

State Forest

Approximate Extent of Approved Mine

Biodiversity Assessment Report Development Site Footprint - for Mining Area

Approximate Extent of Vickery Extension Project (EPBC 2016/7649) Footprint

Vegetation Communities

Semi-arid Woodlands (Grassy Sub-formation)

1 Weeping Myall Woodland (NA219)#

2 Poplar Box Woodland on Alluvial Clay Soils (NA185)

2a Poplar Box Woodland on Alluvial Clay Soils (Secondary/derived grassland)) (NA185)

Dry Sclerophyll Forests (Shrub/Grass Sub-formation)

3 Pilliga Box – Poplar Box Shrubby Woodland (NA324)

3a Pilliga Box – Poplar Box Shrubby Woodland (Secondary/derived grassland) (NA324)

4 White Box – Silver-leaved Ironbark Shrubby Open Forest (NA349)

4a White Box – Silver-leaved Ironbark Shrubby Open Forest (Secondary/derived grassland) (NA349)

Dry Sclerophyll Forests (Shrubby Sub-formation)

5 Narrow-leaved Ironbark – White Box Shrubby Forest (NA311)

5a Narrow-leaved Ironbark – White Box Shrubby Forest (Secondary/derived grassland) (NA311)

Freshwater Wetlands

7 Mixed Marsh Sedgeland (NA201)

Forested Wetlands

8 River Red Gum Riparian Tall Woodland (NA193)

Cleared Land

9 Exotic Dominant Grasslands

DL Disturbed Land

Listed as the Weeping Myall Woodland EEC

Note: Vegetation community 6 and 8a is not present within the mining area.

Threatened Flora

Belson's Panic (*Homopholis belsonii*)

Scant Pomaderris (*Pomaderris queenslandica*)

Tylophora linearis

Winged Peppercress (*Lepidium monoplocoides*)

Winged Peppercress Protection Area

Source:
(1) FloraSearch (2018) *(4) OEH (2017)*
(3) Niche (2013) *(8) Hunter Eco (2018)*
Note: Sources 2 and 5 to 7 are not shown on this figure.
Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); FloraSearch (2018)

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VICKERY EXTENSION PROJECT

Vegetation Communities and Threatened Flora Species - Mining Area

Figure 29

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The remaining three BVTs occur on sloped areas in the immediate vicinity of the Project and are therefore most likely to be targeted for rehabilitation, including:

- Pilliga Box – Poplar Box Shrubby Woodland (NA324);
- White Box – Silver-leaved Ironbark Shrubby Open Forest (NA349); and
- Narrow-leaved Ironbark – White Box Shrubby Forest (NA311).

Note that as per Table 46 of the BARBOS, BVTs NA349 and NA311 would not have an offset deficit if the proposed Offset Strategy is adopted, as their credit requirements would be met via the existing and proposed Offset Areas.

NA324 would have an offset deficit based on the proposed Offset Strategy, which is why it was identified within the BARBOS as a target vegetation type for rehabilitation (Section 6.2.2.1 of the BARBOS).

The specific vegetation types targeted during rehabilitation would be identified once Offset Areas have been secured. The MOP (or equivalent) to be prepared for the Project would detail the vegetation types and areas.

c. Justification of mine site rehabilitation as an offset

The Project Rehabilitation Strategy is described in Section 5 of the EIS. The Rehabilitation Strategy describes how the post-mine landform would be designed to include natural landform design features, such as micro-relief to direct runoff and improve stability and hydrological function of the landform.

The Rehabilitation Strategy also describes soil management measures, which includes progressive stripping, application of soils directly to completed sections of the final landform and management of long-term soil stockpiles to maintain soil viability. The soil re-application depth for areas to be rehabilitated to woodland would be 0.2 m to 0.3 m (to be refined during the Project life).

As part of the Biodiversity Offset Strategy for the Project, woodland vegetation is proposed to be established on a portion of the post-mine landform to enable ecosystem credits to be generated under the *NSW Offset Policy* (OEH, 2014a).

The rehabilitation standards required to generate ecosystem credits are established by the maximum allowable future attribute scores in Table 6 of the FBA. Table 17 below provides the attributes and maximum allowable future attribute scores from Table 6 of the FBA, as well as the relevant targets for the three vegetation types proposed for rehabilitation at Vickery (i.e. BVTs NA324, NA349 and NA311), in accordance with the *Archived BioMetric and Threatened Species Profiles Datasets* (OEH, 2017).

It should be noted that the maximum allowable future attribute scores in the FBA are low for mine rehabilitation (less than or equal to a third of the scores for a high-quality woodland in an offset area) which has the effect of limiting the ecosystem credits that can be generated from mine rehabilitation.

Evidence that it is feasible to meet the allowable future attribute scores in the FBA is from Whitehaven's Werris Creek Mine which commenced mine rehabilitation to native woodland in 2009. The target vegetation type at Werris Creek Mine (i.e. NA226) is different to that proposed to be established for the Project (i.e. NA324 as described in the response to OEH Recommendation 7), however both are woodland vegetation types. Note that the Werris Creek Mine is not required to undertake rehabilitation in accordance with the FBA.

Table 17
Future Attribute Benchmark Scores and Maximum Allowable Future Attribute Scores for Project Target Rehabilitation BVTs

Framework for Biodiversity Assessment (Table 6)				Maximum allowable future attribute score	Target BVTs for Project Rehabilitation					
					NA324		NA349		NA311	
Attribute*		Allowable future attribute scores for mine site rehabilitation*	Required completion/relinquishment standard for the increase in site attribute condition score*		Attribute Benchmark	Target Allowable Future Attribute Score	Attribute Benchmark	Target Allowable Future Attribute Score	Attribute Benchmark	Target Allowable Future Attribute Score
Species richness	NPS	0.5 or 1	*The rehabilitation will achieve >50% of the native plant species richness benchmark for the nominated PCT. Only plant species characteristic of the target PCT may be counted towards native plant species richness.*	1	*≥30*	*≥15*	*≥26*	*≥13*	*≥30*	*≥15*
Over-storey cover	NOS	0.5 or 1	*The rehabilitation will achieve >25% and <200% of the percent native over-storey cover benchmark for the nominated PCT. Only over-storey plant species characteristic of the target PCT may be counted towards percent native over-storey cover.*	1	*≥25 and ≤40*	*≥6.25 and ≤80*	*≥6 and ≤25*	*≥1.5 and ≤50*	*≥25 and ≤40*	*≥6.25 and ≤80*
Mid-storey cover	NMS	0.5 or 1	*The rehabilitation will achieve >25% and <200% of the percent native mid-storey cover benchmark for the nominated PCT. Only mid-storey plant species characteristic of the target PCT may be counted towards percent native mid-storey cover.*	1	*≥6 and ≤25*	*≥1.5 and ≤50*	*≥6 and ≤25*	*≥1.5 and ≤50*	*≥6 and ≤25*	*≥1.5 and ≤50*
Native ground cover (shrubs)	NGCS	0.5 or 1	*The rehabilitation will achieve >25% and <200% of the percent native ground cover (shrubs) benchmark for the nominated PCT. Only native ground cover (shrubs) plant species characteristic of the target PCT may be counted towards percent native ground cover (shrubs).*	1	*≥3 and ≤10*	*≥0.75 and ≤20*	*≥3 and ≤10*	*≥0.75 and ≤20*	*≥3 and ≤10*	*≥0.75 and ≤20*
Native ground cover (grasses)	MGCG	0.5 or 1	*The rehabilitation will achieve >25% and <200% of the percent native ground cover (grasses) benchmark for the nominated PCT. Only native ground cover (grasses) plant species characteristic of the target PCT may be counted towards percent native ground cover (grasses).*	1	*≥20 and ≤30*	*≥5 and ≤60*	*≥20 and ≤30*	*≥5 and ≤60*	*≥20 and ≤30*	*≥5 and ≤60*
Native ground cover (other)	MGCO	0.5 or 1	*The rehabilitation will achieve >25% and <200% of the percent native ground cover (other) benchmark for the nominated PCT. Only native ground cover (other) plant species characteristic of the target PCT may be counted towards percent native ground cover (other).*	1	*≥3 and ≤5*	*≥0.75 and ≤10*	*≥3 and ≤5*	*≥0.75 and ≤10*	*≥3 and ≤5*	*≥0.75 and ≤10*
Exotic plant cover	EPC	0.5 or 1	*The exotic plant cover will be <45%. Exotic plant cover must be calculated as a percentage of the total ground and mid-storey cover. Exotic plant cover is measured as total percent foliage cover of all exotics in all strata.*	1	*N/A*	*≤31.5*	*N/A*	*≤31.5*	*N/A*	*≤31.5*
Number of trees with hollow	NTH	0.5	*N/A*	0	*≥2*	-	*≥1*	-	*≥2*	-

Table 17 (continued)
Future Attribute Benchmark Scores and Maximum Allowable Future Attribute Scores for Project Target Rehabilitation BVTs

Framework for Biodiversity Assessment (Table 6)				Maximum allowable future attribute score		Target BVTs for Project Rehabilitation					
						NA324		NA349		NA311	
Attribute*		Allowable future attribute scores for mine site rehabilitation*	Required completion/relinquishment standard for the increase in site attribute condition score*			Attribute Benchmark	Target Allowable Future Attribute Score	Attribute Benchmark	Target Allowable Future Attribute Score	Attribute Benchmark	Target Allowable Future Attribute Score
Over-storey regeneration	OR	0.5	*At least 25% of over-storey species for the nominated PCT are naturally regenerating. Over-storey regeneration is when a second generation of over-storey plants naturally regenerates on the site as a result of reproduction of established over-storey species. Over-storey regeneration does not include juvenile or young plants which have been planted or seeded. Over-storey regeneration must be present across the vegetation zone.*	0.5		*N/A*	*≥6.25*	*N/A*	*≥1.5*	*N/A*	*≥6.25*
Total length of fallen logs	FL	0.5	*N/A*	0		*≥20*	-	*≥15*	-	*≥20*	-
Predicted site value score				15.89			15.89		-		-
Area of rehabilitation for a single PCT (ha)				**482**	**523**						
Number of ecosystem credits created from rehabilitation				**1,914**	**2,077**						

Charts 6a to 6f provide rehabilitation monitoring results at the Werris Creek Mine for the following attributes listed in the FBA:

a. species richness;
b. over-storey cover;
c. mid-storey cover;
d. native groundcover (grasses);
e. native groundcover (other); and
f. exotic plant cover.

Note that the 'native groundcover (shrubs)' attribute is not relevant to NA226 and therefore no data is presented.

Charts 6a to 6f also include the relevant benchmark and associated target completion criteria for NA324 as a comparison.

The rehabilitation monitoring results demonstrate that current rehabilitation progress at Werris Creek has either already met the target allowable future attribute scores for NA324 or is expected to achieve the allowable future attribute score as rehabilitation growth progresses and management continues.

Rehabilitation monitoring photos which validate the progress of rehabilitation efforts for Years 4 to 9 for Werris Creek Rehabilitation Plot 6 and Years 3 to 7 for Werris Creek Rehabilitation Plot 14 are provided in Plates 11a to 11f and Plates 12a to 12e, respectively.

Given the above, Whitehaven considers it is feasible for the rehabilitation of the Project final landform to achieve the rehabilitation completion criteria standard and provide the maximum amount of offset credits as proposed in the BARBOS (Appendix F of the EIS).

The Project rehabilitation monitoring program would be designed to track rehabilitation progress and determine whether intervention measures are required. Trials and experience from other Whitehaven operations would also inform Project rehabilitation measures.

d. Clarification of timing for proposed rehabilitation as offset

Rehabilitation of the Project landforms would be undertaken progressively over the Project life and include the establishment of native vegetation and fauna habitat. Planned progressive rehabilitation measures and the rehabilitation monitoring program would be detailed in a MOP (or equivalent).

Chart 6a
Werris Creek Rehabilitation Monitoring – Species Richness

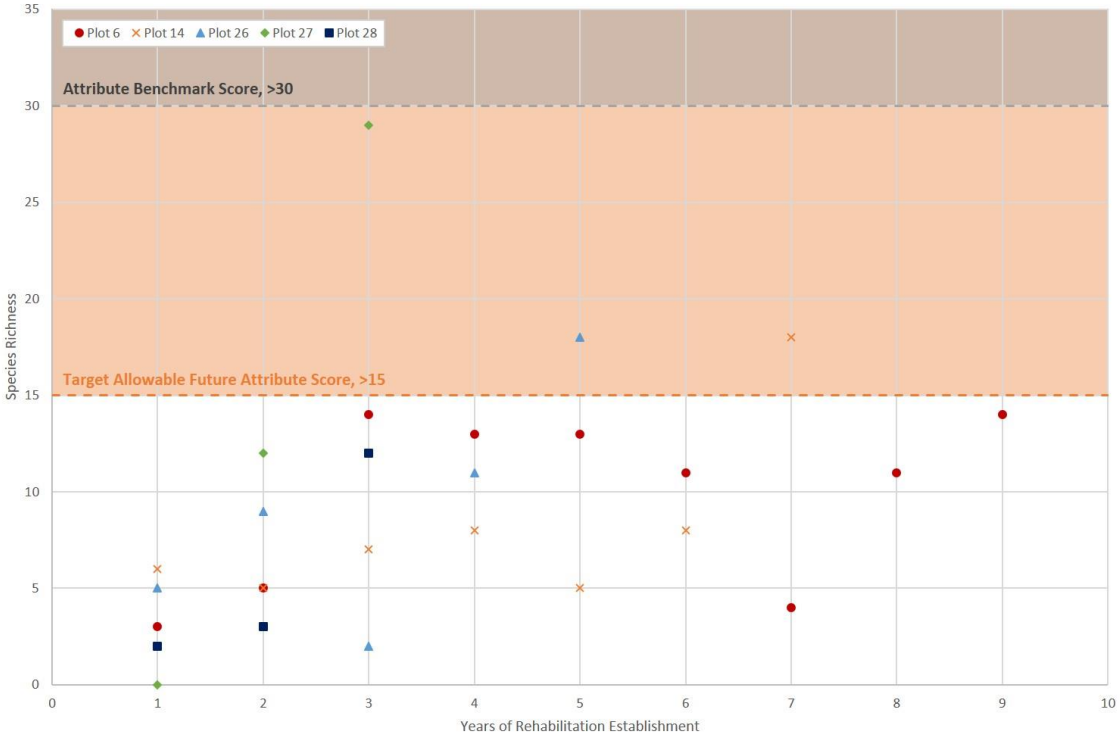

Chart 6b
Werris Creek Rehabilitation Monitoring – Over-storey Cover

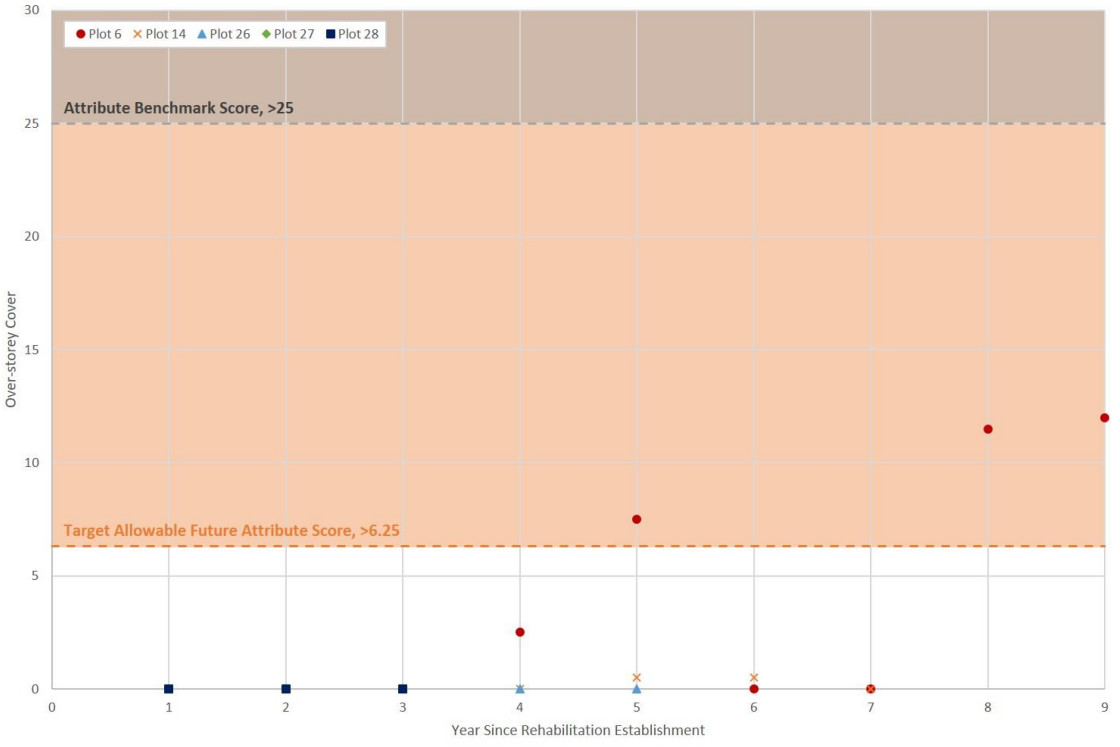

Chart 6c
Werris Creek Rehabilitation Monitoring - Mid-storey Cover

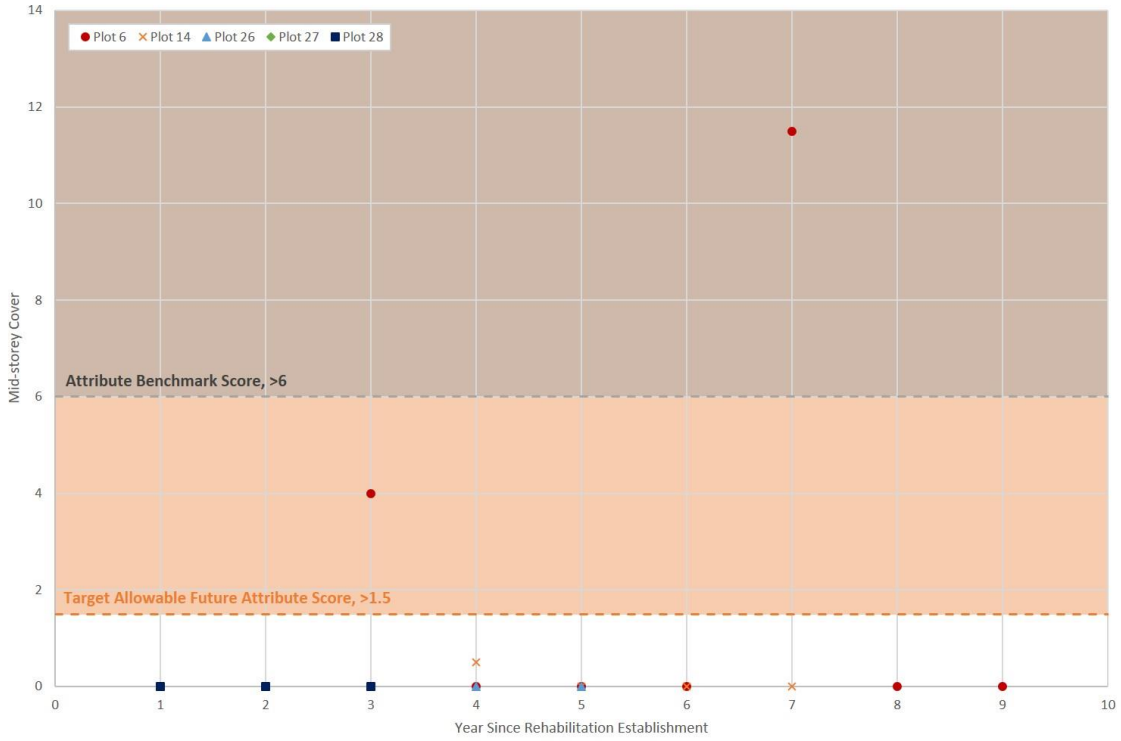

Chart 6d
Werris Creek Rehabilitation Monitoring – Native Groundcover (Grasses)

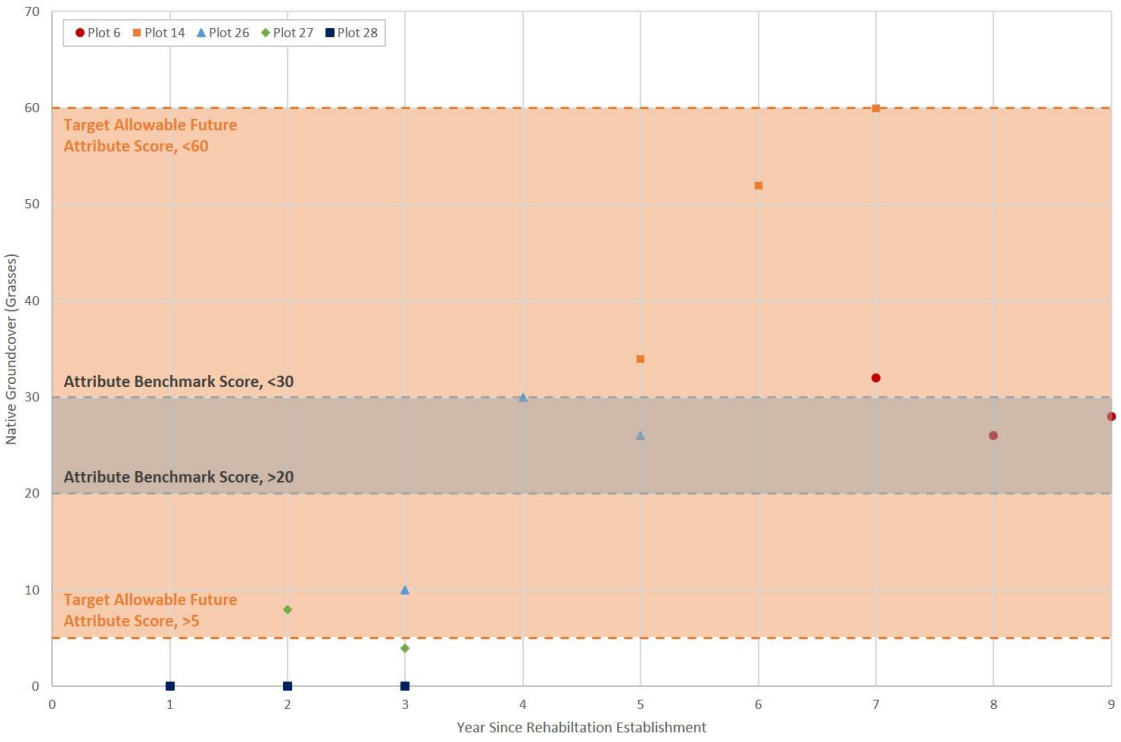

Chart 6e
Werris Creek Rehabilitation Monitoring – Native Groundcover (Other)

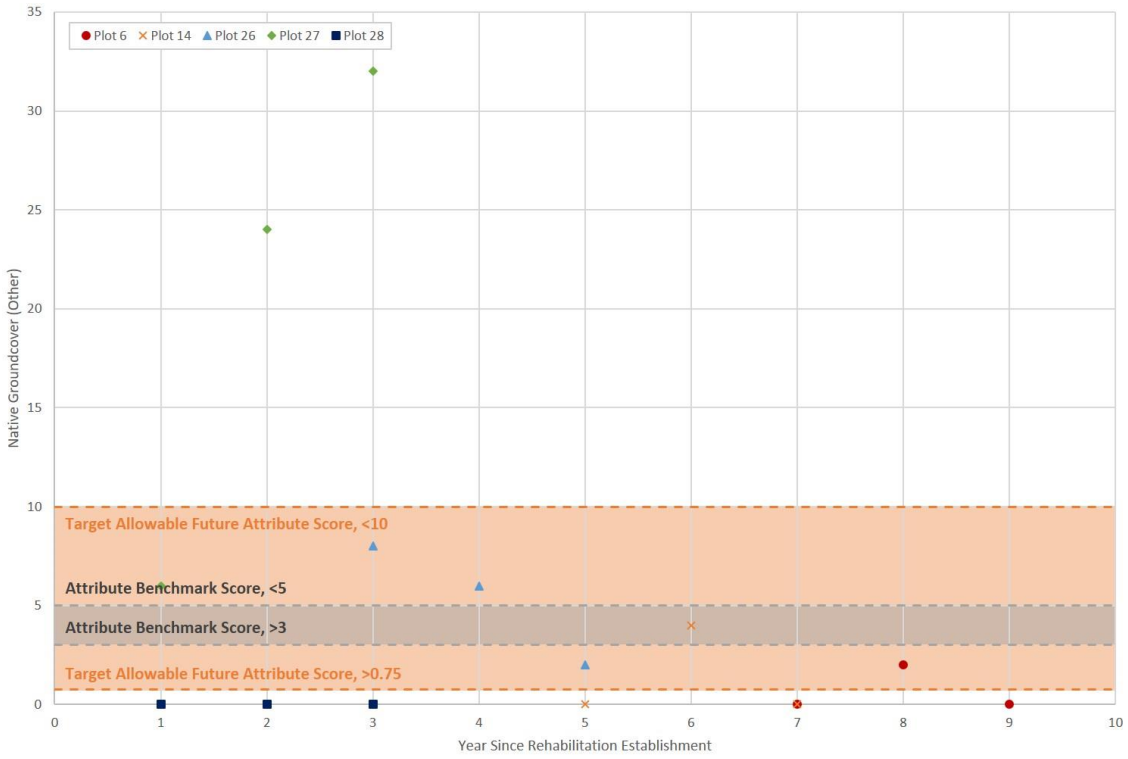

Chart 6f
Werris Creek Rehabilitation Monitoring – Exotic Plant Cover

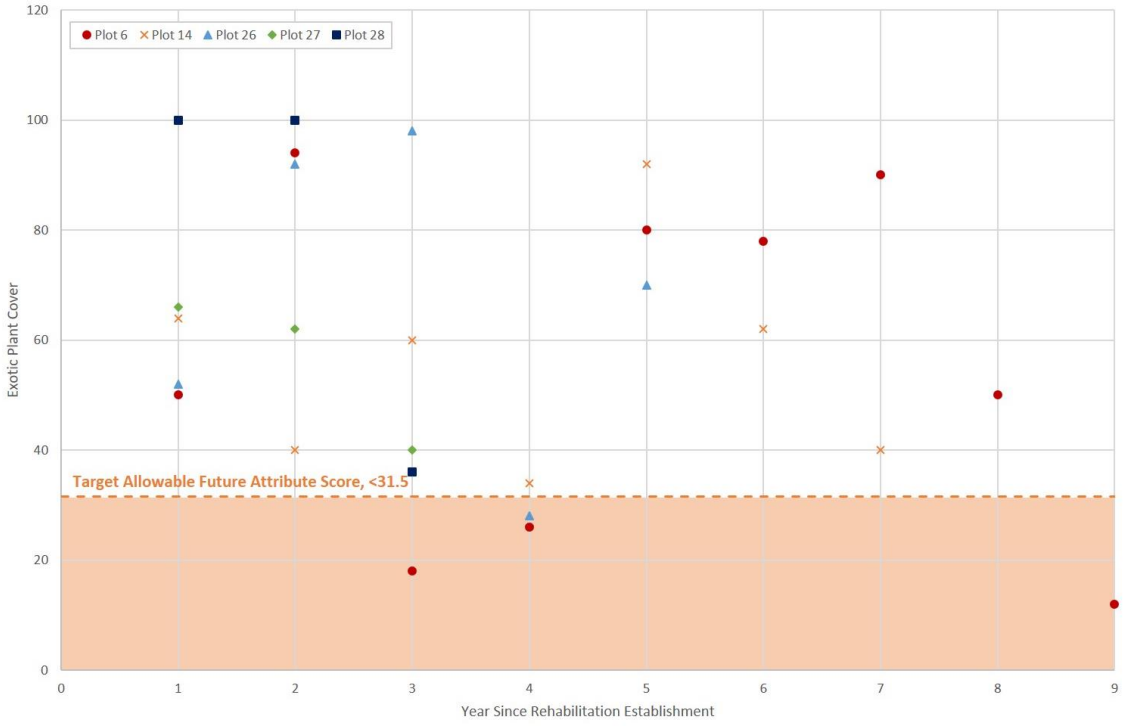

Plate 11a Werris Creek Rehabilitation Plot 6 – Year 4 (2013)

Plate 11b Werris Creek Rehabilitation Plot 6 – Year 5 (2014)

Plate 11c Werris Creek Rehabilitation Plot 6 – Year 6 (2015)

Plate 11d Werris Creek Rehabilitation Plot 6 – Year 7 (2016)

Plate 11e Werris Creek Rehabilitation Plot 6 – Year 8 (2017)

Plate 11f Werris Creek Rehabilitation Plot 6 – Year 9 (2018)

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Source: Whitehaven (2019)

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VICKERY EXTENSION PROJECT

Werris Creek Coal Mine Rehabilitation – Plot 6 (Year 4 to Year 9)

Plate 11a to 11f

Plate 12a Werris Creek Rehabilitation Plot 14 – Year 3 (2014)

Plate 12b Werris Creek Rehabilitation Plot 14 – Year 4 (2015)

Plate 12c Werris Creek Rehabilitation Plot 14 – Year 5 (2016)

Plate 12d Werris Creek Rehabilitation Plot 14 – Year 6 (2017)

Plate 12e Werris Creek Rehabilitation Plot 14 – Year 7 (2018)

WHC15-33_RTS_004A

Source: Whitehaven (2019)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Werris Creek Coal Mine Rehabilitation – Plot 14 (Year 3 to Year 7)

Plate 12a to 12e

Figures 2-4 to 2-7 and 5-3 of the EIS (reproduced as Figures 30 to 34 below) provide the indicative extent of progressive rehabilitation for Project Years 3, 7, 13 and 21 as well as post-mining. Table 5-5 from the Project EIS (reproduced as Table 18 below) summarises the indicative areas of progressive rehabilitation for Project Years 3, 7, 13 and 21 as well as post-mining.

Table 18
Indicative Progressive Rehabilitation for the Project (Table 5-5 of the EIS)

Project Year	Approximate Rehabilitated Area (ha)*		
	Initial Rehabilitation	Established Rehabilitation	Total
Year 3	0	0	0
Year 7	25	0	25
Year 13	75	531	606
Year 21	131	961	1,092
Post-mining	0	2,727	2,727

* These areas are subject to further detailed mine and rehabilitation planning that would be presented in the MOP.

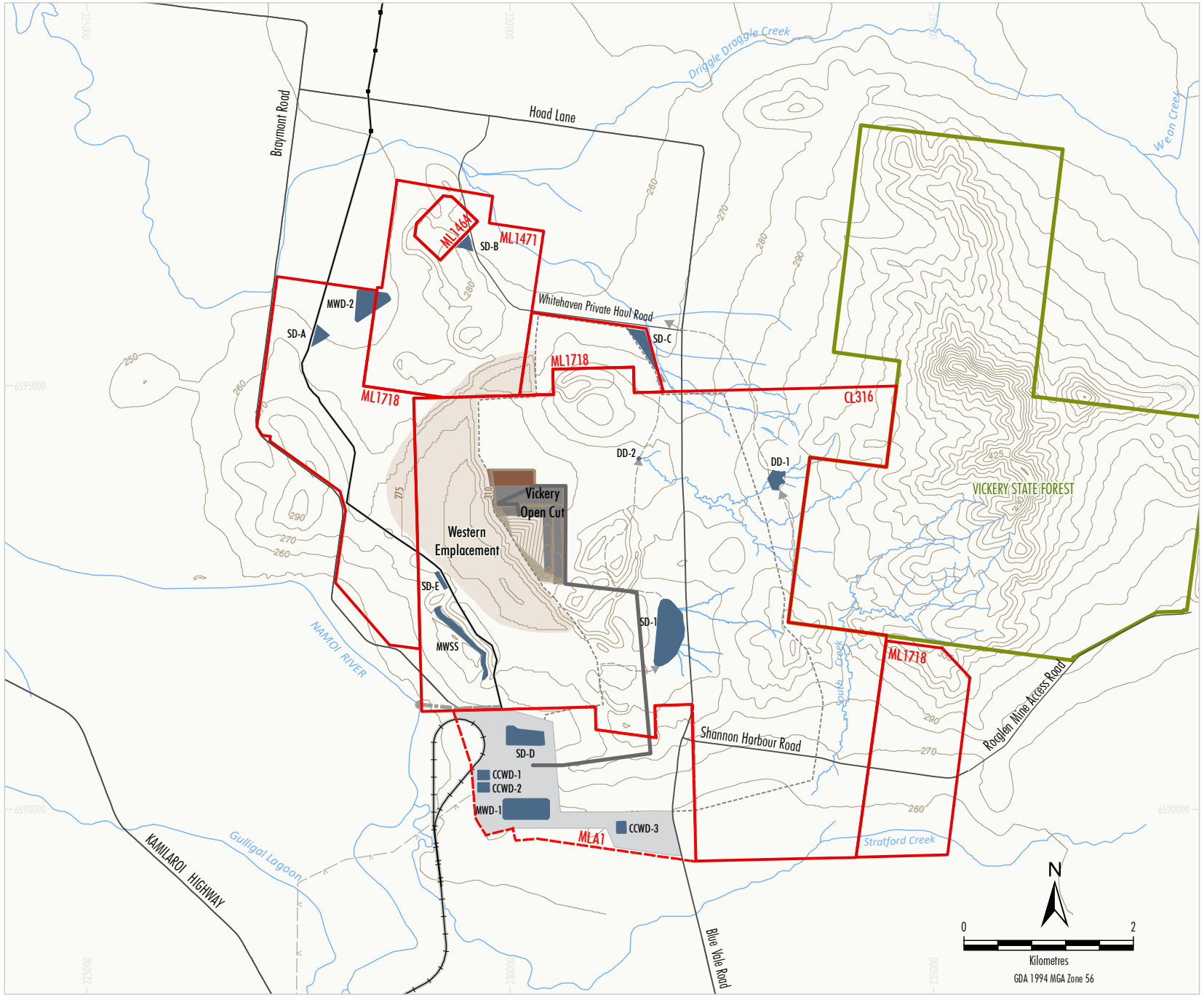
Table 42 of the Project BARBOS provides the final credit value generate from mine rehabilitation at the Project to woodland/forest. Note that if rehabilitation is deemed unsuccessful, these credits associated with rehabilitation of the Project site could be satisfied via payment into the Biodiversity Conservation Fund or provision of funds to other supplementary methods.

4. Koala Plan of Management

Clause 9 of SEPP 44 relates to the requirement for preparation of a Koala Plan of Management for potential impacts to core koala habitat. Clause 9 of SEPP 44 does not apply to Part 4 development applications which are determined by a consent authority other than a local council, including State Significant Developments, such as the Project.

Notwithstanding, Whitehaven committed to preparing a Koala Plan of Management for the Project which describes proposed management measures relevant to core koala habitat along the Namoi River.

The Koala Plan of Management for the Project is in preparation.



LEGEND

- Mining Tenement Boundary (ML & CL)
- Mining Lease Application (MLA)
- State Forest
- Existing 66kV Powerline
- Indicative Up-catchment Diversion
- Indicative Namoi River Pump Station and Pipeline
- Indicative Active Mining
- Indicative Active Waste Rock Emplacement
- Indicative Soil Stripped
- Indicative Infrastructure Area
- Indicative Extent of Water Storage
- Indicative Mine Access Road
- Indicative Main ROM Coal Haul Road
- Indicative Rail Spur Alignment
- Indicative Location of Groundwater Bores and Pipeline
- Indicative Maximum Extent of Open Cut

Source: Department of Land and Property Information (2014); Department of Industry (2015)

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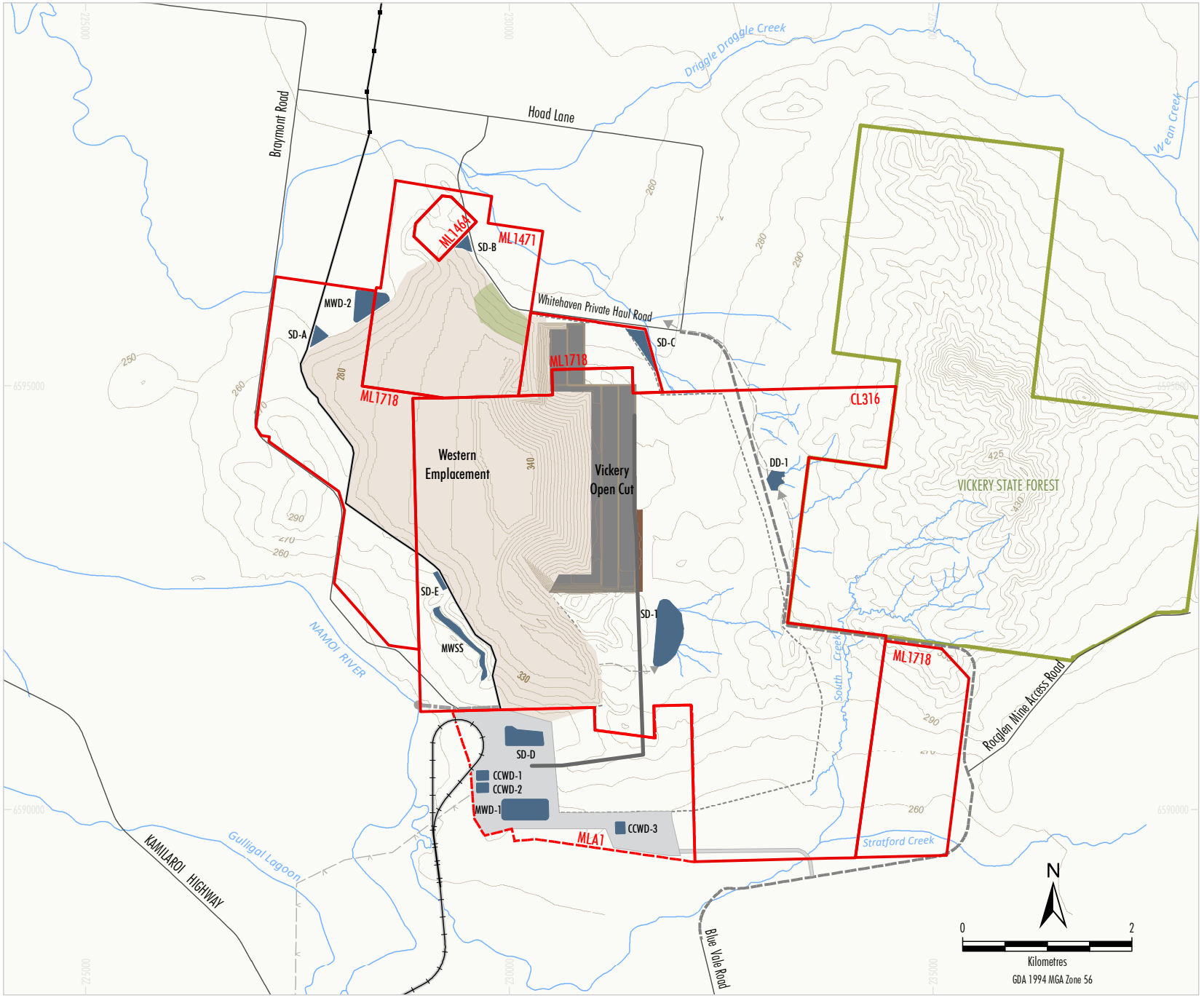
VICKERY EXTENSION PROJECT

Project General Arrangement - Year 3

Figure 30

WHC-15-33_RTS 220A



LEGEND

- Mining Tenement Boundary (ML & CL)
- Mining Lease Application (MLA)
- State Forest
- Existing 66kV Powerline
- Indicative Road Realignment
- Indicative Namoi River Pump Station and Pipeline
- Indicative Up-catchment Diversion
- Indicative Active Mining
- Indicative Active Waste Rock Emplacement
- Indicative Soil Stripped
- Indicative Initial Rehabilitation
- Indicative Infrastructure Area
- Indicative Extent of Water Storage
- Indicative Mine Access Road
- Indicative Main ROM Coal Haul Road
- Indicative Rail Spur Alignment
- Indicative Location of Groundwater Bores and Pipeline
- Indicative Maximum Extent of Open Cut

Source: Department of Land and Property Information (2014); Department of Industry (2015)

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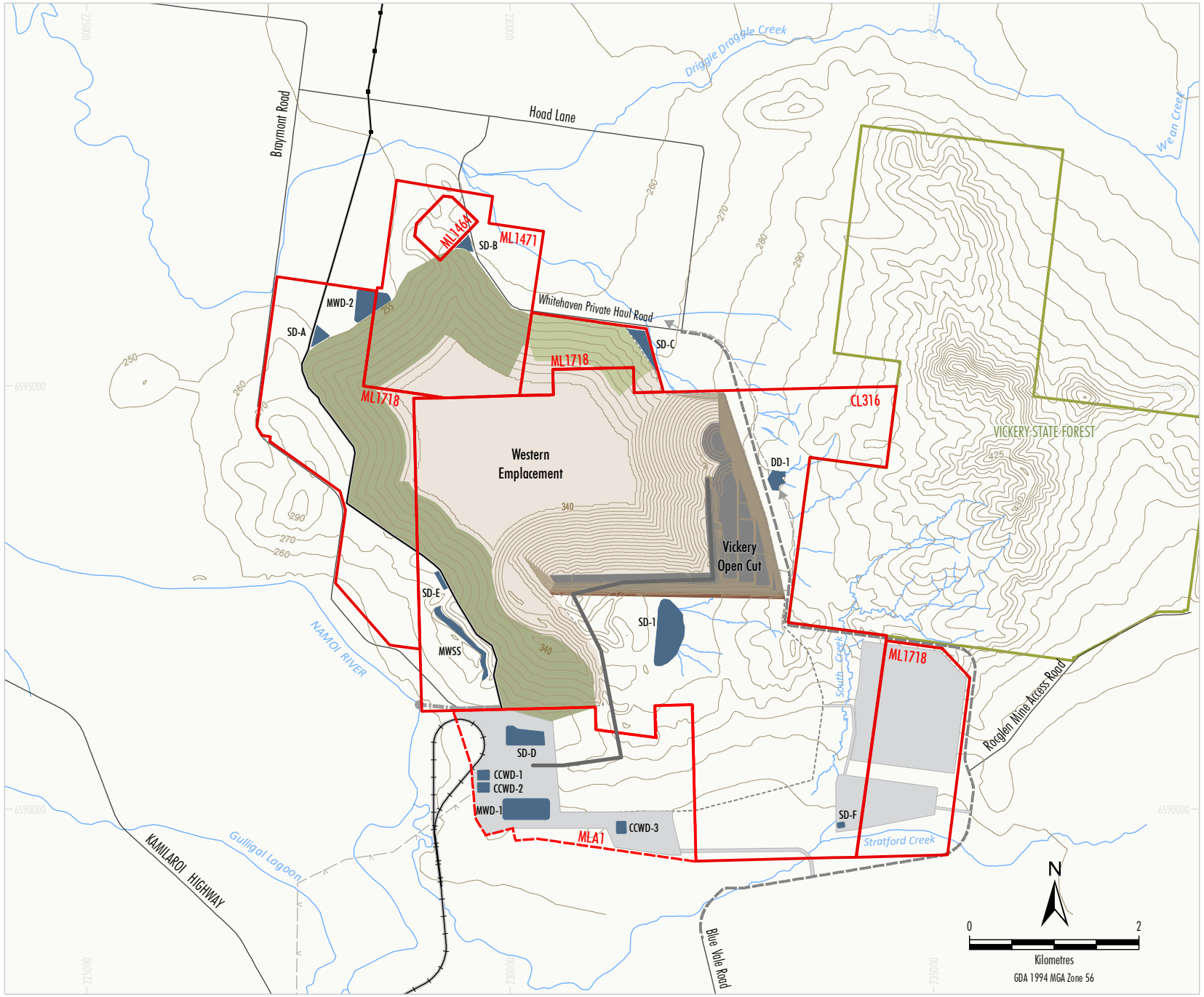
VICKERY EXTENSION PROJECT

Project General Arrangement - Year 7

Figure 31

WHC-15-33_RTS 221A



LEGEND

- Mining Tenement Boundary (ML & CL)
- Mining Lease Application (MLA)
- State Forest
- Existing 66kV Powerline
- Indicative Road Realignment
- Indicative Namoi River Pump Station and Pipeline
- Indicative Up-catchment Diversion
- Indicative Active Mining
- Indicative Active Waste Rock Emplacement
- Indicative Soil Stripped
- Indicative Initial Rehabilitation
- Indicative Established Rehabilitation
- Indicative Infrastructure Area
- Indicative Extent of Water Storage
- Indicative Mine Access Road
- Indicative Main ROM Coal Haul Road
- Indicative Rail Spur Alignment
- Indicative Location of Groundwater Bores and Pipeline
- Indicative Maximum Extent of Open Cut

Source: Department of Land and Property Information (2014); Department of Industry (2015)

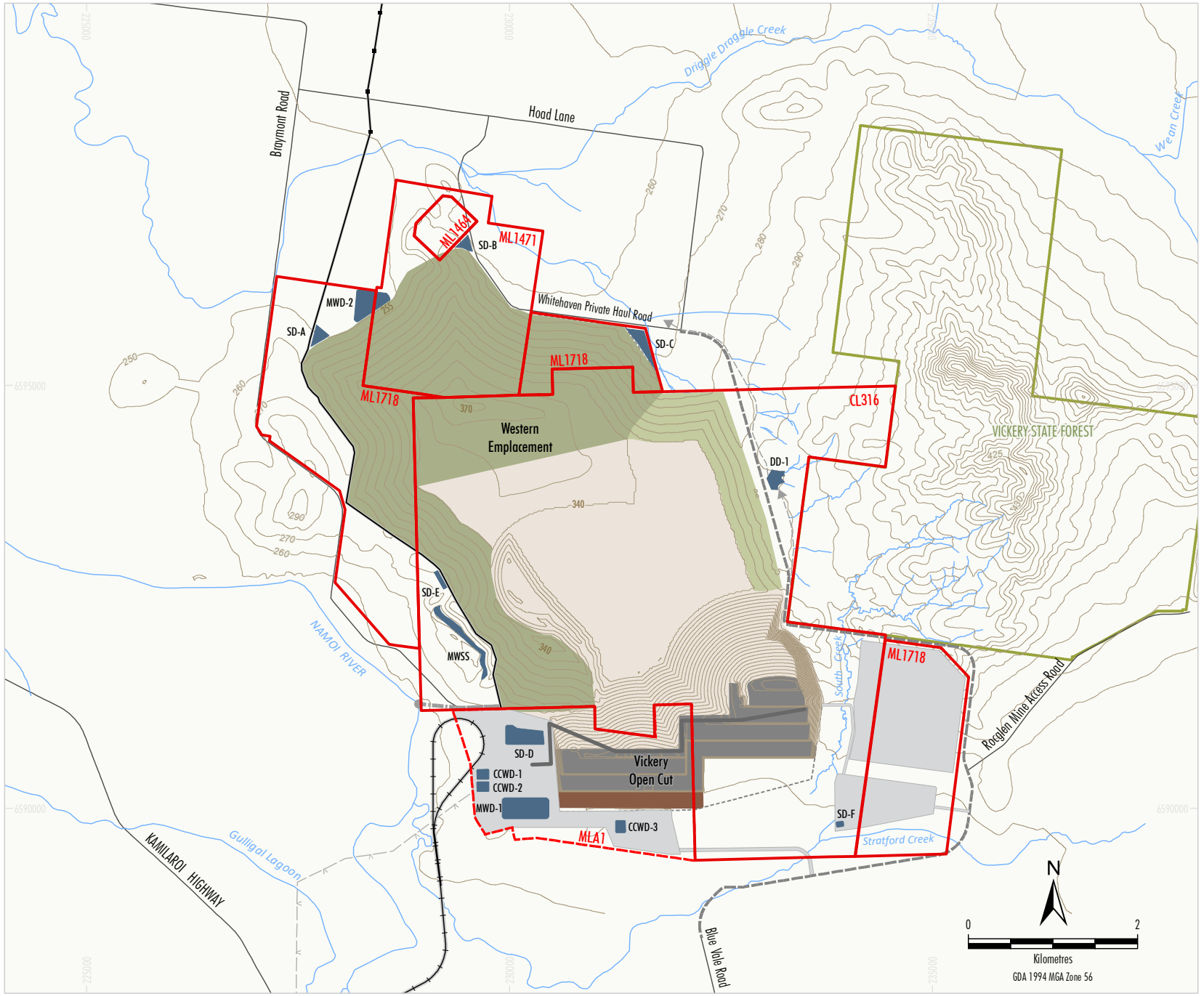
WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project General Arrangement - Year 13

Figure 32

WHC-15-33_RTS 222A



LEGEND

- Mining Tenement Boundary (ML & CL)
- Mining Lease Application (MLA)
- State Forest
- Existing 66kV Powerline
- Indicative Road Realignment
- Indicative Namoi River Pump Station and Pipeline
- Indicative Up-catchment Diversion
- Indicative Active Mining
- Indicative Active Waste Rock Emplacement
- Indicative Soil Stripped
- Indicative Initial Rehabilitation
- Indicative Established Rehabilitation
- Indicative Infrastructure Area
- Indicative Extent of Water Storage
- Indicative Mine Access Road
- Indicative Main ROM Coal Haul Road
- Indicative Rail Spur Alignment
- Indicative Location of Groundwater Bores and Pipeline
- Indicative Maximum Extent of Open Cut

Source: Department of Land and Property Information (2014); Department of Industry (2015)

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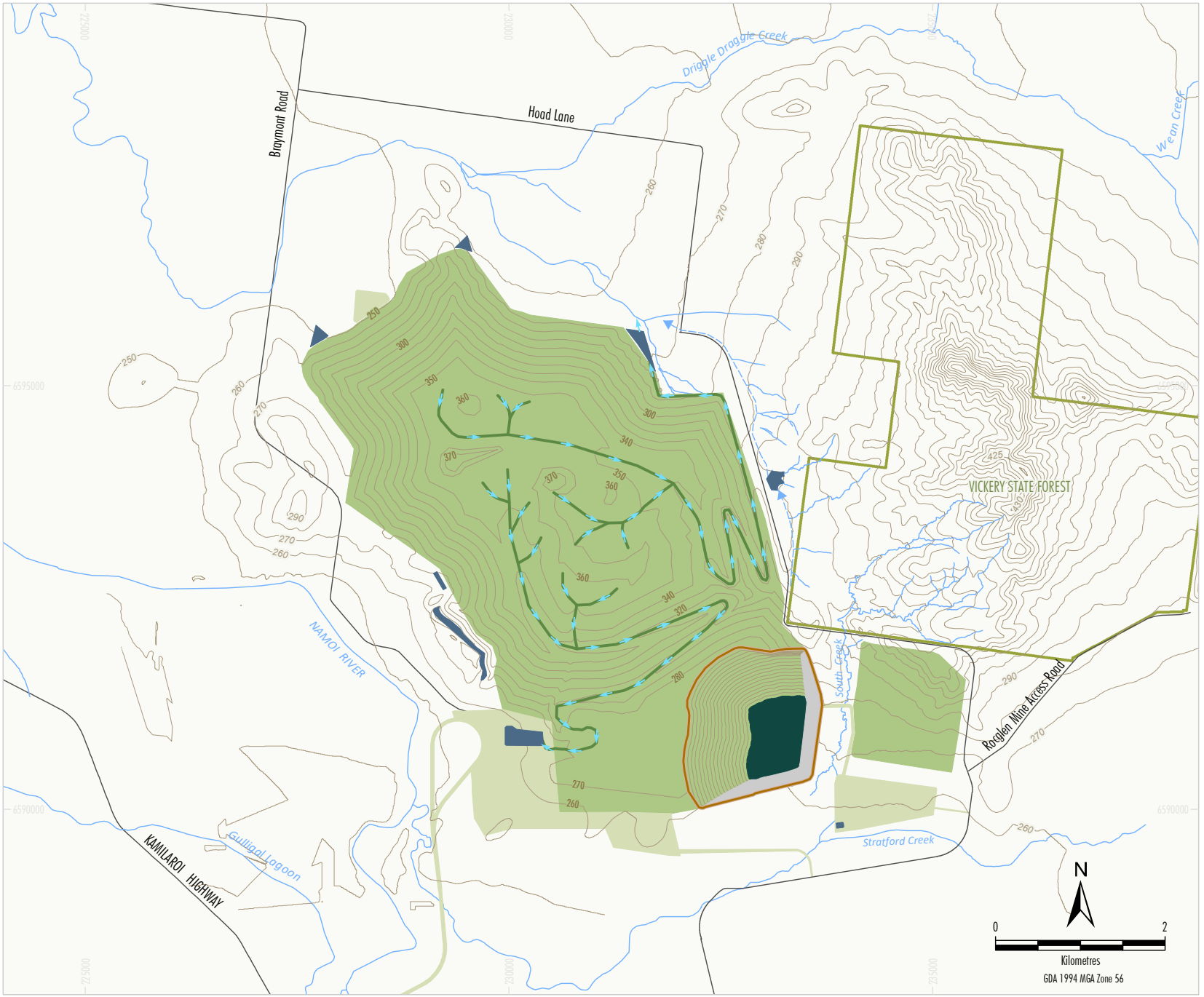
VICKERY EXTENSION PROJECT

Project General Arrangement - Year 21

Figure 33

WHC-15-33_RTS 223A



Source: Department of Land and Property Information (2014); Department of Industry (2015)

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VICKERY EXTENSION PROJECT

Conceptual Final Landform - Rehabilitation Areas

Figure 34

WHC-15-33_RTS 224A

6.10 REHABILITATION, FINAL VOID AND FINAL LANDFORM

6.10.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to rehabilitation, the final landform and the final void included:

- requests to maximise areas of agricultural land in the final landform; and
- justification for the final void with regard to land sterilisation.

Agency Submissions

Agencies and local councils that provided comments on the Project relevant to rehabilitation, the final landform and the final void included DI Crown Lands and Water, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- maximising areas of agricultural land in the final landform;
- clarification and justification of the number of proposed final voids; and
- rehabilitation monitoring and reporting.

Note that the Resources Regulator stated in their submissions that it has "*… determined that sustainable rehabilitation outcomes can be achieved as a result of the project and that any identified risks or opportunities can be effectively regulated …*".

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report reinforced the comments raised by agencies and the public, including further consideration of the proposed final landform and final void, as well as consideration of the post-mining land use with respect to agricultural land, and requested Whitehaven provide further information to address the submissions in the RTS.

Independent Planning Commission Issues Report

Regarding rehabilitation, paragraph 287 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 286, the Commission considers that the Department should give detailed consideration to:*
>
> - *how areas of existing rehabilitated soils would be effectively used for further rehabilitation in other areas of the proposed mine;*
> - *how the final landform (including the outer batters) would be designed using both macro and micro relief to ensure that the final landform is consistent with and ties into the surrounding landscape;*
> - *if the final landform would be suitable for other land uses. For instance, the rehabilitated area could be classed as Class 2 or Class 3 Agricultural Land;*
> - *agricultural land versus offset (rehabilitation to woodland communities) for the final land use;*

- *if the definition of the long-term sediment and chemical consequences of runoff from the external batters should be better defined. For instance, at what date would the sediment basins fill with sediment and what would the sediment loads be that subsequently drain offsite; and*
- *if the Applicant should revise the Rehabilitation Strategy to include additional detailed information around the final void water levels and water quality, including an assessment of any potential beneficial uses for the water that could be considered following closure of the mine.*

Regarding the proposed final void and final landform, paragraph 293 of the IPC's Issues Report states:

Based on the Commission's observations, as listed in paragraph 292, the Commission considers that the Department should give detailed consideration to:

- *if the Applicant should quantify the water quality impacts offsite of the surface runoff (and any groundwater seeps) from the rehabilitated landform. This would include an assessment of the potential impact of the type of ecosystem to be developed on the site (e.g. woodland versus agriculture will have different implications for sediment delivery and thus transport of sorbed pollutants);*
- *the Applicant's evidence of the trials that were taken for three different spoil properties that demonstrate that the change in spoil properties did not have an impact on the groundwater inflows;*
- *any available evidence (including such evidence as the Applicant may provide) to support final voids as a preferred landform outcome versus infill, and evidence of all risks associated with each landform outcome; and*
- *the definition of the incremental long-term deep hard rock (i.e. non-alluvial) groundwater impacts (both head and flow) over the long-term (at least to the 300 years that it takes for the final void water levels to stabilise), particularly to the east of the Project where drawdowns interact with the drawdowns from the Rocglen Mine site.*

6.10.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Use of soils obtained by disturbing previous rehabilitated areas for further rehabilitation in other areas of the Project.
2. Design of the final landform (including the outer batters) using both macro and micro relief to tie into the surrounding landscape.
3. Final land use considerations, including consideration of agricultural land uses instead of woodland rehabilitation.
4. Water quality considerations for runoff from the waste emplacements, including after rehabilitation is complete.
5. Spoil properties adopted in the groundwater model and the influence this has on predicted groundwater inflows.
6. Clarification of the number of proposed final voids.
7. Proposed rehabilitation reporting.

Note that discussion regarding the final void is provided in Section 6.2 and further information to support the proposed rehabilitation to native woodland is provided in Section 6.9.

6.10.3 Responses

1. Use of Soil from Existing Rehabilitated Areas

The conclusion that suitable soil resources are available to achieve the rehabilitation outcomes for the Project includes consideration of soil test work within rehabilitated mining areas.

The *Vickery Coal Project Agricultural Resource Assessment* undertaken by McKenzie Soil Management (2012) (Attachment A to the Approved Mine Agricultural Impact Assessment) assessed a total of 75 soil test pits within the extent of the Approved Mine, including within rehabilitated historic mining areas as shown on Maps 1 to 14 from the *Vickery Coal Project Agricultural Resource Assessment* (McKenzie Soil Management, 2012).

The soils within the existing rehabilitated mining areas are generally classified as 'Anthroposols', which are soil types strongly modified by the activities of humans (McKenzie Soil Management, 2012). The key soil parameters for soil test pits within the existing rehabilitated mining areas are provided in Attachment 5.

Photos of representative Anthroposol soil profiles identified during the soil survey for the Approved Mine are shown in Plates 13a to 13e.

McKenzie Soil Management (2012) established that soils within the Approved Mine area (including historic mine rehabilitation) are suitable as a rehabilitation medium for agricultural and native vegetation land uses, provided suitable soil management measures and amelioration are implemented.

The *Vickery Extension Project Soil Resource Assessment* undertaken by SESL Australia (2018) for the Project considered the results of McKenzie Soil Management (2012), including within rehabilitated historic mining areas, as well as further soil test studies conducted in the Project extension areas to inform the calculation of the indicative soil inventory available for rehabilitation over the life of the Project.

SESL Australia (2018) concluded that there would be adequate soil resources available to meet the rehabilitation concepts for the Project.

Soil management measures that would be implemented for the Project are detailed in Sections 4.3.3 and 5.4.2 of the Project EIS.

To manage soil resources to meet rehabilitation objectives, Whitehaven commits to implementing soil monitoring, management and amelioration measures for the Project as recommended by SESL (2018) and to be described in Mining Operations Plans (or equivalent).

2. Design of Final Landform incorporating Micro and Macro Relief

Including natural landform design features (e.g. drainage lines, hills and valleys) is a design objective of the Western Emplacement, and a proposed improvement in comparison to the Approved Mine.

Plate 13a Pit 3 - Anthroposol

Plate 13b Pit 5 - Anthroposol

Plate 13c Pit 37 - Anthroposol

Plate 13d Pit 2 - Anthroposol

Plate 13e Pit 51 - Anthroposol

WHC.15-33_RTS_005A

Source: McKenzie Soil Management (2012)

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VICKERY EXTENSION PROJECT

Examples of Soil Profiles Observed in the Rehabilitated Areas Within the Project Mining Area

Plate 13a to 13e

The waste rock emplacement for the Project would reach an elevation of approximately 370 m Australian Height Datum (AHD), which is similar to the maximum elevation of the Approved Mine, however, it would include the following features that were not incorporated in the Approved Mine landform (Section 5.3 of the Project EIS):

- Micro-relief (i.e. gently undulating surface typically ranging in elevation by 1 to 2 m) to assist in drainage design that replicates natural drainage systems.
- Macro-relief (i.e. 10 to 20 m hills similar to those found in the Vickery State Forest) to the top surface of the waste rock emplacement to improve the integration of the landform with the surrounding environment and mitigate potential visual impacts.

Design Integration of Micro-relief

Micro-relief would be integrated into the waste rock emplacement to direct runoff into vegetated drainage paths and improve the geotechnical performance, stability and hydrological function of the final landform.

The vegetated drainage paths would be designed to minimise flow velocities and located to minimise the overall slope of the drainage path. The drainage paths would be developed in consideration of length, slope, catchment area and final land use. For example, drainage paths with longer overall length and larger catchment would have a lower slope than minor drainage paths of shorter length and smaller catchment.

The conceptual landforms presented in the EIS would be further refined over the life of the Project, including further review using GeoFluv™ software or similar catchment/drainage review and landform design software to examine whether the development of further micro-relief could reasonably be incorporated to limit the need for bench drains on the outer batters of the Western Emplacement.

The primary objective of GeoFluv™ is to design stable landforms that convey water in the same way as natural landforms. The key principles of GeoFluv™ include:

- Creation of a natural-looking landscape with ridges that transition from convex to concave slopes.
- Maximising the number of sub-catchments (or watersheds) to reduce the catchment area of individual constructed drainage lines. This reduces reliance on contour banks and engineered drop structures (such as rock drains).
- Designing larger water channels with the required cross-sectional profile and sinuosity to handle variable flows.

Design Integration of Macro-relief

The waste rock emplacement has been designed to incorporate natural landform design features that reflect characteristics of the topography found in the adjacent Vickery State Forest (e.g. elevated landforms with steeper slopes in some areas relative to the surrounding plains).

The waste rock emplacement would be approximately 70 m higher than the high points within the Project area and approximately 110 m higher than the surrounding floodplains. The peak of the ridge in the adjacent Vickery State Forest would be approximately 110 m higher than the waste rock emplacement.

The conceptual batters of the waste rock emplacement, have an overall slope of up to approximately 10% (i.e. approximately 6°). Design considerations to improve geotechnical performance, stability and hydrological function of the final landform (e.g. micro-relief and macro-relief) may result in localised areas with batter angles steeper than 10%.

Consistent with the NSW Mineral Council's *Rehabilitation by Design Practice Notes* (2007) and DECCW's *Managing Urban Stormwater Soils and Construction Volume 2E Mines and Quarries* (2008), benches are not expected to be required to control the velocity of runoff from the batters where the waste emplacement slopes are less than 10%.

To maximise opportunities for micro-relief in the Project landform and to minimise the need for bench drains on the outer batters of the Western Emplacement, Whitehaven commits to landform review using GeoFluv™ software or similar during the life of the Project.

Whitehaven commits to establishing a waste rock emplacement that incorporates natural landform design features that reflect characteristics of the topography found in the adjacent Vickery State Forest (e.g. elevated landforms with steeper slopes in some areas relative to the surrounding plains).

3. Final Land Use Considerations

As noted by the Commission, a number of agencies including DI Crown Lands and Water, Gunnedah Shire Council and Narrabri Shire Council recommended further justification for not returning a greater portion of the final landform to land for agricultural uses, as opposed to native woodland.

This objective contrasts with the Gunnedah Shire Council's submission to the EIS, which states:

> *Council implores the developer to consider implementing suitable biodiversity offsets within the development site itself or on immediate adjoining allotments, to ensure that the endangered ecological communities present within the immediate area are not faced with destruction and reduction in available habitat.*

The overall rehabilitation goal for the Project is to enhance the cover and connectivity of native woodland on the final landform between the Vickery State Forest and the Namoi River, maximising the ability to meet Federal and State biodiversity offset requirements, while returning some areas of the final landform to agricultural land capable of supporting grazing.

Sections of the Project mining area to be rehabilitated to agricultural land include the mine infrastructure area, the southern part of the secondary infrastructure area, water management dams (except those retained for agricultural purposes or as passive water control storages) and the Project rail spur corridor. These areas have been selected as they are inherently more suitable for agriculture practices, given they are relatively flat, immediately adjacent existing agricultural land and proximal to water management infrastructure.

Rehabilitation of areas of the Project mining area to woodland/forest has been strategically selected consistent with the surrounding existing land uses (e.g. vegetation and fauna habitat in the Vickery State Forest and along the Namoi River) and to provide a biodiversity corridor linking the Vickery State Forest and the Namoi River. This biodiversity corridor would also be extended by proposed rehabilitation of the Rocglen Coal Mine to the immediate east of the Vickery State Forest.

If the waste rock emplacement were to be rehabilitated to agricultural land, Whitehaven may need to secure additional areas for biodiversity conservation in perpetuity outside the Project mining area to meet its offset obligations. This may result in the sterilisation of existing agricultural land.

Whitehaven commits to implementing a rehabilitation strategy that enhances the cover and connectivity of native woodland on the final landform between the Vickery State Forest and the Namoi River, maximises the ability to meet Federal and State biodiversity offset requirements, and returns some relatively flat areas of the final landform to agricultural land capable of supporting grazing.

Whitehaven commits to developing a Mine Closure Plan (or equivalent) three to five years in advance of the Project's anticipated closure date, which would describe any beneficial uses of the post-mining landform.

4. Water Quality of Waste Emplacement Runoff

Sedimentation Control

Sedimentation control for the Project would be implemented using sediment dams (Section 6.3.3. Sediment dams would contain runoff from partially rehabilitated mine areas that have been shaped to final profiles, covered with soil and seeded.

The proposed sediment dams have been conceptually designed according to standard practice detailed in *Managing Urban Stormwater: Soils & Construction* (Landcom, 2004) (consistent with the SEARs for the Project and contemporary EPL requirements for sediment dams. The sediment dams would be designed with sufficient capacity to retain the runoff from a 90th percentile five-day rainfall event of 38.4 mm as well as provide an additional 50% for sediment storage (as well as additional capacity to provide supply for water carts).

The sediment storage volume is the portion of the basin storage volume that progressively fills with sediment until the dam is de-silted. Where required, level markers will be installed in sediment dams to identify the required storage volumes. Dams would be managed over the life of the Project to maintain sufficient design capacity, including periodic desilting (i.e. removal of accumulated sediment) as required.

Sediment dam storage capacity would be maintained through transfer of water to other storages or through controlled release via licensed discharge points, in accordance with the requirements of an EPL following rainfall events that exceed sediment dam design capacity. Pump and pipeline facilities (or other transfer mechanisms) would be designed with sufficient capacity to transfer water to a mine water dam and restore the runoff capture capacity of the sediment dams within five days of the end of the rainfall event. In practice, transfer would commence before the end of a rainfall event and this would further limit the frequency of overflow.

Controlled discharges from sediment dams would only occur in order to restore sediment dam capacity for the next rainfall event and would be undertaken in accordance with an EPL for the Project under the following circumstances:

- rainfall in excess of 38.4 mm over five days has been received in the vicinity of the Project and there is insufficient capacity in the MWDs and water carts to receive water from the sediment dams;

- controlled discharges would occur within five days of the end of the rainfall event; and
- prior to controlled discharge, the water would be sampled and analysed to confirm its suitability for discharge in accordance with EPL requirements, including demonstrating a TSS concentration of less than 50 mg/L (if required, flocculation may be required prior to discharge to ensure that water quality is within acceptable EPL limits).

Overflows from sediment dams would only occur in the event of a storm rainfall in excess of the design rainfall (38.4 mm over five days) and after all possible transfers of water to the MWDs and water carts has occurred. Overflows would be managed in accordance with Project EPL requirements.

Advisian (2018) concluded that the frequency of discharges from Project sediment dams would be less than that prescribed in Landcom (2004). This is because:

- the sediment dams are inherently over-designed at the start of the Project to account for the maximum reporting catchment area over the Project life; and
- water captured in sediment dams would be preferentially used to meet on-site water demands to reduce the reliance on water from external sources, which would reduce the likelihood of overflow.

Table 8.10 of the Project Surface Water Assessment (Advisian, 2018) details the sediment dam water balance for the median climatic scenario. Controlled discharges from sediment dams are predicted to be between 148 ML and 681 ML over the Project life. If averaged, these discharges equate to between 6 megalitres per year (ML/year) and 26 ML/year. Overflows from each sediment dam are predicted to be between 184 ML and 2,026 ML over the life of the Project, which equates to an average discharge of between 7 ML/year and 78 ML/year). In comparison, the average flow of the Namoi River is approximately 618,000 ML/year (based on an average streamflow of 1,695 ML per day, as reported by Advisian [2018]).

Advisian (2018) concludes that, with the implementation of the controls described above, the Project would have negligible impact on water quality in the receiving creeks.

Runoff from Rehabilitated Landforms

Sediment dams would be maintained until runoff from catchment areas reporting to the sediment dams has similar water quality characteristics to areas that are undisturbed by mining activities (i.e. when vegetation successfully establishes on partially rehabilitated areas). Given water runoff from rehabilitated areas would be managed through sediment dams until it is comparable to undisturbed areas, potential offsite water quality impacts associated with the rehabilitated landform are considered negligible.

To minimise the risk of downstream water quality impacts, Whitehaven commits to maintaining sediment dams designed in accordance with Landcom (2004) and any Development Consent and EPL conditions until such time as runoff from rehabilitated areas reporting to the sediment dam has similar water quality characteristics to areas that are undisturbed by mining activities.

Geochemistry of Waste Rock

The Project Geochemistry Assessment (GEM, 2018) concluded that the majority of the overburden and interburden generated from the Project would generally be expected to have a low sulfur content and be non-acid forming (NAF) with a low salinity risk. Therefore, the bulk of the overburden and interburden is expected to be relatively barren with no risk of generating acid or saline conditions.

A small quantity of overburden, typically identified as non-continuous units adjacent to some coal seams, was identified as containing increased sulfur concentrations but with low acid generating capacity. These materials are anticipated to produce acidic conditions only when left exposed to the atmosphere for a number of years (which is not expected to occur for the Project).

Some interburden material (typically mudstone) was identified as containing increased sulfur concentrations and higher acid generating capacity which would have the potential to generate acidic conditions in a shorter period of time (within weeks of exposure to the atmosphere). Blending of this material during excavation, transport and dumping is expected to produce an overall NAF material. Potentially acid forming material would not be placed in the final lift of the waste rock emplacement.

Under the prevailing quasi-neutral to moderately alkaline conditions of the overburden and interburden, arsenic, molybdenum and selenium are likely to be readily soluble. Accordingly, the Project Geochemistry Assessment (GEM, 2018) and Project Surface Water Assessment (Advisian, 2018) recommended that monitoring of water quality in sediment dams capturing runoff from the waste emplacement include monitoring of: pH, EC, total alkalinity/acidity, sulphate, aluminium, arsenic, molybdenum and selenium (in addition to TSS).

In addition, and consistent with contemporary EPL conditions, the following parameters would be monitored during a controlled discharge from a sediment dam (i.e. when releases to restore the capacity of the dam are required following a rainfall event that exceeds the dam design capacity, and when there is insufficient storage available in other on-site storages): pH, EC, TSS, oil and grease and total organic carbon.

5. Groundwater Model Spoil Properties

Waste rock would be placed within the footprint of the open cut void as mining progresses. For the purposes of groundwater modelling, emplaced waste rock (or spoil) has been given uniform hydraulic conductivity of 1 metre per day (m/day), specific yield of 10% and rainfall recharge set to 5% of average rainfall by HydroSimulations.

Recovery groundwater modelling indicates a strong hydraulic gradient exists towards the void (i.e. it is a groundwater sink and water would flow towards the void and not from the void). Accordingly, there is negligible risk for any water quality impacts emanating from the final void (Section 6.2.3).

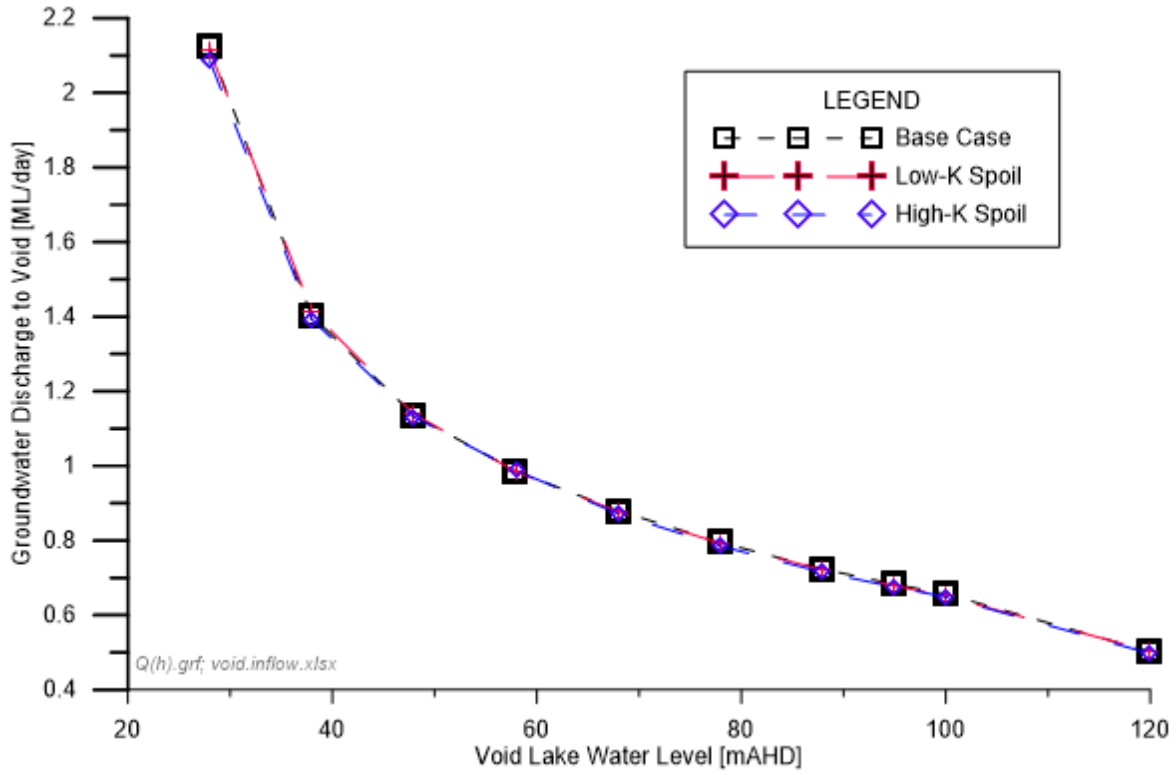
The groundwater model was used to develop a discharge-stage curve to show the groundwater inflows that would occur at different pit lake elevations. This discharge-stage curve was implemented in a surface water final void model, which also considered rainfall runoff and evaporation to determine the equilibrium pit lake elevation.

Sensitivity analysis for the spoil conductivity parameters has been undertaken by HydroSimulations. The sensitivity analysis included the following scenarios:

1. Base Case: Kx = 1 m/day and Kz = 0.1 m/day
2. Low-K Case: Kx = 0.3 m/day and Kz = 0.03 m/day
3. High-K Case: Kx = 3 m/day and Kz = 0.3 m/day

The outcomes of the sensitivity analysis are shown on Chart 7. As the three curves are very similar, the discharge-stage curve provided to surface water modellers is insensitive to spoil hydraulic properties.

Chart 7
Spoil Parameter Sensitivity Results (Source: HydroSimulations)



Although the hydraulic gradients through the spoil differ for the three cases, the spoil hydraulic properties provide a compensating effect so that the product of the hydraulic gradient and the hydraulic conductivity (that is, the discharge per unit area) is essentially unchanged.

6. Clarification of the number of proposed final voids.

The current landscape of the Project mining area contains five final voids remaining from past mining activities (i.e. Blue Vale, Canyon, Red Hill, Greenwood and Shannon Hill final voids). Four of the existing voids (Canyon, Red Hill, Greenwood and Shannon Hill) would be backfilled with waste rock for the Project.

Two final voids were proposed for the Approved Mine, in addition to the existing Blue Vale final void (i.e. three final voids would remain in total).

The Project final landform would include only one final void (a reduction from two when compared to the Approved Mine), in addition to the existing Blue Vale final void (i.e. two final voids would remain in total).

7. Proposed rehabilitation reporting

Rehabilitation would be reported in the MOP (or equivalent), including the rehabilitation monitoring program, rehabilitation parameters and completion criteria.

The MOP (or equivalent) would include detailed and quantifiable performance measures and completion criteria that are specific, measureable, achievable, realistic and time-bound in order to validate that rehabilitation across the site has been completed prior to closure.

6.11 HERITAGE

6.11.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to Aboriginal cultural and historic heritage included:

- adequacy of consultation for the Aboriginal Cultural Heritage Assessment (ACHA);
- implementation of best practice Aboriginal cultural heritage management during Project operations;
- potential impacts to Aboriginal cultural heritage sites, including the grinding groove site on the Namoi River (AHIMS 24-4-0009);
- identification of Aboriginal cultural heritage sites within the Project area;
- cumulative impact of the Project on Aboriginal cultural heritage in the region;
- adequacy of assessment of the significance of the Namoi River;
- provision of the report prepared by Dr Sue Rosen (2011) regarding the significance of the Kurrumbede Homestead; and
- potential impacts to the Kurrumbede Homestead and associated outbuildings and ongoing community access.

Agency Submissions

Agencies and local government which provided comments on the Project relevant to heritage included OEH, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- clarification of consultation undertaken with Registered Aboriginal Parties (RAPs) regarding scarred tree reassessment;
- provision of the scarred tree reassessment reports to the Aboriginal Heritage Information Management System (AHIMS) Registrar;
- justification of required Aboriginal cultural heritage survey west of the Namoi River;
- further analysis of the grinding groove site (AHIMS 24-4-0009);
- justification of proposed disturbance of a weatherboard dwelling;
- clarification of proposed management measures for the Kurrumbede Homestead; and
- clarification of proposed ongoing Aboriginal community consultation and access to the Namoi River.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report identified that Aboriginal cultural and historic heritage were raised in submissions on the Project and requested Whitehaven provide further information to address the submissions in the RTS.

Independent Planning Commission Issues Report

Regarding heritage, paragraph 300 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 294, the Commission considers that the Department should give detailed consideration to:*
>
> - *the deficiencies identified by the Commission in the Applicant's engagement with the local traditional owners and the Aboriginal surveys; and*
> - *how the Kurrumbede Homestead could be protected from the impacts of the Project, and details of the proposed Kurrumbede Homestead Management Plan, including timing and funding, to be provided by the Applicant.*

6.11.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Aboriginal Cultural Heritage Assessment.
    a. Clarification of outcome of scarred tree reassessments and associated consultation.
    b. Clarification of assessment of cumulative impact and cultural values assessment.
    c. Justification of required Aboriginal cultural heritage survey west of the Namoi River.
    d. Clarification of predicted impacts to the grinding groove site 'Wilga' (AHIMS 24-4-2009).
2. Justification of proposed disturbance of the weatherboard dwelling.
3. Kurrumbede Homestead.
    a. Clarification of predicted impacts and provision of report regarding significance.
    b. Proposed mitigation and conservation measures.
4. Proposed Aboriginal cultural and historic heritage mitigation and management measures.

6.11.3 Responses

1. Aboriginal Cultural Heritage Assessment

a. Clarification of outcome of scarred tree reassessments and associated consultation

The scarred tree reassessment reports prepared by Kamminga and Lance (2016) and Burns (2016) concluded that none of the identified scarred trees were of Aboriginal cultural origin. These reports were appended to the draft (and final) ACHA, which was provided to the RAPs for comment during each of the consultation periods as well as during the EIS public exhibition. No comments received from the RAPs during any of the ACHA consultation periods identified any issues with the results of the scarred tree reassessments.

None of the possible scarred trees were entered into the AHIMS database during the initial assessment undertaken by Hudson in 2012 (Whincop Archaeology, 2018).

Therefore the scarred tree reassessment reports (Kamminga and Lance, 2016; Burns, 2016), which concluded that none of the identified scarred trees were of Aboriginal cultural origin, do not need to be provided to the AHIMS Registrar as there are no AHIMS site cards to be updated.

b. Clarification of assessment of cumulative impact and cultural values assessment

Consultation for the Project ACHA (Appendix G of the EIS) was undertaken in accordance with *the Aboriginal cultural heritage consultation guidelines for proponents 2010* (DECCW, 2010a), and involved a registration process to identify RAPs (Section 5.1 of Appendix G of the EIS).

The definitions of cultural heritage significance provided in the *Australia ICOMOS Charter for Places of Cultural Significance* (the Burra Charter) (Australia International Council on Monuments and Sites, 2013) were applied to the significance assessment undertaken for the Aboriginal cultural heritage sites identified within the Project area (Section 10 of Appendix G of the EIS).

The cumulative impacts of the Project with regard to Aboriginal cultural heritage were assessed in Section 11.5 of the ACHA (Appendix G of the EIS). The cumulative assessment, which considered the existing mining operations in the region, concluded that the cumulative impact that would result would be low.

During the survey and throughout the consultation process, representatives of the RAPs were asked to identify any areas of cultural significance within the Project area and surrounds or any cultural values relevant to the area. All cultural comments relating to the Project area and/or the wider region were recorded and are included in the ACHA (Appendix G of the EIS). Accordingly, the cultural values assessment is considered to adequately assess all identified areas of cultural significance.

The known cultural values of the Namoi River are discussed in Section 9.2.2 of the ACHA (Appendix G of the ACHA), as informed by consultation with the RAPs.

c. Justification of required Aboriginal cultural heritage survey west of the Namoi River

Some areas of the rail corridor west of the Namoi River were unable to be accessed by RAPs during the Project field surveys, however, the landscape of these survey units was inspected by the archaeologist at a later date to determine the potential for Aboriginal cultural heritage sites. The vast majority of the unsurveyed rail corridor is through cleared cropping or grazing land, and it was assessed that any artefacts present would not be considered scientifically significant.

The unsurveyed potions of the Project rail spur alignment would be subject to systematic survey prior to surface disturbance works, with access permission of relevant landholders. Surveys would be undertaken in accordance with the methodology outlined in Appendix G of the EIS and any requirements in the Heritage Management Plan prepared for the Project.

As requested by OEH, and if determined to be required during survey, best practice salvage and/or excavation would be undertaken in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010b).

OEH's comment that it is satisfied that the Project rail spur will not impact the 'chain of ponds' feature close to the Namoi River is noted.

d. Clarification of predicted impacts to the grinding groove site 'Wilga' (AHIMS 24-4-2009)

Wilkinson Murray (2018) predicted vibration levels at the grinding groove site 'Wilga' (AHIMS 20 4-0009) would not exceed 6.3 mm/s (note the nominated vibration criteria is 80 mm/s) and therefore would not be indirectly impacted by the Project (Section 8.3.2 of Appendix D of the EIS). The grinding groove site would be inspected by a structural engineer prior to commencement of blasting to confirm the nominated blasting criteria is suitable.

Blast vibration monitoring, including monitoring at the grinding groove site, would be undertaken for the Project and would be detailed in the Blast Management Plan.

A detailed site inspection of the grinding groove site (including ground truthing and artefact identification) would be undertaken by a suitably qualified archaeologist to update the site card for the site, prior to commencement of Project blasting.

2. Justification of proposed disturbance of the weatherboard building

The weatherboard building (Site 22) is situated within the Project disturbance footprint and is owned by Whitehaven. The structure is in a poor state of repair and is currently unoccupied (Appendix K of the EIS).

The weatherboard building is located within the Project open cut footprint, approximately 1 km within the Project disturbance extent. Accordingly, avoiding impacts to the weatherboard building is not feasible.

The weatherboard building was assessed as having potential local significance and as such direct disturbance would constitute a low-level adverse heritage impact (Appendix K of the EIS).

The weatherboard building would be subject to archival recording prior to disturbance, as recommended by the Historic Heritage Assessment (Appendix K of the EIS) and in accordance with relevant NSW Government guidelines.

3. Kurrumbede Homestead.

a. Clarification of predicted impacts and provision of report regarding significance

The Project would not directly impact the Kurrumbede Homestead or its associated outbuildings. Blasting for the Project would be designed to remain below the building damage criteria at the Kurrumbede Homestead, as demonstrated by the modelling conducted by Wilkinson Murray (2018).

Amenity impacts (e.g. audible noise and visual modification) may occur at the Kurrumbede Homestead Complex as a result of the Project, however, such impacts would be manageable and reversible (as they would occur during the life of the Project only). Although indirect impacts to the Kurrumbede Homestead Complex are considered to have a low potential of occurring (Appendix K of the EIS), vibration monitoring and structural inspections of the infrastructure would be undertaken (Section 4.16.3 of the EIS).

b. Proposed mitigation and conservation measures

Consistent with the recommendations of the Historic Heritage Assessment (Extent Heritage, 2018), Whitehaven will implement the following management measures for the Kurrumbede Homestead:

- blast monitoring to demonstrate blast levels remain below building damage criteria;
- maintenance of the landscaping surrounding the Homestead; and
- maintenance of the Homestead and associated outbuildings.

Whitehaven will prepare a Heritage Management Plan for the Project incorporating the recommended management measures in the Historic Heritage Assessment, including those specific to the Kurrumbede Homestead.

It is noted that, in its submission on the Project, the NSW Heritage Council supported the proposed mitigation and management measures outlined in the Historic Heritage Assessment, including preparation of a Heritage Management Plan.

Whitehaven has also recently advised the Dorothea Mackellar Society of a significant financial contribution to enhance the landscaping surrounding the Kurrumbede Homestead. Whitehaven will continue to consult with the Dorothea Mackellar Society regarding the implementation of the enhancement works. Any enhancement works would also be detailed in the Heritage Management Plan.

The Kurrumbede Homestead is located entirely on Whitehaven-owned land. Whitehaven would consider providing community access to the Kurrumbede Homestead following restoration and maintenance activities. Any community access would be detailed in the Heritage Management Plan.

Whitehaven commits to avoiding direct adverse impacts to the Kurrumbede Homestead, with management and monitoring measures to be described in a Heritage Management Plan.

4. Proposed Aboriginal cultural and historic heritage mitigation and management measures.

Whitehaven will prepare a Heritage Management Plan for the Project incorporating the recommended management measures in the Historic Heritage Assessment (Appendix K of the EIS) and the ACHA. The Heritage Management Plan would be developed prior to any Project-related works that would potentially harm Aboriginal cultural or historic heritage sites.

The Heritage Management Plan will also detail specific maintenance and management measures for the Kurrumbede Homestead Complex, as described above.

Aboriginal cultural heritage sites identified in the Project area would be managed in accordance with the recommendations of the ACHA (Appendix G of the EIS) as well as Approved Mine ACHA (Landskape, 2012), which were prepared in consultation with the RAPs.

Ongoing consultation would be undertaken with the RAPs over the life of the Project, including Aboriginal representation during archaeological fieldwork (e.g. salvage of artefacts prior to disturbance). Whitehaven would provide opportunities for Aboriginal community members to access known Aboriginal heritage sites located on Whitehaven-owned land (e.g. for cultural reasons or as part of scheduled field activities) and also allow access to the Namoi River.

The RAPs and OEH would be given an opportunity to provide comments on the draft Heritage Management Plan prior to submission to DPIE for approval.

6.12 SOCIAL AND ECONOMIC

6.12.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to social and economic considerations included:

- impacts to Boggabri (which is the closest town to the Project), including:
  - cumulative impacts with other existing operations in the region;
  - flow on effects of the CIVEO accommodation camp;
  - housing prices;
  - access to childcare services;
  - impact of additional rail movements; and
  - consideration of mine closure.
- large non-local construction workforce;
- potential for workforce automation;
- physical and mental health impacts on the community;
- amenity impacts (e.g. noise, air and visual), effect on rural lifestyle and associated reduction in property values;
- population decline as a result of land acquisition and associated loss of farming families from the region;
- lack of consultation with affected landholders;
- post-mining use of Project infrastructure (specifically the Project rail spur);
- Whitehaven's existing relationship with regional small businesses; and
- adequacy of economic assessment of sterilisation of agricultural land.

As discussed previously (Section 3), the majority of public submissions (60%) supported the Project on the basis of the positive social and economic outcomes to the local region and NSW.

Agency Submissions

Agencies and local government which provided comments on the Project relevant to social and economic considerations included the DI Crown Lands and Water, Narrabri Shire Council and Gunnedah Shire Council. These comments included:

- cumulative impact of the Project, particularly with respect to regional Biophysical Strategic Agricultural Land (BSAL);
- clarification of the baseline employment data used;
- accuracy of Local Government rate estimates;
- clarification of production-related costs;

- request for further Local Effects Analysis (LEA), specifically regarding potential impacts to the tourism industry;
- gender balance in communities as a result of the Project workforce;
- provision of scholarships, training and apprenticeship programs;
- potential for workforce automation;
- clarification of the Project workforce, including indigenous employment targets;
- potential impacts on Boggabri township, both during and post-mining;
- ongoing community consultation;
- Voluntary Planning Agreements (VPAs) with councils; and
- demand for infrastructure and services.

It is noted the DRG in its submission stated:

> *AnalytEcon has also estimated royalties to the New South Wales Government of $671 million in Net Present Value (NPV) terms, which is slightly less than the independent royalty calculation conducted by the Division* [DRG] *($695 million). The difference relates to slightly higher coal price assumptions used by the Division.*

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report reinforced the Narrabri Shire Council and Gunnedah Shire Council's concerns regarding social and economic issues associated with the Project, including use of a local workforce, Indigenous employment and skills development.

As part of DPIE's Preliminary Issues Report, an Independent Expert (Gavan Dwyer of Marsden Jacobs Associates) was engaged to peer review key aspects of the Project Economic Assessment. DPIE's Independent Expert concluded:

> *AnalytEcon has undertaken a robust economic assessment of the Vickery Extension Project. The methodology aligns with the required guidelines and the indicative estimates broadly align with our expectations.*

Independent Planning Commission Issues Report

Regarding social and economic issues, paragraph 335 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraphs 320 and 334,the Commission considers that the Department should give detailed consideration to:*
>
> - *the impacts of a 'mining' based economy on that section of the community that does not receive 'mining' income;*
> - *all matters relevant to the economic contribution of the Project, including but not limited to:*
>   - *assumptions used in the CBA in comparing the Approved Project to the Project, particularly in regard to the current consent conditions for the Approved Project relating to total combined output of the three mines (i.e. Approved Project, Tarrawonga and Rocglen Mines);*
>   - *economic impact of the Approved Project scenario after accounting for the restrictions on output from the Rocglen and Tarrawonga Mines and current approval limitation of the Gunnedah CHPP;*

- *incremental economic impact of the Project compared to the Approved Project, after taking account of the Approved Project 2014 consent conditions for combined mine output and the CHPP;*
- *comparative economic assessment of the relocation of the CHPP 400 m east to accommodate a bund to the west of the CHPP, including impact on sterilisation of coal resources;*
- *comparative economic assessment of the relocation of the CHPP and rail loop, to an alternative location in the south east (secondary infrastructure area); and*

- *the SIA risk assessment for post mining impacts could be expanded to provide more detail, particularly focused on transitional strategies for impacted communities such as Boggabri.*

6.12.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Adequacy of the Social Impact Assessment.
   a. Currency of the health profile data.
   b. Consideration of relevant guidelines.
   c. Cumulative social impact assessment.
2. Clarification of Project workforce requirements.
   a. Justification of non-local construction workforce.
   b. Gender balance within local communities.
   c. Justification of predicted workforce.
   d. Potential for workforce automation.
3. Industrialisation of Biophysical Strategic Agricultural Land.
4. Voluntary Planning Agreements.
5. Amenity impacts and associated physical and mental health impacts on the community.
6. Clarification of potential impacts to the Boggabri township.
7. Proposed social management measures:
   a. Ongoing consultation.
   b. Training and employment.
   c. Mine closure planning.
8. Indirect economic impacts.
9. Tarrawonga and Rocglen Coal Mine production rate.

Note a comparative economic assessment of relocation of the Project CHPP is provided in Section 6.8.3.

6.12.3 Responses

1. Adequacy of the Social Impact Assessment

a. Currency of the health profile data

The health profile information used in the Social Impact Assessment was sourced from the most recent available data. Section 4.7.1 of Appendix R of the EIS describes potential impacts to the capacity of health services as a result of the Project.

Relevant health professionals in the region (including the Hunter New England-Gunnedah Hospital and Health Service Manager and Emergency Service providers) were consulted with during the Social Impact Assessment engagement process.

Whitehaven would consult with the Gunnedah Shire Council, Narrabri Shire Council and relevant community infrastructure providers to pre-empt gaps in the provision of health services to local residents due to new patients as a result of the Project.

b. Consideration of relevant guidelines

The Social Impact Assessment (Appendix R of the EIS) was prepared in accordance with the *Social impact Assessment Guideline for state significant mining, petroleum production and extractive industry development* (DPE [now DPIE], 2017), consistent with the requirements of the revised SEARs for the Project (Attachment 1 of the EIS).

c. Cumulative social impact assessment

Cumulative impacts of other proposed major projects in the region have been assessed in Section 4.8 of the Social Impact Assessment (Appendix R of the EIS) and Section 2.4 of the Economic Assessment (Appendix J of the EIS) during both construction and operational phases of the Project.

2. Clarification of Project workforce requirements

Whitehaven's experience with workforce requirements for existing mining operations (e.g. Maules Creek Coal Mine) have been used as the basis for the employment estimations provided in the Project EIS.

Further detail regarding the Project workforce would be provided to Councils and other relevant stakeholders during the resourcing stage of the Project, to allow for adequate community infrastructure planning.

a. Justification of non-local construction workforce

As a result of the specialised construction workforce force required, Whitehaven is predicting that the majority of construction personnel would be non-local (i.e. sourced from outside the Project region). This prediction is based on Whitehaven's experience with existing operations in the region, including the Maules Creek Coal Mine. These non-local personnel would be required only during the construction phase of the Project (approximately a 12-month period). However, construction personnel would be preferentially hired from within the Project region, where possible.

Non-local construction personnel would be encouraged by Whitehaven to use the Boggabri Accommodation Camp to relieve short-term pressure on local housing prices and availability, consistent with feedback from the local community.

Notwithstanding, approximately 70% of the operational workforce is expected to be sourced from within the region. Non-local operational personnel would be encouraged to settle permanently within the Gunnedah and Narrabri LGAs.

b. Gender balance within local communities

Significant changes to gender balance in smaller communities are likely to only occur in the short term (i.e. during the construction period [approximately 12 months]). Whitehaven would encourage the Project operational workforce, including their families, to relocate permanently to within the Project region.

c. Justification of predicted workforce

Whitehaven does not support a Development Consent condition which dictates where the workforce will reside, as it is ultimately dependent on individual preference where Project personnel and their families choose to reside within the region.

Based on Whitehaven's experience with the existing workforce in the region, for the purposes of impact assessment it was anticipated that approximately 30% of the operational workforce would migrate to the region, of which it was assumed that approximately 34% of the operational workforce would reside in the Narrabri LGA and 54% would reside in the Gunnedah LGA. Note approximately 73 operational personnel are expected to move to Gunnedah, excluding their families (i.e. not 243, as stated in Gunnedah Shire Council's submission).

Whitehaven would continue to support the provision of school-based traineeships, scholarships, apprenticeships and graduate programs in accordance with the housing and workforce management strategy outlined in the Social Impact Assessment (Section 5.4 of Appendix R of the EIS).

The operations recruitment strategy for the Project would focus on employment of local residents and implementation of the Whitehaven Workforce Diversity Policy. Whitehaven would also encourage contractors and suppliers to preferentially employ residents from within the local region.

Whitehaven would target employment of 10% of the operational workforce being of Aboriginal and/or Torres Strait Islander descent within 5 years of commencement of operations. This is representative of the demographics of the regional population and in accordance with Whitehaven's Stretch Reconciliation Action Plan (prepared in consultation with the community).

Whitehaven's Stretch Reconciliation Action Plan (which includes an Aboriginal Employment Strategy) details Indigenous employment targets and strategies for ongoing Aboriginal training and apprenticeships in the region, including continued support for the Winanga-Li Aboriginal Child and Family Centre and partnership with the Girls Academy at Gunnedah High School.

d. Potential for workforce automation

Whitehaven has no current plans for the Project to include an automated fleet.

3. Industrialisation of Biophysical Strategic Agricultural Land

On 8 February 2016, the Secretary for the DPIE issued a Site Verification Certificate (SVC) certifying that the Project extension into MLA 1 is not located on BSAL. The SVC is presented in Attachment 9 of the EIS.

The Project rail spur would be located on land owned by Whitehaven or on land where an existing land access agreement is in place. The alignment of the Project rail spur has been selected in consultation with landholders to minimise impacts to existing agricultural enterprises (i.e. by running along the edge of properties it traverses and avoiding irrigated cropping areas and water management infrastructure).

Therefore, the contribution of the Project to cumulative impacts to BSAL in the region would be negligible.

The loss in agricultural gross margins due to use of Whitehaven's allocated water licences for the Project was estimated to be approximately $0.5 million annually in net present value (NPV) terms (Section 3.3.7 of Appendix J of the EIS).

The potential change in regional agricultural value is not expected to cause significant losses to related services. As such, agricultural production values in the region are not expected to drop below critical mass thresholds (Appendix J of the EIS).

4. Voluntary Planning Agreements

Whitehaven is currently discussing VPAs for the Project with the Gunnedah Shire Council and Narrabri Shire Council.

Whitehaven's Donations and Sponsorship Policy, which provides support to local charities and community organisations, including within Boggabri, would continue to be implemented over the life of the Project.

Whitehaven would also continue to consult with the Gunnedah Shire Council, Narrabri Shire Council and relevant community infrastructure providers throughout the life of the Project to assist with service planning and determine opportunities to maximise benefits and offset impacts of the Project.

5. Amenity impacts and associated physical and mental health impacts on the community

Potential impacts to physical health as a result of the Project have been assessed in Section 4.6.1 of the Social Impact Assessment (Appendix R of the EIS). Potential impacts to mental health as a result of the Project have been assessed in Section 4.6.2 of the Social Impact Assessment (Appendix R of the EIS).

The risk of adverse impacts from fugitive coal dust emissions associated with coal transport along the Project rail spur is considered low based on the results of air quality monitoring commissioned by the EPA in the vicinity of existing rail corridors.

Upon request, Whitehaven will implement reasonable and feasible visual mitigation measures for privately-owned residences along the rail spur which are determined to be experiencing a high level of visual impact.

No existing privately-owned receivers along the Project rail spur are predicted to experience exceedances of the relevant non-network rail line criteria (Appendix D of the EIS).

Noise levels from trains on the Project rail spur would be managed such that there would be no more than negligible exceedances (i.e. 1 to 2 dBA) of the relevant criteria if the dwelling is constructed in the absence of an agreement with the landowner (Appendix D of the EIS).

Whitehaven will continue to engage with landholders within 5 km of the Project mining area and 2 km of the Project rail spur, including preparation of property-specific mitigation and management plans where required, consistent with the stakeholder engagement and community participation management strategy outlined in the Social Impact Assessment (Appendix R of the EIS).

6. Clarification of potential impacts to the Boggabri township

It is estimated that approximately 20% of the Project's operational workforce would reside in Boggabri (note this was assumed for the purposes of impact assessment, however is ultimately dependent on an individual preference in regard to where personnel [and their families] choose to reside). Whitehaven estimates that approximately 70% of the Project workforce would be comprised of people already living in the region and approximately 30% of the workforce would migrate to the area. This would result in approximately 28 new households moving to Boggabri.

Stakeholders (including Boggabri residents) consulted with during development of the Social Impact Assessment (Appendix R of the EIS) generally indicated that they would like to see families settle in Boggabri as a result of the Project, which would provide support for local businesses.

Potential social impacts and opportunities of the Project due to changes in population have been assessed in the Economic Assessment and Social Impact Assessment (Appendices J and R of the EIS).

Whitehaven is currently negotiating VPAs for the Project with the Gunnedah Shire Council and Narrabri Shire Council to support public infrastructure and services within the Gunnedah and Narrabri LGAs. Note it is not at Whitehaven's discretion where funds from the VPAs are allocated.

Whitehaven's Donations and Sponsorship Policy, which provides support to local charities and community organisations, including within Boggabri, would continue to be implemented over the life of the Project.

Whitehaven is working closely with the newly formed Business Workshop group in Boggabri to facilitate greater commercial interaction between Whitehaven's mines and the businesses operating in the Boggabri township.

Whitehaven would also continue to consult with the Gunnedah Shire Council, Narrabri Shire Council and relevant community infrastructure providers to determine opportunities to maximise the benefits of the Project.

Note, no additional train movements would travel through Boggabri as a result of the Project as the Project rail spur alignment joins the Werris Creek Mungindi Railway south of Boggabri, and Project trains would travel south to Newcastle.

7. Proposed social impact mitigation and management measures

a. Ongoing consultation

In accordance with the recommendations of the Social Impact Assessment (Appendix R of the EIS), Whitehaven will continue to engage with the community regarding the Project during the assessment process and throughout the construction and operation of the Project. Community consultation would primarily occur through the Vickery Community Consultative Committee.

b. Training and employment

Whitehaven currently supports the provision of school-based traineeships, scholarships, apprenticeships and graduate programs in the region.

Whitehaven would continue to support these programs consistent with the workforce management strategy outlined in the Social Impact Assessment and in consultation with the Gunnedah Shire Council and Narrabri Shire Council and key education/trainee providers.

Whitehaven's existing operations support a large number of local, regional and national suppliers. Whitehaven will continue to implement their Local Content Strategy, including maintenance of a local supplier database to support ongoing and preferential use of local and regional businesses in the Project supply chain (Section 5.5 of Appendix R of the EIS).

Whitehaven will also encourage all contractors and suppliers to preferentially hire within the Project region where possible, in accordance with the housing and workforce management strategy outlined in the Social Impact Assessment (Section 5.4 of Appendix R of the EIS).

Whitehaven's Donations and Sponsorship Policy, which provides support to local charities and community organisations, would also continue to be implemented over the life of the Project.

c. Mine closure planning

Whitehaven would prepare a Mine Closure Plan 3 to 5 years in advance of the Project's anticipated closure date to accurately inform mine closure planning and management of potential social impacts. The Mine Closure Plan would be prepared in consultation with Gunnedah Shire Council, Narrabri Shire Council and relevant community stakeholders, including within the Boggabri township.

The Project Rehabilitation Strategy, including infrastructure decommissioning, is detailed in Section 5.3.3 of the EIS.

The Project rail spur and rail loop infrastructure would be dismantled and removed following closure of the Project unless otherwise agreed with the relevant government agencies and landholders.

Infrastructure within the mine infrastructure area and secondary infrastructure area would be removed at the end of the Project life, unless otherwise agreed with the relevant government agencies and landholders (e.g. concrete hardstands, site access roads, sheds, buildings and sediment dams may provide for alternate post-mining uses).

Whitehaven commits to developing a Mine Closure Plan (or equivalent) three to five years in advance of the Project's anticipated closure date, which would inform mine closure planning and management of potential social impacts.

8. Indirect Economic Impacts

The local effect analysis component of the Economic Assessment (AnalytEcon, 2018) included consideration of the direct and indirect economic impacts of the Project on the regional economy (i.e. Gunnedah, Narrabri, Liverpool Plains and Tamworth Regional LGAs).

In addition to significant direct economic impacts, the Project is projected to result in the following indirect economic impacts in the regional economy (AnalytEcon, 2018):

- An additional 181 full-time equivalent jobs over the Project life associated with related upstream or downstream industries.
- An additional $92 million in NPV terms (or $8 million per annum) in disposal income associated with the additional indirect employment.

The Project would however marginally reduce agricultural production (i.e. due to use of land for mining rather than agriculture) and therefore the demand for downstream agricultural services and upstream value-adding enterprises. The indirect impacts to agricultural activities effectively represent an offset to the indirect benefits of the Project to the regional economy, corresponding to a reduction of approximately 0.5 full-time equivalent jobs per annum and a reduction in disposable income of approximately $0.7 million per annum (AnalytEcon, 2018). These indirect economic impacts to agricultural activities are however much lower than the estimated indirect economic benefits of the Project.

These indirect economic benefits of the Project in the regional economy occur in mining (e.g. mining services) and non-mining (e.g. retail) related sectors. The Project would therefore have economic benefits for non-mining sectors in the regional economy. To maximise the opportunities for local businesses in non-mining sectors to benefit from the Project, Whitehaven would implement the following mitigation and management strategies (Elliott Whiteing, 2018):

- development of a local content strategy for Project contractors/suppliers and implementation of a local supplier database;
- consultation with local business groups and chambers, including the Boggabri Business and Community Progress Association; and
- support of a courtesy bus between the Boggabri Accommodation Camp and Boggabri town.

It is acknowledged however that the Project may result in other economic impacts to non-mining related sectors such as:

- draw of labour from other industries which can result in labour shortages in the region; and
- housing availability and affordability (particularly for lower-income residents) during Project operations.

The Project's demand for labour can result in labour being drawn away from other industries, which can result in labour shortages in the region in other sectors. Agriculture is the primary source of employment in rural Australia (including the Project area). Agriculture-related employment in rural Australia has reduced by almost 19% over the last 12 years (including non-mining areas). This is reflected by unemployment levels in the region which are markedly higher than for NSW as a whole (Elliot Whiteing, 2018). The coincident increases in mining-related employment in the region have provided alternative employment opportunities and assisted to curtail population decline (or increased population) which can have associated economic and socio-economic benefits in the region.

Labour draw from the agricultural sector as a result of the Project is predicted to be negligible (AnalytEcon, 2018). However, stakeholders consulted as part of the Social Impact Assessment engagement noted that mining recruitment exacerbated local shortages of tradespeople in the construction and manufacturing industries (Section 4.2.1 of Appendix R of the EIS).

Potential labour draw as a result of the Project is predicted to be a temporary impact as the labour market equalises. Whitehaven would continue to support the provision of school-based traineeships, scholarships, apprenticeships and graduate programs in the region and consult with the Gunnedah Shire Council and Narrabri Shire Council regarding current employment and training trends in the region.

Whitehaven would implement the following management strategies to minimise the potential for labour shortages:

- operations recruitment strategy, including preferential employment of local residents and implementation of the Whitehaven Workforce Diversity Policy;
- support for locally based training programs; and
- work with Gunnedah Shire Council, Narrabri Shire Council, Chambers of Commerce and TAFE on trade and service industry excellence initiatives.

The Project is expected to increase demand for housing in the region. Where housing supply is insufficient to meet demand, even temporarily, this may manifest itself in increased property prices and higher rent prices. While this may be seen as beneficial for property owners, it can adversely affect existing tenants, particularly those on lower incomes. Whitehaven would implement the following management strategies to minimise the potential impacts on housing availability and affordability:

- encouraging Project contractors and suppliers to preferentially employ local residents within the region;
- operations recruitment strategy, including preferential employment of local residents and implementation of the Whitehaven Workforce Diversity Policy;

- encouraging non-local personnel to use the Boggabri Accommodation Camp; and
- monitoring of cumulative impacts to housing availability and affordability, in consultation with DPIE and other mining operations.

To minimise potential adverse socio-economic impacts to non-mining sections of the economy Whitehaven commits to implement the strategies recommended by specialist social impact practitioner Elliot Whiteing (2018) in regard to:

- **maximising benefits to non-mining local business;**
- **minimising the potential for labour shortages in other sectors; and**
- **minimising potential impacts on housing availability and affordability.**

9. Tarrawonga and Rocglen Coal Mines production rate

The anticipated ROM coal production schedule for the Tarrawonga and Rocglen Coal Mines is provided in Table 2-3 of the Project EIS.

The Project would not change the anticipated production schedule of the Tarrawonga and Rocglen Coal Mines (refer to Section 2.6 of the Project EIS).

The Approved Mine would however potentially limit production at the Tarrawonga and Rocglen Coal Mines as the combined production from these three mines is limited by the approved coal haulage transport rates (i.e. up to a total of 3.5 Mtpa, or up to 4.5 Mtpa ROM coal transport subject to the construction of the approved private haul road and Kamilaroi Highway overpass).

For example, if the Approved Mine ROM coal production schedule included in the Approved Mine EIS was adopted, the anticipated ROM coal production from the Tarrawonga and Rocglen Coal Mines would have reduced by approximately 28 Mt over the life of the mine compared to the anticipated ROM coal production schedule provided in Table 2-3 of the Project EIS. This 28 Mt reduction is required in order to comply with the approved coal haulage transport rates.

This is because, at the time of the Approved Mine, it was anticipated that commercial arrangements would be in place for Tarrawonga coal to be transported via the Boggabri Coal Mine CHPP and rail loop. However, such commercial arrangements are not in place.

The ROM coal production from the Tarrawonga and Rocglen Coal Mines for the "No Project or Approved Mine" scenario (i.e. combined approved Tarrawonga and Rocglen production); "Approved Mine" scenario (i.e. combined Approved Mine, Tarrawonga and Rocglen production); and "Project" scenario (i.e. combined Project, Tarrawonga and Rocglen production) is presented on Chart 8.

The cost-benefit analysis component of the Economic Assessment (AnalytEcon, 2018) considered two scenarios:

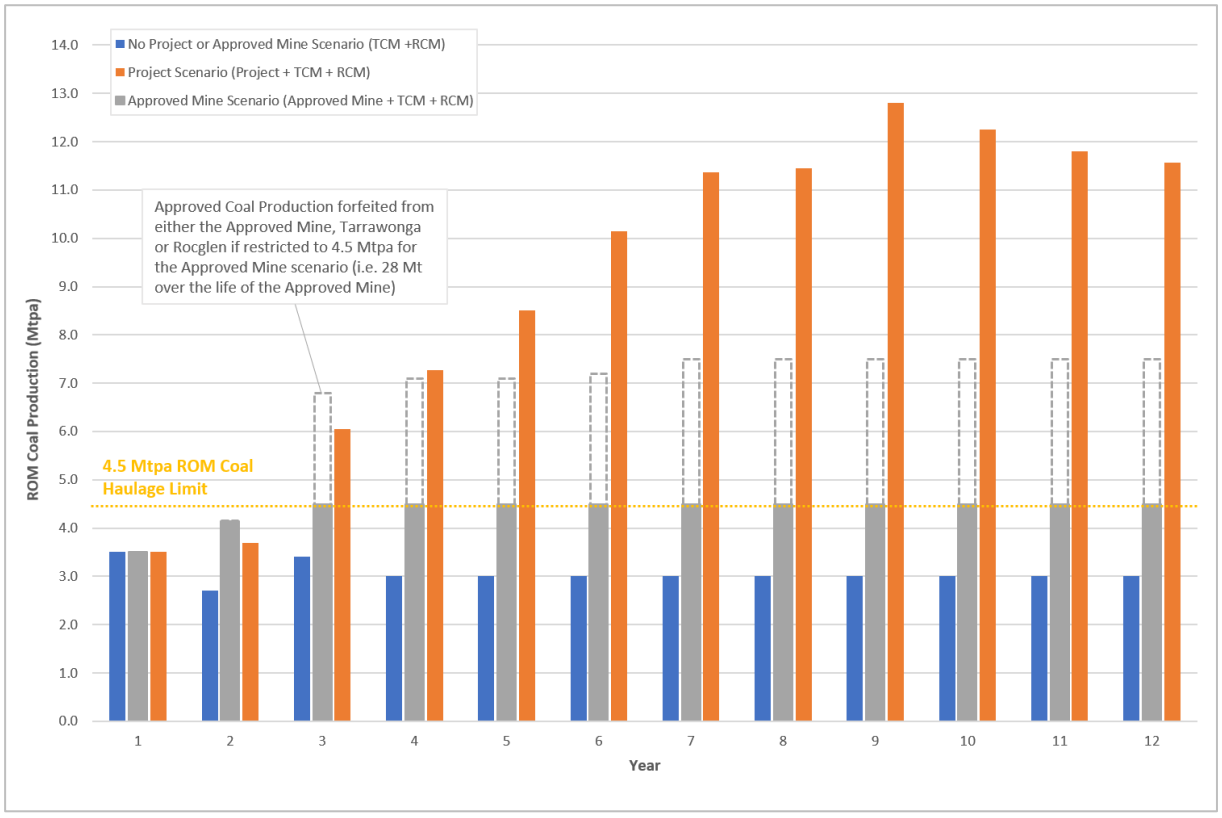
- Reference Case – the Project was assessed on a stand-alone basis; and
- Approved Mine Case – where the Project was assessed relative to the Approved Mine.

The Reference Case did not include the benefits of coal production from the Tarrawonga and Rocglen Coal Mines as the Project would not change their approved production schedules (Chart 8). Therefore the outcomes of the cost-benefit analysis presented in the Economic Assessment would also be unchanged.

The Approved Mine Case also did not specifically include the Tarrawonga and Rocglen Coal Mines production. This is considered to be conservative as the Project would 'unlock' the production of an additional 28 Mt of ROM coal already approved to be mined (i.e. as there would be no restriction on road haulage of ROM coal to the Whitehaven CHPP in Gunnedah) (Chart 8). The additional coal production allowed by the Project would result in additional benefits associated with employment benefits (disposable income), NSW share of income taxes and NSW share of gross operating surplus (royalties, company taxes, profits) that are not included in the cost-benefit analysis.

It is noted that the economic assessment prepared for the Tarrawonga Coal Mine (Gillespie Economics, 2011) included a cost-benefit analysis that concluded that the Tarrawonga Coal Mine would have net benefits to NSW and hence is desirable and justified from an economic efficiency perspective.

Chart 8
Approved Mine, Project, Tarrawonga and Rocglen ROM Coal Production



Note:

- *"No Project and Approved Mine" and "Project" scenarios based on the approved maximum production (Year 1) and then based on the production schedule in Table 2-3 of the Project EIS (Years 2 to 12).*
- *"Approved Mine" scenario based on the approved maximum coal haulage transport rates less the Approved Mine ROM coal production from Table 2-1 of the Approved Mine EIS.*

6.13 VISUAL AMENITY

6.13.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to visual amenity included:

- visual amenity impacts of Project landforms at privately-owned residences;
- loss of scenic value of the region; and
- night-lighting impacts to sensitive receivers (including privately-owned residences, the Siding Springs Observatory, stock and nocturnal animals).

Agency Submissions

Agencies and local government which provided comments on the Project relevant to visual amenity included the Siding Springs Observatory, Gunnedah Shire Council and Narrabri Shire Council. These comments included:

- clarification of proposed visual mitigation measures at residences, as well as timing;
- clarification of proposed night-lighting controls; and
- request for modelling of the Project night-lighting in accordance with the *Dark Sky Planning Guideline*.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report identified that visual amenity was raised in submissions on the Project and requested Whitehaven provide further information to address the submissions in the RTS.

Independent Planning Commission Issues Report

Regarding visual amenity, paragraph 349 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 348, the Commission considers that the Department should give detailed consideration to:*
>
> - *mitigation options for those residences forecast to experience high visual impact, particularly from the waste emplacement areas during the mine's operation;*
> - *requesting the Applicant to provide montages showing the proposed infrastructure and waste and coal handling areas superimposed on photographs of existing land forms, to be done from a number of vantage points;*
> - *the Applicant's ongoing consultation with the Siding Spring Observatory; and*
> - *the potential night-time lighting impact on the Siding Spring Observatory, in line with the Department's Dark Sky Planning Guideline.*

6.13.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Visual mitigation measures proposed for the Project.
2. Montages of the Project waste rock emplacement, infrastructure and coal handling areas.
3. Potential impacts of Project night-lighting on the Siding Springs Observatory.

6.13.3 Responses

1. Visual mitigation measures proposed for the Project

Potential visual impacts of the Project at residences (and public roads) would be mitigated in the following ways:

- mitigation measures implemented at residence locations;
- mitigation measures implemented along public roads; and
- mitigation measures implemented on-site, which would reduce the visual impact of the Project at residences and public roads.

Visual Mitigation at Residences

At privately-owned residences where the Project would have a high visual impact (and upon request from the landholder), Whitehaven would implement reasonable and feasible visual mitigation measures in consultation with the landholder. Specific examples of mitigation options at residences include:

- Planting shrubs/trees or other natural vegetation screens along the property perimeter.
- Planting vegetation screens at other select locations on the property (e.g. adjacent to the residence).
- Conducting other landscaping treatments, such as construction of a visual bund.
- Installing artificial visual screens on the property.
- Installing curtains or cladding at or within the residence.

The implementation of these measures, or other reasonable and feasible measures agreed upon between the landholder and Whitehaven, would consider the unique features of each residence (e.g. location of the residence relative to Project operations and infrastructure, aspect of the residence and available space). Agreed measures would be implemented within a reasonable timeframe.

To reiterate Whitehaven's commitment to implementing visual mitigation measures at residences, Whitehaven anticipates the existing Condition 47 of the Approved Mine Development Consent (SSD-5000) below would be carried forward to the Project Development Consent:

> *Upon receiving a written request from the owner of any residence on privately-owned land which has, or would have, significant direct views of the mining operations and on-site infrastructure during the development, the Applicant shall implement additional visual impact mitigation measures (such as landscaping treatments or vegetation screens) to reduce the visibility of the mining operations and infrastructure from the residences on the privately-owned land.*
>
> *These mitigation measures must be reasonable and feasible, and must be implemented within a reasonable timeframe.*
>
> *If the Applicant and the owner 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 Secretary for resolution*
>
> *Notes:*
>
> - *The additional visual impact mitigation measures must be aimed at reducing the visibility of the mining operations on site from affected residences, and do not require measures to reduce the visibility of the mining operations from other locations on the affected properties.*
> - *The additional visual impact mitigation measures do not necessarily have to include the implementation of measures on the affected property itself (i.e. the additional measures could involve the implementation of measures outside the affected property boundary that provide an effective reduction in visual impacts).*
> - *Except in exceptional circumstances, the Secretary will not require additional visual impact mitigation to be undertaken for residences that are more than 7.5 kilometres from the mining operations.*

In addition to the measures above, the visual impact of the Project at residences would be further mitigated by measures employed adjacent to the Project and on-site, which are described below.

At privately-owned residences where the Project would have a high visual impact, Whitehaven commits to implementing reasonable and feasible visual mitigation measures in consultation with the landowner.

Visual Mitigation on Public Roads

To mitigate the Project's visual impact from public roads, vegetative screens, and in some cases bunds, would be installed along sections of the Blue Vale Road realignment where prominent views of the active mine operations would be available to road traffic.

The vegetative screens and bunds, over time, would mitigate some of the visual impact along the Blue Vale Road realignment, although it is anticipated that residual visual impacts would be experienced by motorists due to the close proximity to the Project landforms.

Whitehaven anticipates the existing Condition 46 of the Approved Mine Development Consent (SSD-5000) would be carried forward to the Project Development Consent, which contains the following in relation to screening on roads and public places:

(f) provide for the establishment of trees and shrubs and/or the construction of mounding or bunding:

- *along the re-aligned Blue Vale Road;*
- *along the access road to the mine site; and*
- *at other areas identified as necessary for the maintenance of satisfactory visual amenity; and*

Visual Mitigation On-site

Whitehaven would implement a number of measures on-site which would assist to mitigate visual impacts to residences and public roads, including:

- Progressive rehabilitation of Project landforms (e.g. the Western Emplacement) during operations.
- Mitigation and decommissioning of Project infrastructure post-mining (including subsequent rehabilitation of infrastructure areas).
- Other visual mitigation measures.
- Night-lighting mitigation measures, discussed in the following subsection.

Progressive Rehabilitation

Rehabilitation of the Project landforms would be undertaken as part of the Project rehabilitation strategy and would assist in reducing the contrast between them and the surrounding environment.

The rehabilitation strategy for the Project has been developed based on experience gained from extensive rehabilitation works undertaken by Whitehaven at the Project site as well as in the region (e.g. at the Rocglen, Tarrawonga and Werris Creek Coal Mines), including consideration of the successful methodology used at these sites.

The key Project landform visible from private residences would be the Western Emplacement. The design of the waste rock emplacement would assist with the visual shielding of the active open cut operations from viewpoints to the north, west and south-west of the Project. The level of visual modification by the waste rock emplacement itself would vary over time, reducing as vegetation becomes established and mature.

Introduction of macro-relief (i.e. 10 to 20 m hills similar to those found in the Vickery State Forest) to the top surface of the waste rock emplacement would improve the integration of the landform with the surrounding environment and further mitigate potential visual impacts.

The waste rock emplacement would be revegetated with native tree, shrub and grass species, between the existing native vegetation in the Vickery State Forest and the Namoi River (Figure 34). Plates 14a and 14b and 15a and 15b show woodland rehabilitation conducted at the Canyon Coal Mine and Tarrawonga Coal Mine, which is representative of rehabilitation that would occur to the Western Emplacement.

Plate 14a Canyon Coal Mine - Woodland Vegetation Rehabilitation

Plate 14b Canyon Coal Mine - Woodland Vegetation Rehabilitation

WHC-15-53_RTS_007A

Source: Whitehaven (2017)

Plate 15a Tarrawonga Coal Mine - Northern Emplacement Following Reshaping, Fauna Habitat Placement and Cover Crop Establishment (2013)

Plate 15b Tarrawonga Coal Mine - Northern Emplacement with Established Woodland Vegetation Rehabilitation and Fauna Habitat (2017)

WHC-15-33_RTS_008A

Source: Whitehaven (2013; 2017)

Mitigation and Decommissioning of Project Infrastructure

During mining operations, the Project would require infrastructure such as the Project rail spur and loop, administration buildings and coal handling areas. As far as feasible, Whitehaven would ensure that the visual appearance of all infrastructure is aimed at blending with the surrounding landscape, as far as practical.

Post-mining, infrastructure including the Project rail spur and rail loop would be removed unless otherwise agreed with relevant government agencies and landholders (e.g. concrete hardstands, site access roads, sheds, buildings and sediment dams may provide for alternate post-mining uses).

Once all the equipment and infrastructure components have been removed, the mine infrastructure areas would be returned to land suitable for cattle grazing and the Project rail spur corridor would be returned to agricultural land, reducing the long-term visual impact of the Project.

Other Mitigation Measures

Whitehaven notes that the Project would include the following improvements to visual character relative to the Approved Mine:

- Reduction in the number of final voids from five to two within the Project area (including the existing Blue Vale final void) (noting that three final voids would be retained for the Approved Mine).
- Removing the requirement for the Eastern Emplacement as a waste rock emplacement (i.e. creating a permanent change to the final landform), with its approved footprint to be used as a secondary infrastructure area for the Project.
- Increased areas of woodland/forest revegetation to enhance the biodiversity value of the rehabilitated Project mining area and improve the connectivity of woodland between the Vickery State Forest and the Namoi River.

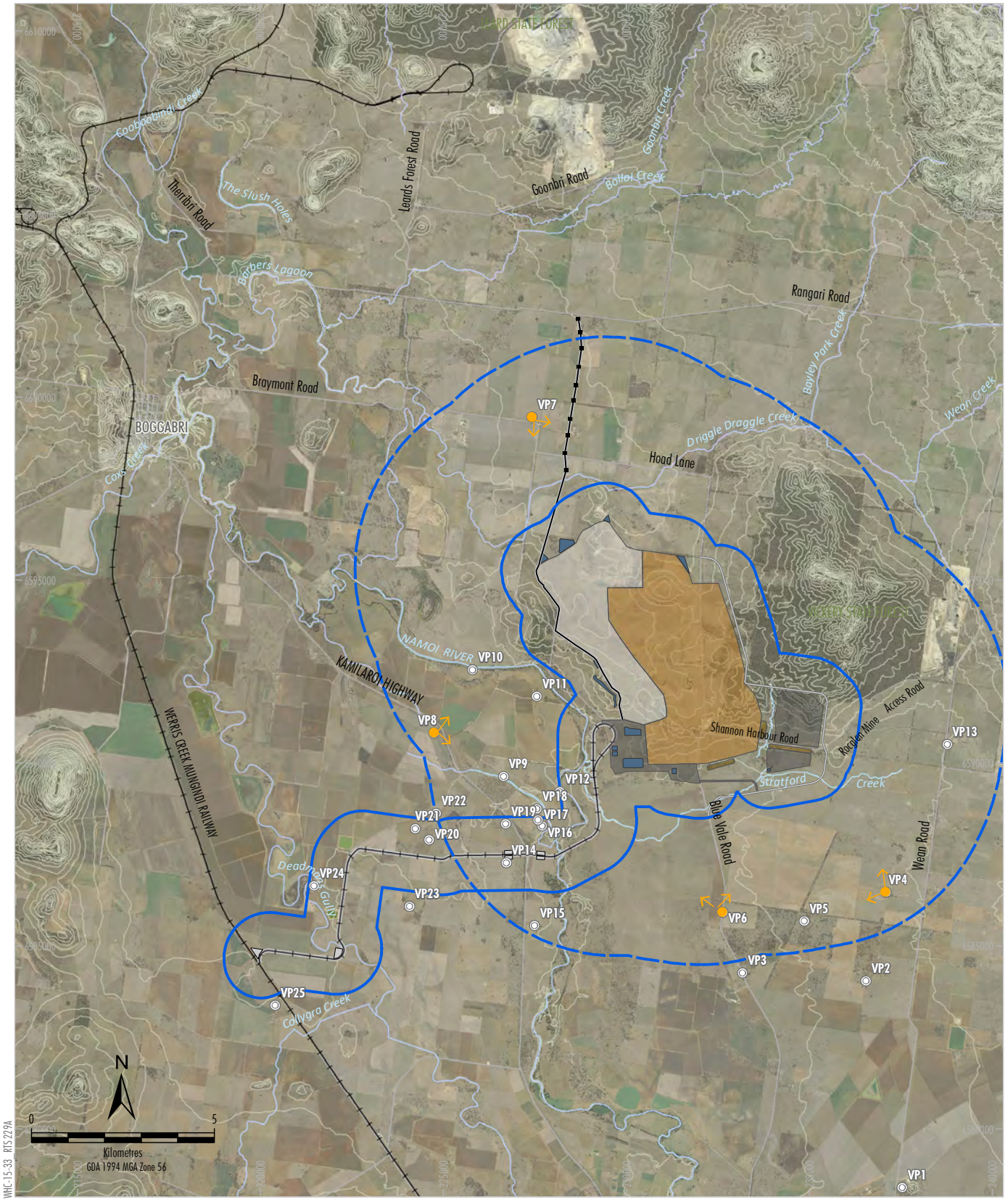
Whitehaven would also implement night-lighting mitigation measures as described in the following subsection.

In summary, Whitehaven would implement a variety of visual impact mitigation measures consistent with Condition 46 of the Approved Mine Development Consent (SSD-5000), which includes:

> *(a) implement all reasonable and feasible measures to minimise the visual and off-site lighting impacts of the development;*
>
> *…*
>
> *(g) ensure that the visual appearance of all buildings, structures, facilities or works (including paint colours and specifications) is aimed at blending as far as possible with the surrounding landscape,*

2. Montages of Project waste rock emplacement, infrastructure and coal handling areas.

Of the visual simulations prepared for the Project Visual Assessment (Appendix L of the EIS), VP8 (along the Kamilaroi Highway) is considered to provide a simulation of the closest publicly-accessible location to the Project on the western side of the Namoi River (Figures 35, 36a and 36b).


LEGEND
Railway
Project Components
Indicative Extent of Open Cut
Indicative Extent of Out of Pit Waste Rock Emplacement
Indicative Extent of Infrastructure Area
Indicative Extent of Soil Stockpile
Indicative Extent of Water Storage
Indicative Rail Spur Alignment
Indicative Location of Groundwater Bores and Pipeline
Project Mining Area Local Setting Boundary (1 km from Project Mining Area)
Project Mining Area Sub-Regional Setting Boundary (5 km from Project Mining Area)
Viewpoint
Visual Simulation Location
Source: Orthophoto - Department of Land and Property Information, Aerial Photo (July 2011); Department of Industry (2016); Whitehaven (2016)
WHITEHAVEN COAL
VICKERY EXTENSION PROJECT
Visual Simulation Locations
Figure 35
N
0
5
Kilometres
GDA 1994 MGA Zone 56
WHC-15-33 RTS229A
VP1
VP2
VP3
VP4
VP5
VP6
VP7
VP8
VP9
VP10
VP11
VP12
VP13
VP14
VP15
VP16
VP17
VP18
VP19
VP20
VP21
VP22
VP23
VP24
VP25
BOGGABRI
Braymont Road
Therribri Road
Leards Forest Road
Goombri Road
Rangari Road
Hoad Lane
Shannon Harbour Road
Racglen Mine Access Road
Blue Vole Road
Wean Road
KAMILAROI HIGHWAY
NAMOI RIVER
WERRIS CREEK MUNGINDI RAILWAY
Coolabrobundi Creek
The Slush Holes
Barbers Lagoon
Goombri Creek
Bollol Creek
Bayley Park Creek
Wean Creek
Driggle Draggle Creek
Cox Creek
Stratford Creek
Dead Horse Gully
Collygra Creek
PILLIGA STATE FOREST
WEEDIN STATE FOREST

Existing View

Existing View with Simulation Outline - Year 7

WHC-15-33 RTS 010A

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Existing View and
Visual Simulation Outline (Year 7) -
Kamilaroi Highway (VP8)

Figure 36a

Simulation - Year 7

Simulation - Post-Mining

WHC-15-33 RTS 011A

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Visual Simulation
(Year 7 and Post-Mining) -
Kamilaroi Highway (VP8)

Figure 36b

Within the visual simulations from VP8, the Vickery State Forest comprises a small portion of the overall landscape. Note that the Vickery State Forest is approximately twice the maximum height of the Project waste rock emplacement, and approximately 10 times the height of the largest infrastructure components.

Properties 127, 131, 132 and 133 are located closer to the Project mining area and CHPP than the location of VP8. The most sensitive viewpoints on these properties are from dwellings. Potential visual impacts to each of the dwellings on these properties have been individually communicated to the relevant landowners, as follows:

- All Project Years:
  - All residences may have views of the mine landforms and infrastructure.
  - All residences may have views of Project night-lighting sources.
- Early Project life (up to Project Year 7):
  - All residences would have potential views of the waste rock emplacement, which would be developed to its approximate maximum height and not yet rehabilitated.
  - Contrast between the existing landscape and the waste rock emplacement would be greatest at this point and would represent the greatest potential for visual impact.
- Later Project Life (following Project Year 7):
  - Rehabilitation of the waste rock emplacement with native vegetation would reduce contrast with the surrounding landscape and reduce potential visual impacts.
- Final Landform:
  - No further visual impact from the Project mine infrastructure area, which would be decommissioned, removed and the areas ripped, covered with soil and seeded with grass species.
  - No further visual impact from night-lighting.
  - The fully rehabilitated waste rock emplacement would remain visible, but would be compatible with the surrounding landscape (e.g. Vickery State Forest).

It is noted established riparian vegetation along the Namoi River (Plate 16), which is situated between residences and the Project mining area, would screen the mine infrastructure area and waste rock emplacement from these dwellings. In addition, existing vegetation surrounding the dwellings would also serve to screen potential views of the Project.

Notwithstanding, potential visual impacts to the closest dwellings to the Project mining area were conservatively assessed as high throughout the life of the Project.

At privately-owned residences where the Project would have a high visual impact (and upon request from the landholder), Whitehaven would implement reasonable and feasible visual mitigation measures in consultation with the landholder (see response above). If requested by the landholder, Whitehaven would prepare additional visual simulations from the residence.

In addition, the Project waste rock emplacement, which is by far the most visible aspect of the Project, is similar in height and extent as the Approved Mine. Therefore, the Project would not result in significant additional visual impact when compared to the Approved Mine.

Additional visual simulations of the mine infrastructure area and waste emplacement are therefore not considered to be warranted for the purposes of considering potential visual impacts.

Plate 16: Namoi River Riparian Vegetation

3. Potential impact of Project night-lighting on the Siding Springs Observatory

Whitehaven consulted with the Siding Springs Observatory in July and August 2019 to further understand the function of the observatory, and the relevance of managing generation of light from industry and regional towns. In particular, Whitehaven and the Siding Springs Observatory discussed key aspects of the *Dark Sky Planning Guideline* (Department of Planning and Environment [DPE] [now DPIE], 2016), and related controls and key mitigation measures described in the guideline.

Based on consultation conducted between Whitehaven and the Siding Springs Observatory to date, and the lighting principles outlined in the *Dark Sky Planning Guideline* (DPE [now DPIE], 2016), Whitehaven would implement the following measures to mitigate potential impacts from night-lighting (including sky glow) where practicable and without compromising operational safety:

- All external lighting associated with the Project would comply with AS 4282:1997 – *Control of the Obtrusive Effects of Outdoor Lighting* (e.g. upward light spill would be minimised through adequate aiming of lights and the use of shielded fittings where practicable).
- Night-lighting would be restricted to the minimum required for operations and safety requirements so as to avoid over-lighting.
- Appropriate positioning and orientation of lights.
- Use of warm white colours, where appropriate.
- Screens would be installed where required along sections of the Project rail spur to mitigate potential train lighting impacts to neighbouring residents and users of the Kamilaroi Highway.
- Mitigation measures at private residences, where warranted and if requested by the landholder (e.g. curtains, cladding, screens and tree planting).

Whitehaven anticipates the existing Condition 46 of the Approved Mine Development Consent (SSD-5000) would be carried forward to the Project Development Consent, which contains the following in relation to night-lighting and the Siding Springs Observatory:

(b) minimise the lighting impacts of the development on the Siding Springs Observatory;

(c) ensure no outdoor lights shine above the horizontal;

(d) wherever possible, ensure that mobile equipment is appropriately designed and/or retrofitted to prevent light being directed above the horizontal;

(e) ensure that all external lighting associated with the development complies with relevant Australian Standards, including Australian Standard AS4282 (INT) 1997 – Control of Obtrusive Effects of Outdoor Lighting or its latest version;

Whitehaven commits to implementing reasonable and feasible measures to mitigate potential impacts from night lighting (including sky glow) in consideration of the lighting principles outlined in the *Dark Sky Planning Guideline*.

6.14 TRAFFIC AND TRANSPORT

6.14.1 Submissions

Public and Special Interest Group Submissions

Comments made in public and SIG submissions relevant to traffic and transport included:

- construction of the Blue Vale Road realignment;
- accuracy of cumulative assessment;
- additional coal haulage along the Kamilaroi Highway and enforcement of night-time curfew;
- construction of the approved private haul road and Kamilaroi Highway overpass;
- potential impacts to the safety and efficiency of the road network as a result of Project-related traffic;
- use of local roads (in particular Braymont Road) by Project employees; and
- access restrictions to the Traveling Stock Route and Namoi River as a result of closure of Braymont Road.

Agency Submissions

Agencies and local government which provided comments on the Project relevant to traffic and transport included NSW Roads and Maritime Service (RMS), Gunnedah Shire Council and Narrabri Shire Council. These comments included:

- clarification of requirement of approved private haul road and Kamilaroi Highway overpass;
- implementation of a Traffic Management Plan;
- justification that the employee access route can be enforced;
- clarification of the proposed Blue Vale Road realignment design, and proposed construction timing; and
- clarification of proposed ongoing road maintenance agreements with Gunnedah Shire Council and Narrabri Shire Council.

Note that the Australian Rail Track Corporation (ARTC) provided a submission on the Project which confirmed that sufficient capacity is available for Project rail movements on the Werris Creek Mungindi Railway (the Main Line), as proposed in the EIS. Whitehaven will continue to consult with ARTC regarding Project-related rail transport.

Department of Planning, Infrastructure and Environment Preliminary Issues Report

DPIE's Preliminary Issues Report identified that traffic and transport was raised in submissions on the Project and requested Whitehaven provide further information to address the submissions in the RTS.

Independent Planning Commission Issues Report

Regarding traffic and transport, paragraph 364 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 363, the Commission considers that the Department should give detailed consideration to:*
>
> - *whether it would be appropriate to require that once the CHPP and rail spur is operational, all movement of product coal must be via the Project's rail spur; and*
> - *the available information/data on road and rail capacities and wait times at level crossings, and whether or not further information is required from the Applicant in this regard.*

6.14.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Accuracy of assessment predictions.
    a. Justification of data used in cumulative assessment.
    b. Clarification of impacts to safety and efficiency of the road network.
    c. Clarification of impacts to wait times at level crossings.
2. Proposed coal haulage by road.
3. Clarification of access restrictions as a result of closure of Braymont Road.
4. Proposed traffic and transport management measures.

6.14.3 Responses

1. Accuracy of assessment predictions

a. Justification of data used in cumulative assessment

Available traffic volume data from RMS, the *Vickery Coal Project Transport Assessment Baseline Assessment* (Halcrow, 2012), the *Tarrawonga Coal Project Road Transport Assessment* (Halcrow, 2011) and the *Maules Creek Coal Project Traffic and Transport Impact Assessment* (Hyder Consulting, 2010) were reviewed for the Road Transport Assessment (Appendix I of the EIS).

Additional traffic counts were conducted in 2015 and 2016 (Appendix I of the EIS).

The Road Transport Assessment modelling included predicted increases in traffic volume as a result of approved and proposed developments throughout the life of the Project, including the Tarrawonga, Rocglen and Boggabri Coal Mines (Section 5 of Appendix I of the EIS). Accordingly, Whitehaven considers that the assessment used accurate baseline date.

b. Clarification of impacts to safety and efficiency of the road network

The Road Transport Assessment (Appendix I of the EIS) considered potential impacts to the safety and efficiency of the road network as a result of the Project.

No upgrades to existing infrastructure were recommended due to Project-related traffic.

Notwithstanding, Whitehaven currently has road maintenance agreements with the Gunnedah Shire Council and Narrabri Shire Council. It is anticipated that similar agreements would continue to be maintained over the life of the Project, based on the levels of traffic generated.

c. Clarification of impacts to wait times at level crossings

Based on an estimated average level crossing closure time of approximately 3 minutes per train (GTA Consultants, 2018), the total closure time per hour of each of the level crossings between Gunnedah and the Project rail spur associated with all trains would increase by approximately 1 minute 30 seconds per hour on an average rail traffic day and by 2 minutes 6 seconds per hour on a peak rail traffic day as a result of the Project rail movements (Table 19).

Table 19
Rail Traffic Impact on Road Capacity at Level Crossings

Level Crossing	Average Number of Trains (trains/hour)		Level Crossing Closure Time (minutes/hour)	
	No Project	Project	No Project	Project
Average Day				
526 "Rothsay" Access Emerald Hill (passive)	1.4	1.9	4:12	5:42
527 Gunnedah Road Emerald Hill (active)	1.4	1.9	4:12	5:42
Peak Day				
526 "Rothsay" Access Emerald Hill (passive)	2.2	2.9	6:36	8:42
527 Gunnedah Road Emerald Hill (active)	2.2	2.9	6:36	8:42

After GTA Consultants (2018).

While the total delay per hour experienced by road traffic as a result of level crossing closures would increase, the average delay experienced by an individual driver who is stopped at a level crossing by a passing train would not be changed, nor would the length of queues formed at level crossings. As discussed in GTA Consultants (2018), it is the likelihood of an individual driver being delayed by a train that would be increased with the increased number of train movements.

It is noted that a new rail overpass is currently being constructed in Gunnedah and is expected to be completed in mid-2021. The rail overpass will allow traffic to avoid level crossings while travelling through Gunnedah and is expected to improve local traffic efficiency and road safety (RMS, 2019).

2. Proposed coal haulage by road

Whitehaven has no objections to the inclusion of a condition in any Development Consent issued for the Project that requires the cessation of the road haulage of Project coal once the Project CHPP, train load-out facility and rail spur have been fully commissioned.

Until the Project CHPP, train load-out facility and rail spur infrastructure reach full operational capacity, the Approved Road Transport Route would continue to be used to transport Project ROM coal to the Whitehaven CHPP consistent with the Development Consent conditions for coal haulage for the Approved Mine.

It is anticipated that construction and commissioning of the Project CHPP, train load-out facility and rail spur would be completed approximately 12 months following Project commencement. Actual timing would be dependent on Whitehaven obtaining all necessary approvals.

If, prior to reaching full operational capacity of the Project CHPP and rail spur infrastructure, combined transport of ROM coal from the Project, Tarrawonga Coal Mine and Rocglen Coal Mine to the Whitehaven CHPP exceeds 3.5 Mtpa, construction of the approved private haul road and Kamilaroi Highway overpass would be required, in accordance with the relevant conditions of the Development Consent (SSD-5000).

Whitehaven commits to the movement of all product coal from the site via the Project rail spur once the rail spur and CHPP is fully commissioned (except in extraordinary circumstances, such as bushfire, with agreement from the Secretary).

3. Clarification of access restrictions as a result of closure of Braymont Road

Closure of part of Braymont Road would prevent graziers from moving cattle from the Travelling Stock Reserve (associated with the parcel of Crown Land near the Namoi River) along the public road to Blue Vale Road. Whitehaven would facilitate continued access for graziers between the Travelling Stock Reserve and Blue Vale Road through Whitehaven-owned land around the mine infrastructure area and across the rail spur, subject to operational and safety requirements.

Access to the Namoi River and associated land would be maintained as far as practicable throughout the Project life. The Aboriginal community would be consulted regarding potential safety-related access restrictions during blast events/construction etc.

4. Proposed traffic and transport management measures

Condition 43 of the Approved Mine Development Consent (SSD-5000) provides that Braymont Road would not be used by any mine-related traffic to get to or from the site, except in an emergency to avoid the loss of lives, property and/or environmental harm.

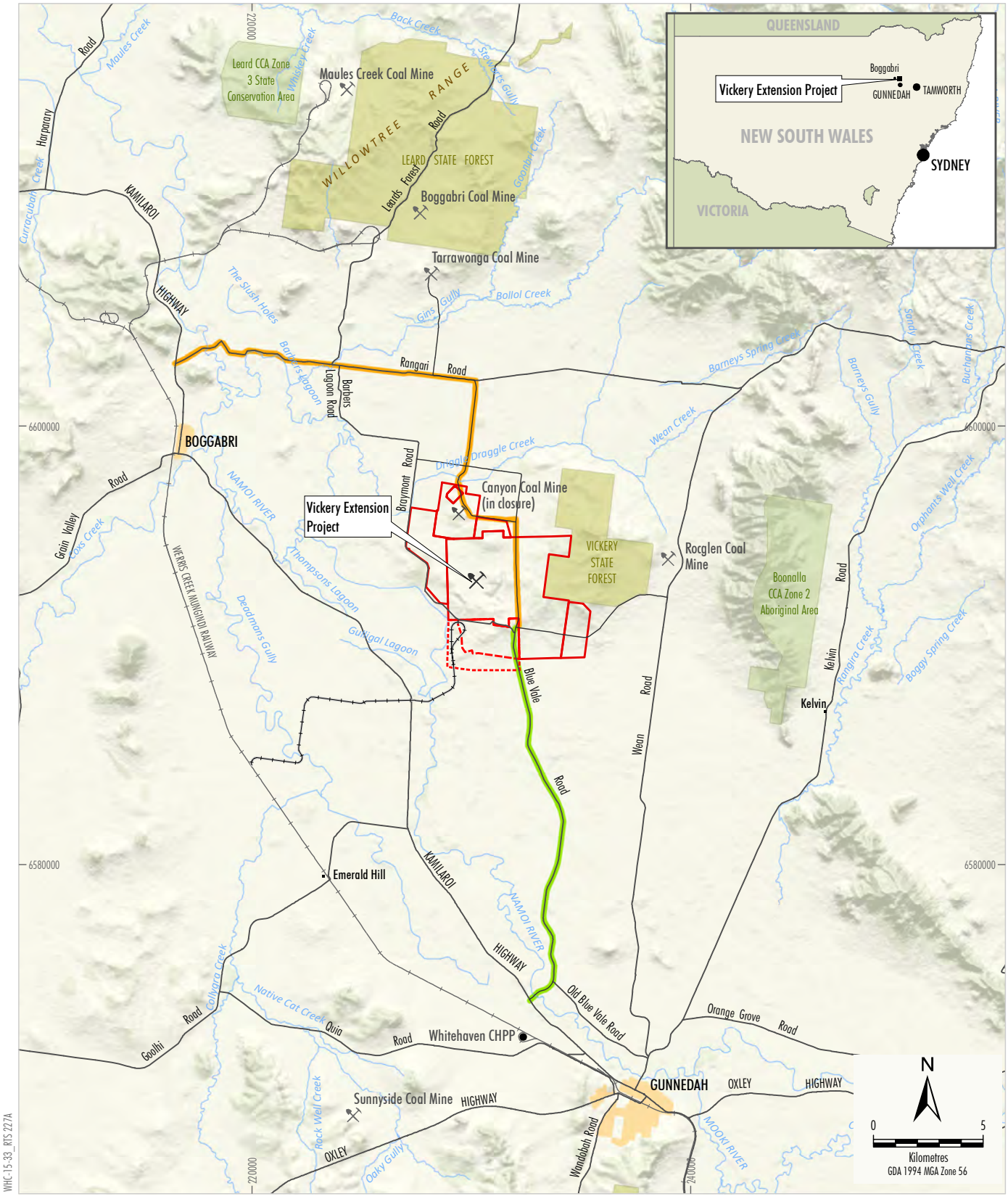
It is expected a similar condition would be included in any Development Consent for the Project. Project employees and contractors would not use local unsealed roads to access the Project. Employee and contractor access from the north would be via Hoad Lane (sealed) and from the south would be via Blue Vale Road (sealed) (Figure 37).

Whitehaven's existing Traffic Management Plan, which would be revised for the Project, will detail the prescribed site access route for mine-related traffic, access restrictions (i.e. no use of Braymont Road) and access route management measures (e.g. personnel inductions and signage). In addition, the revised Traffic Management Plan will:

- address proposed construction traffic at intersections of Kamilaroi Highway/Blue Vale Road and Kamilaroi Highway/Rangari Road;
- include Traffic Control Plans; and
- incorporate a Driver Code of Conduct that addresses the requirements identified by RMS.

Whitehaven would enter into a Works Authorisation Deed (WAD) for any works on classified roads (e.g. Kamilaroi Highway), if determined to be required, incorporating detailed design plans and a Road Safety Audit.

The approved Blue Vale Road realignment would be designed and constructed in accordance with Ausroad Guidelines and in consultation with the Narrabri Shire Council and Gunnedah Shire Council, and funded by Whitehaven.



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LEGEND

- Mining Tenement Boundary (ML and CL)
- Exploration Licence Boundary (EL)
- Mining Lease Application (MLA)
- State Forest
- State Conservation Area, Aboriginal Area
- Major Roads
- Railway
- Indicative Project Rail Spur
- Project Access Route from North (Sealed)
- Project Access Route from South (Sealed)

Source: LPMA - Topographic Base (2010); NSW Department of Industry (2015)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project Employee and Contractor Access Routes

Figure 37

6.15 PUBLIC INTEREST

6.15.1 Submissions

Independent Planning Commission Issues Report

Regarding consideration of 'the public interest', paragraph 375 of the IPC's Issues Report states:

> *Based on the Commission's observations, as listed in paragraph 374, the Commission considers that the Department should give detailed consideration to:*
>
> - *how the Project adheres to the objects of the EP&A Act, in particular the principles of ESD;*
> - *the assessments which have been completed for the Project in relation to the forecast of direct and indirect GHG emissions (i.e. Scope 1, Scope 2 and Scope 3 emissions);*
> - *GHG emission forecasts provided by the Applicant having regard to current relevant climate change policy frameworks (e.g. NSW Climate Change Policy Framework and the Paris Agreement); and*
> - *the demand for product coal from the Project and whether its sale will be to a country that is a signatory to the Paris Agreement.*

6.15.2 Key Issues

In consideration of the submissions described above, detailed responses to the following key issues are provided below:

1. Consideration of the Project against the objects of the NSW *Environmental Planning and Assessment Act, 1979*, including (but not limited to) consideration of:
   a. the principle of inter-generational equity; and
   b. the precautionary principle.
2. Greenhouse gas emissions, specifically considering the following matters:
   a. Forecast direct and indirect greenhouse gas emissions.
   b. Relevant climate change policy frameworks.
   c. Demand for Project product coal and expected customer countries.

6.15.3 Responses

1. Consideration of the Project against the objects of the NSW Environmental Planning and Assessment Act, 1979

Whitehaven considers that the EIS presents sufficient information to allow the consent authority to evaluate the merits of the Project against all relevant matters, including the heads of consideration in section 4.15 of the EP&A Act and the objects in section 1.3 of the EP&A Act. Based on the information provide in the EIS, Whitehaven considers that the consent authority can comfortably reach a conclusion that the benefits of the Project outweigh its impacts.

Notwithstanding, further discussion of the objects of the EP&A Act and the principles of ecologically sustainable development (ESD) is provided below.

Section 1.3 of the EP&A Act describes the objects of the EP&A Act as follows:

(a) to promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the State's natural and other resources,

(b) to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment,

(c) to promote the orderly and economic use and development of land,

(d) to promote the delivery and maintenance of affordable housing,

(e) to protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats,

(f) to promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage),

(g) to promote good design and amenity of the built environment,

(h) to promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants,

(i) to promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the State,

(j) to provide increased opportunity for community participation in environmental planning and assessment.

The Project is considered to be generally consistent with the objects of the EP&A Act, as:

- The Project would facilitate local and regional employment and other socio-economic benefits.
- The Project would develop the State's coal resources within Whitehaven's mining and exploration tenements.
- The Project incorporates relevant ESD considerations (as discussed further below).
- The Project would allow for the economic use and development of land, while maintaining key existing land uses including grazing uses on surrounding Whitehaven-owned lands.
- Measures have been developed and incorporated into the Project to manage and conserve resources including water, agricultural land and natural areas and to protect the environment (including native plants and animals, threatened species and their habitats).
- Reasonable and feasible measures have been developed and incorporated into the Project to minimise potential amenity impacts associated with noise, blasting, air quality and visual impacts on surrounding land uses.
- The Project would support the provision of community services and facilities through significant contributions to State royalties, State taxes, Commonwealth tax revenue and any applicable contributions to local councils.
- The Project is a State Significant Development Project that would be determined by the IPC or the Minister; however, a wide range of stakeholders have been consulted throughout the assessment process.
- The Project would be developed in a manner that incorporates community engagement through the Project EIS consultation program as well as the public exhibition of the EIS document and the major project assessment process.

ESD requires the effective integration of social, economic and environmental considerations in decision-making processes. Under the *Protection of the Environment Administration Act, 1991*, ESD is defined as being achieved through the implementation of the following principles and programs:

- the precautionary principle;
- inter-generational equity;
- conservation of biological diversity and ecological integrity; and
- improved valuation, pricing and incentive mechanisms.

It is noted that the above components of ESD are applied in combination, and no single component is necessarily given greater weight than the other components. The consent authority is obliged to consider and determine the development application for the Project on its own individual merits, having regard to all of the impacts of the Project (both positive and negative) and undertake an intuitive synthesis of the relevant factors.

The design, planning and assessment of the Project has been carried out applying the principles of ESD, through:

- incorporation of risk assessment and analysis at various stages in the Project design, environmental assessment and decision-making;
- adoption of high standards for environmental and occupational health and safety performance;
- consultation with regulatory and community stakeholders;
- assessment of potential greenhouse gas emissions associated with the Project;
- optimisation of the economic benefits to the community arising from the development of the Project; and
- taking into account biophysical considerations in the Project design.

Consideration of each of the components of ESD is provided in Section 6.1.4 of the EIS. In response to the request from the IPC, further discussion on the principle of inter-generational equity and the precautionary principle is provided below.

a. Inter-generational equity

Inter-generational equity is the concept that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The Project would benefit current and future generations through employment. It would also provide significant stimulus to local and regional economies and provide NSW export earnings and royalties, thus contributing to future generations through social welfare, amenity and infrastructure.

The Project incorporates a range of operational and physical controls and environmental management and mitigation measures to minimise potential impacts on the environment. The cost of these measures would be met by Whitehaven and, where relevant, these costs have been included in the Economic Assessment. The potential benefits to current and future generations have, therefore, been calculated in the context of the mitigated Project.

The IPC and submissions from members of the public raised the following issues in the context of inter-generational equity:

- cumulative impacts of final voids;
- impacts on critically endangered habitat;
- damage to water resources; and
- contribution to climate change through greenhouse gas emissions.

A number of options were considered by Whitehaven with respect to the number and location of the final voids in the Project final landform. Whitehaven considers that the proposed final landform and the final void are the preferred option in consideration of all relevant short, medium and long-term environmental and economic considerations. Further justification of the final void is provided in Section 6.2.

In relation to potential impacts on critically endangered habitat, the Project incorporates a number of avoidance and mitigation measures in the Project design that minimise potential impacts on biodiversity. With the incorporation of these measures, the Project is not likely to have a significant impact on any threatened species and communities listed under the BC Act, such that a local population would be lost. In addition, the Project's biodiversity offset strategy would address the potential residual impacts on biodiversity values associated with the Project, such that biodiversity values of the region are maintained or improved in the medium to long-term (i.e. for future generations).

The Groundwater Assessment and Surface Water Assessment include long-term modelling of post-mining conditions (100+ years) to inform assessment of potential long-term impacts on water resources that may affect future generations. The Project is not expected to result in a significant impact on water resources. In addition, sufficient water licence allocations could be retired at the completion of the Project to account for (i.e. offset) groundwater inflows to the final void post-mining.

The potential contribution of the Project to global climate change effects was described and assessed in the EIS, and is considered further in the sub-section below. It is noted that the judgement in the case of *Australian Coal Alliance Inc v Wyong Coal Pty Ltd* [2019] NSW Land and Environment Court (NSWLEC) 31 held that the fact that a Project generates greenhouse emissions does not mean that the starting position for consideration of a development application is that the Project should be refused. Consistent with the ESD principle of valuation, the Economic Assessment for the Project incorporates direct valuation for the social cost of carbon emissions as a component of the cost benefit analysis.

b. Precautionary principle

Narrabri Shire Council, in its submission on the Project, requested: "*That DPIE apply the precautionary principle in the assessment for the economic, environmental and social impact of the Project*."

It is noted that the application of the precautionary principle is triggered by two conditions precedent:

- the threat of serious or irreversible environmental damage; and
- scientific uncertainty as to the environmental damage.

It is noted that Narrabri Shire Council has not identified any particular environmental aspect that it considers requires the application of the precautionary principle.

Minimal uncertainty regarding the information used in the specialist assessments in the EIS is expected given:

- Whitehaven's operational experience in NSW and specifically the Gunnedah Basin;
- the number of site-based surveys and assessments conducted at the Approved Mine and for the Project;
- the comprehensive nature of the assessments; and
- the consultation process conducted with key stakeholders.

An Environmental Risk Assessment (Appendix O of the EIS) and a Preliminary Hazard Analysis (Appendix P of the EIS) were conducted to identify Project-related risks and develop appropriate mitigation measures and strategies. In addition, long-term risks were considered by the specialist studies conducted in support of the EIS.

Risk and uncertainty were taken into account through sensitivity analysis as part of the groundwater, surface water and economic assessments. Other specialist studies have accounted for uncertainty by adopting conservative Project assumptions and/or prediction methodologies, such as the Noise and Blasting Assessment and the Air Quality and Greenhouse Gas Assessment (Appendices D and E of the EIS, respectively).

In addition, for key Project environmental assessment studies, peer reviews by recognised experts have been undertaken by Whitehaven and/or DPIE.

A range of measures have been adopted as components of the Project design to minimise the potential for serious and/or irreversible damage to the environment. These include operational controls (e.g. modification of mining operations during adverse weather conditions) and physical controls (e.g. the use of water trucks for dust suppression along haul roads), the development of environmental management and monitoring programmes and biodiversity offsets. Where residual risks are identified, contingency controls have also been considered.

The Project would achieve the relevant noise and air quality criteria in the Development Consent through an adaptive management approach using real-time monitoring and management. The implementation of an adaptive management approach is consistent with the precautionary principle as described by Justice Preston, Chief Judge of the NSWLEC in *Newcastle & Hunter Valley Speleological Society Inc v Upper Hunter Shire Council and Stoneco Pty Limited* [2010] NSWLEC 48 at [184]:

> *In adaptive management the goal to be achieved is set, so there is no uncertainty as to the outcome and conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.*

2. Greenhouse gas emissions

a. Forecast direct and indirect greenhouse gas emissions

Consistent with the approach adopted for the *Greenhouse Gas Protocol* (World Business Council for Sustainable Development and World Resources Institute, 2004), the Project's Scope 1 emissions would be attributed to Whitehaven, whereas the Project's Scope 2 emissions and Scope 3 emissions are the Scope 1 emissions of another party (e.g. the Project's Scope 2 emissions associated with purchased electricity would be the Scope 1 emissions of the power generator).

Greenhouse gas emissions associated with the Project were estimated by Ramboll Australia Pty Ltd (Ramboll) (2018) based on the *National Greenhouse Accounts Factors August 2015* (Department of the Environment, 2015) and are presented in detail in Appendix E of the EIS.

Table 20 outlines the sources of greenhouse gas emissions included in the emissions forecast for the Project. Other minor sources of greenhouse gas emissions, such as those generated by employee travel and waste disposal, are anticipated to be negligible in comparison and were not considered in Ramboll's (2018) assessment.

Table 20
Summary of Key Potential Project Greenhouse Gas Emissions

Component	Direct Emissions	Indirect Emissions	
	Scope 1	Scope 2	Scope 3
Electricity Consumption for the Processing of ROM Coal	N/A	Emissions from the consumption of purchased electricity used at the Project.	Emissions from the extraction, production and transport of fuel burned for the generation of electricity consumed, and the electricity lost in delivery in the transmission and distribution network.
Diesel Consumption	Emissions from the combustion of diesel at the Project.	N/A	Emissions attributable to the extraction, production and transport of diesel consumed at the Project.
Explosives	Emissions from the use of explosives.	N/A	N/A[1]
Fugitive	Fugitive emissions that result from the extraction of coal.	N/A	N/A
Product Coal Transport	N/A	N/A	Emissions from the combustion of diesel used during road and rail haulage.
Combustion of Coal	N/A	N/A	Third party emissions from the combustion of product coal from the Project.

Source: Ramboll (2018).

[1] The contribution of Scope 3 emissions from explosive use is not material in the context of overall emissions.

The total direct (i.e. Scope 1) emissions over the life of the Project are estimated to be approximately 3.2 Mt $CO_{2\text{-}e}$, which is an average of approximately 0.13 Mt CO_2-e per annum over the life of the Project (Ramboll, 2018).

The total indirect emissions (i.e. Scopes 2 and 3) over the life of the Project are estimated to be approximately 390 Mt CO_2-e, which is an average of approximately 15.6 Mt CO_2-e per annum. Approximately 99% (388 Mt CO_2-e) of these emissions would be associated with the Scope 3 combustion of product coal by third parties (Ramboll, 2018).

The estimated greenhouse gas emissions intensity of the Project is approximately 0.02 tonnes of carbon dioxide equivalent per tonne (t CO2-e/t) of ROM coal (this includes all Scope 1 and 2 emissions). This is comparable to the greenhouse gas emissions intensity of other existing local mines, including (Ramboll, 2018):

- Tarrawonga Coal Mine (0.07 t CO2-e/t ROM) (including ROM coal haulage to the Whitehaven CHPP);
- Boggabri Coal Mine (0.06 t CO2-e/t ROM);
- Rocglen Coal Mine (0.06 t CO_2-e/t ROM) (including ROM coal haulage to the Whitehaven CHPP); and
- Maules Creek Coal Mine (0.02 t CO_2-e/t ROM).

The Project would have the benefit of reducing the greenhouse gas emissions intensities of the Rocglen and Tarrawonga Coal Mines as a result of reduced haulage distances to the Project CHPP, as opposed to the Whitehaven CHPP. This benefit was not quantified as part of Ramboll's (2018) assessment, due to the conservative approach of that assessment.

The value of externalities from Project Scope 1 and Scope 2 greenhouse gas emissions (i.e. the adoption of a social cost of carbon) has been incorporated into the cost benefit analysis in the Economic Assessment for the Project (Appendix J of the EIS).

The value of externalities from indirect (Scope 3) greenhouse gas emissions are not considered in the cost benefit analysis. This is consistent with conventional cost benefit analysis, where the potential direct negative and positive economic impacts of an activity are considered together, in the country where the activity takes place (e.g. economic positives and externalities of Japanese steel manufacturing in a customer industrial facility, including the Scope 1 greenhouse gas emissions of that facility).

b. Relevant Climate Change Policy Frameworks

At the Conference of Parties 21 (in 2015), parties to the United Nations Framework Convention on Climate Change (UNFCCC) reached an agreement to combat climate change at a global level (the *Paris Agreement*). The goal of the *Paris Agreement* is to limit global temperature increases to well below 2°C (UNFCCC, 2019a).

Under the *Paris Agreement*, the Australian Government made a commitment to reduce national greenhouse gas emissions by between 26% and 28% from 2005 levels by 2030 (Commonwealth of Australia, 2015). Australia has committed to meeting this target through initiatives that focus on expanding renewable energy sources, supporting low emissions technologies, improving energy efficiencies and incentivising companies to reduce their emissions without compromising economic growth and driving up energy prices.

The Project's annual average Scope 1 emissions equate to less than 0.03% of Australia's 2030 commitment under the *Paris Agreement*[4].

The main climate change policy implemented by the NSW Government is the *NSW Climate Change Policy Framework* (OEH, 2016).

The *NSW Climate Change Policy Framework* seeks to provide aspirational goals and broad policy directions to achieve NSW's objective of achieving net-zero emissions by 2050, and to allow NSW to be more resilient and responsive to climate change (OEH, 2016). Its other aspirational objectives include the implementation of policies consistent with the Commonwealth's plan for long-term emissions savings, to reduce emissions in government operations, and to advocate for action by the Commonwealth, Council of Australian Governments (COAG) and internationally consistent with the *Paris Agreement* (OEH, 2016).

[4] Based on the Commonwealth Department of the Environment and Energy's (2019) *Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2018*, a 28% reduction on 2005 levels would equate to approximately 439.6 Mt CO_2-e.

Under the *NSW Climate Change Policy Framework*, NSW has committed to work to complement national action taken in respect to Australia's commitments under the *Paris Agreement*. The policy framework is being delivered through (OEH, 2016):

- the Climate Change Fund;
- the development of a value for emissions savings that will be applied consistently in government economic appraisals;
- embedding climate change mitigation and adaptation across government operations including service delivery, infrastructure, purchasing decisions and regulatory frameworks;
- building on NSW's expansion of renewable energy; and
- developing action plans and strategies, including for advanced energy, energy efficiency, climate change adaptation, energy productivity, fugitive emissions, primary industry emissions and adaptation and health and wellbeing.

The Project is not inconsistent with either the policy directions or the proposed delivery mechanisms outlined in the *NSW Climate Change Policy Framework* (OEH, 2016).

Ongoing monitoring and management of greenhouse gas emissions and energy consumption at the Project would occur through Whitehaven's participation in the Commonwealth Government's *National Greenhouse and Energy Report Scheme* (NGERS).

Under NGERS requirements, relevant sources of greenhouse gas emissions and energy consumption must be measured and reported on an annual basis, allowing major sources and trends in emissions/energy consumption to be identified.

c. Demand for Project product coal and expected customer countries

The *Paris Agreement* does not specify how global emission reductions are to be achieved. It requires countries that are parties to the *Paris Agreement* to prepare, communicate and maintain nationally determined contributions (NDCs) and to pursue domestic measures to achieve them (UNFCCC, 2019a). The NDCs are to be communicated every five years, with each successive NDC to represent a progression beyond the previous NDC.

As coal from the Project is expected to be used overseas, emissions associated with the end use of Project coal would be managed under the NDCs of these countries.

The Project would produce the following product streams for export markets:

- semi-soft coking coal;
- pulverised coal injection (PCI) coal (which is used in blast furnace steel production as a supplemental carbon source); and
- thermal coal.

It is anticipated that the Project's main coal markets are likely to be Japan, South Korea and Taiwan, although Whitehaven observes that there are other countries to which the Project's coal will be transported from time-to-time, having regard to prevailing global coal markets at any given point in time during the life of the Project.

It is recognised that international measures to 'decarbonise' global economies may alter the future demand for and/or supply of coal. Expected global trends are factored into coal price forecasts considered in the Economic Assessment (Appendix J of the EIS). The Economic Assessment also includes sensitivity analysis for variations in export coal prices and consideration of three different valuation methods for the social cost per tonne of carbon emissions. These analyses show that the Project would still generate a substantial net benefit to NSW under the scenarios considered.

Table 21 provides a summary of the current NDCs under the *Paris Agreement* (i.e. first NDCs) of the expected customer countries for Project product coal. It should be noted that, under the *Paris Agreement*, these NDCs are interim steps that are updated every 5 years, with the next round of NDCs due by 2020 (UNFCCC, 2019b). The review mechanisms under the *Paris Agreement*, therefore, provide for the ratcheting up of emission control measures as required over time to achieve the goals of the *Paris Agreement*.

Table 21
Current Nationally Determined Contributions of Expected Customer Countries

Destination Country/State	Summary of First NDC
Japan	26% reduction in greenhouse gas emissions compared to 2013 emissions by 2030, or a total of approximately 1,042 Mt CO_2-e in 2030.
South Korea	37% reduction in greenhouse gas emissions compared to the business-as-usual projection for 2030 by 2030, or a total of approximately 536 Mt CO_2-e in 2030.
Taiwan (Republic of China)	While not a party to the UNFCCC or the *Paris Agreement*, Taiwan has put forward an Intended NDC and committed to a 50% reduction in greenhouse gas emissions compared to the business-as-usual projection for 2030 by 2030, or a total of approximately 214 Mt CO_2-e in 2030.

After: Government of Japan (2015), Government of South Korea (2015), Government of Taiwan (2015).

7 PROJECT EVALUATION

Submissions on the Project were received from government agencies, SIGs and members of the public (including businesses) during the EIS public exhibition period. The majority of the submissions were made in support of the Project. DPIE (in its Preliminary Issues Report) and the IPC (in their Issues Report) have analysed the submissions and characterised issues requiring further consideration.

This RTS provides responses to issues raised by submissions from government agencies, SIGs and members of the public from the EIS exhibition period, as well as issues identified by the DPIE and IPC. The responses have been structured according to the characterisation of issues in the IPC's Issues Report.

Since lodgement of the Project EIS, Whitehaven has continued to consult with community members, Councils, NSW and Commonwealth government agencies, DPIE and its independent experts regarding the Project.

Further modelling and analysis has also been undertaken to provide clarification of key aspects of the Project in response to submissions received.

This further modelling and analysis supports the predictions in the Project EIS, and accordingly also supports the conclusion in the EIS that, on balance, the Project has merit on the basis of the positive social and economic outcomes to the local region and NSW.

In summary, for key issues identified in the submissions, the Project is predicted to have the same or less environmental impacts than those approved for the Approved Mine, or can be designed and managed in accordance with standard guidelines and principles for mining projects. This includes the following:

- The Project rail spur has been designed to comply with the objectives of the FMP.
- Predicted groundwater impacts comply with the 'minimal impact' considerations of the AIP.
- Sediment dams would be designed and operated in accordance with Landcom (2004).
- Predicted water requirements are within Whitehaven's existing licenses for the Project.
- Air quality emissions are predicted to comply with the criteria in the EPA's Approved Methods at relevant receivers.
- Operational noise emissions are predicted to comply with the criteria in the NPfI, or can be managed in accordance with procedures outlined in the Voluntary Land Acquisition and Mitigation Policy at relevant receivers.
- Rail noise emissions are predicted to comply with the non-network criteria in the RING at relevant existing receivers.
- Construction noise levels outside of standard hours would be maintained to comply with the 'Noise Affected' noise management level in accordance with the ICNG at relevant receivers.
- Biodiversity offset requirements can be satisfied in accordance with the FBA and the *NSW Offset Policy*.
- The Project final landform would reduce the number of voids in the landscape when compared to Approved Mine and the current landform.

In consideration of the information provided in the EIS and RTS, Whitehaven considers the consent authority can reach a conclusion that the benefits of the Project outweigh its impacts.

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ATTACHMENT 1

SUBMISSIONS SUMMARY

Table A1-1
Summary of Submissions Received during the Public Exhibition Period

Submitter	Reference Number	Suburb	Postcode	State	Group	View	Form Letter / petition	Project Justification	Groundwater	Surface Water	Flooding	Water Balance	Noise and Blasting	Air Quality	Project Infrastructure	Biodiversity	Rehabilitation, Final Void and	Heritage	Social and Economic	Visual Amenity	Traffic and Transport	Public Interest
Australian National University (Siding Springs Observatory)	286507	Coonabarabran	2357	NSW	Public Authorities	Comments	-													1		
Australian Rail Track Corporation	286351	Broadmeadow	2292	NSW	Public Authorities	Comments	-														1	
NSW Department of Industry - Lands and Water	289814	Sydney	2000	NSW	Public Authorities	Comments	-		1	1	1	1					1		1			
NSW Department of Planning - Resources Regulator	290774	Maitland	2320	NSW	Public Authorities	Comments	-										1					
NSW Division of Resources and Geoscience	288799	Maitland	2320	NSW	Public Authorities	Comments	-		1							1			1			
NSW Environment Protection Agency	291384	Armidale	2350	NSW	Public Authorities	Comments	-		1	1		1	1	1								
NSW Health - Hunter New England Local Health District	289564	Wallsend	2287	NSW	Public Authorities	Comments	-			1			1	1					1			
NSW Heritage Council	286884	Parramatta	2150	NSW	Public Authorities	Comments	-											1				
NSW Office of Environment and Heritage	289812	Dubbo	2830	NSW	Public Authorities	Comments	-				1					1		1				
NSW Roads and Maritime Services	290819	Grafton	2460	NSW	Public Authorities	Comments	-														1	
NSW Rural Fire Service	289894	Granville	2142	NSW	Public Authorities	Comments	-									1						
Gunnedah Shire Council	287231	Gunnedah	2380	NSW	Councils	Comments	-	1	1		1	1	1	1	1	1	1	1	1	1	1	1
Liverpool Plains Shire Council	289568	Quirindi	2343	NSW	Councils	Comments	-												1			
Narrabri Shire Council	291388	Narrabri	2390	NSW	Councils	Comments	-		1	1	1	1	1	1		1	1	1	1	1	1	1
Gunnedah & District Chamber of Commerce	282396	Gunnedah	2380	NSW	Stakeholder Groups	Support	-												1			
Boggabri Business & Community Association	289779	Boggabri	2382	NSW	Stakeholder Groups	Object	-		1	1	1		1									
Boggabri Farming and Community Group	289704	Boggabri	2382	NSW	Stakeholder Groups	Object	-		1	1	1		1	1		1	1	1	1		1	1
Cotton Australia	289179	Mascot	2020	NSW	Stakeholder Groups	Object	-			1	1		1	1			1		1			
CountryMinded	289310	Boggabillla	2409	NSW	Stakeholder Groups	Object	-		1					1					1			
Dorothea Mackellar Memorial Society	289199	Gunnedah	2380	NSW	Stakeholder Groups	Comments	-											1		1		
Emerald Hill Progress Association	283673	Emerald Hill	2380	NSW	Stakeholder Groups	Object	-		1		1		1						1			1
Leard Forest Research Node	289670	Maules Creek	2382	NSW	Stakeholder Groups	Object	-						1									
Lock the Gate Alliance	289496	Newcastle	2300	NSW	Stakeholder Groups	Object	-					1					1	1	1			1
Maules Creek Branch of the Country Womens Association of NSW	289584	Maules Creek	2382	NSW	Stakeholder Groups	Object	-			1			1			1			1		1	1
Maules Creek Community Council Inc	289492	Maules Creek	2382	NSW	Stakeholder Groups	Object	-			1				1					1			1
Namoi Water	289517	Narrabri	2390	NSW	Stakeholder Groups	Object	-					1										
National Park Association Armidale Branch	289582 / 289612	Armidale	2350	NSW	Stakeholder Groups	Object	-			1			1	1		1			1		1	
New England Greens Armidale Tamworth	289265	Breeza	2381	NSW	Stakeholder Groups	Object	-		1	1			1	1		1		1	1		1	1
NSW Farmers' Association	289510	St Leonards	2065	NSW	Stakeholder Groups	Comments	-		1	1	1		1	1								
people for the Plains	289527	Boggabri	2382	NSW	Stakeholder Groups	Object	-		1	1	1	1	1	1			1	1	1	1	1	1

Submitter	Reference Number	Suburb	Postcode	State	Group	View	Form Letter / petition	Project Justification	Groundwater	Surface Water	Flooding	Water Balance	Noise and Blasting	Air Quality	Project Infrastructure	Biodiversity	Rehabilitation, Final Void and	Heritage	Social and Economic	Visual Amenity	Traffic and Transport	Public Interest
Red Chief Local Aboriginal Land Council	289251	Gunnedah	2380	NSW	Stakeholder Groups	Object	-											1				
Sustainable Living Armidale	289602	Armidale	2350	NSW	Stakeholder Groups	Object	-		1	1				1					1			1
Upper Mooki Landcare Inc	289302	Willow Tree	2339	NSW	Stakeholder Groups	Object	-									1						
Wando Conservation and Cultural Centre Inc	289692	Maules Creek	2382	NSW	Stakeholder Groups	Object	-		1		1		1			1	1	1	1	1	1	1
Absolute Services Group	289308	Mudgee	2850	NSW	Businesses	Support	-												1			
Advitech Group	286957	Mayfield	2304	NSW	Businesses	Support	-												1			
AED	282849	Pyrmont	2009	NSW	Businesses	Support	-												1			
Alert Workplace	284688	Newcastle	2300	NSW	Businesses	Support	-												1			
Ali's Northwest Sheds	282882	Inverell	2360	NSW	Businesses	Support	-												1			
AMCI Investments Pty Ltd	288550	Brisbane	4000	QLD	Businesses	Support	-												1			
APM Engineering Pty Limited	280880	Tomago	2322	NSW	Businesses	Support	-												1			
ASG Equipment Pty Ltd	289312	Mudgee	2850	NSW	Businesses	Support	-												1			
Aztech Earthmoving Repairs Pty Ltd	282276	Gunnedah	2380	NSW	Businesses	Support	-												1			
Banksia Group Pty Ltd	284516	Narrabri	2390	NSW	Businesses	Support	-												1			
Boggabri IGA Express	289614	Boggabri	2382	NSW	Businesses	Support	-												1			
Brand Energy & Infrastructure Services	288765	Muswellbrook	2333	NSW	Businesses	Support	-												1			
Briteforce Pty Ltd	288725	Rouse Hill	2155	NSW	Businesses	Support	-												1			
Cbased Environmental	280674	Gunnedah	2380	NSW	Businesses	Support	-												1			
Complete Hydraulic Services Pty Ltd	280694	Port Kembla	2505	NSW	Businesses	Support	-												1			
D & T Burns Pty Ltd	280408	Singleton	2330	NSW	Businesses	Support	-												1			
Daracon Group	285581	Beresfield	2322	NSW	Businesses	Support	-												1			
Ditchfield Contracting Pty Ltd	289498	Tuncurry	2428	NSW	Businesses	Support	-												1			
Engineering Unlimited Pty Ltd	287070	Tamworth	2340	NSW	Businesses	Support	-												1			
Environstay	286511	Tamworth	2340	NSW	Businesses	Support	-												1			
GB Auto	282508	Boggabri	2382	NSW	Businesses	Support	-												1			
GBP Cranes	283271	Gunnedah	2380	NSW	Businesses	Support	-												1			
GBP Heavy Haulage	283273	Gunnedah	2380	NSW	Businesses	Support	-												1			
Gunnedah Freight Centre and Fourways Haulage	289105	Gunnedah	2380	NSW	Businesses	Support	-												1			
Gunnedah Serviced Apartments	280636	Gunnedah	2380	NSW	Businesses	Support	-												1			
Huesker Australia Pty Ltd	286938	Redhead	2290	NSW	Businesses	Support	-												1			
INtegrated Reliability Solutions	284130	Cardiff	2285	NSW	Businesses	Support	-												1			
iPUT Pty Ltd	286989	Gateshead	2290	NSW	Businesses	Support	-												1			

Submitter	Reference Number	Suburb	Postcode	State	Group	View	Form Letter / petition	Project Justification	Groundwater	Surface Water	Flooding	Water Balance	Noise and Blasting	Air Quality	Project Infrastructure	Biodiversity	Rehabilitation, Final Void and	Heritage	Social and Economic	Visual Amenity	Traffic and Transport	Public Interest
J&S Engineering	283059	Rutherford	2320	NSW	Businesses	Support	-												1			
J.A.Berry Pty Ltd	282545	Gunnedah	2380	NSW	Businesses	Support	-												1			
Liverpol Plains Non Destructive Testing	287408	Boggabri	2382	NSW	Businesses	Support	-												1			
Lovick Engineering	282543	Orange	2800	NSW	Businesses	Support	-												1			
Mannion Drilling	282496	Gunnedah	2380	NSW	Businesses	Support	-												1			
Marathon Tyres	287029	Gunnedah	2380	NSW	Businesses	Support	-												1			
Marathon Tyres	287031	Sandgate	2304	NSW	Businesses	Support	-												1			
McElroy & Peterson	287004	Gunnedah	2380	NSW	Businesses	Support	-												1			
Minera Mining Technologies	283335	Joondalup	6027	WA	Businesses	Support	-												1			
Namoi Valley Bricks	282380	Gunnedah	2380	NSW	Businesses	Support	-												1			
Namoi WasteCorp Pty Ltd	280424	Narrabri	2390	NSW	Businesses	Support	-												1			
Newcastle Coal Infrastructure Group	289646	Kooragang	2304	NSW	Businesses	Support	-												1			
PBE Rutherford	281528	Tomago	2322	NSW	Businesses	Support	-												1			
Premier Conveyors	287131	Thornton	2322	NSW	Businesses	Support	-												1			
Programmed	289442	Newcastle	2300	NSW	Businesses	Support	-												1			
RiteDrill	287089	Rutherford	2320	NSW	Businesses	Support	-												1			
Specialised Civil Services Pty Ltd	288297	Narrabri	2390	NSW	Businesses	Support	-												1			
Stewart Surveys Pty Ltd	283259	Gunnedah	2380	NSW	Businesses	Support	-												1			
Stripes Asset Services Pty Ltd	289099	Gunnedah	2380	NSW	Businesses	Support	-												1			
Stripes Electrical Services Pty Ltd	289103	Gunnedah	2380	NSW	Businesses	Support	-												1			
Stripes Engineering Services Pty Ltd	289095	Gunnedah	2380	NSW	Businesses	Support	-												1			
T M Earthmoving Pty Ltd	283094	Singleton	2330	NSW	Businesses	Support	-												1			
Tema Engineers Pty Ltd	289189	Revesby	2212	NSW	Businesses	Support	-												1			
TJ Tools	282559	Malvern	5061	SA	Businesses	Support	-												1			
Tradecore Industries Pty Ltd	284493	McDougalls Hill	2330	NSW	Businesses	Support	-												1			
Triple A Group (Australia) Pty Ltd	280672	Kawana	4701	QLD	Businesses	Support	-												1			
Bilby Blooms	280899	Binnaway	2395	NSW	Businesses	Object	-												1			
HV Line Bore and Machining	280550	Rutherford	2320	NSW	Businesses	Comments	-												1			
Mike Maher Electrical	284505	Tamworth	2340	NSW	Businesses	Comments	-												1			
Top Caps	284701	Perth	6000	WA	Businesses	Object	-												1			1
Alexandra Stuart	289588	Sydney	2000	NSW	Individuals	Object	-															1
Alicia Braithwaite	285243	Kanimbla	2790	NSW	Individuals	Object	-			1				1			1					1

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Aliison Kelly	289630	Tullera	2480	NSW	Individuals	Object	-		1		1								1			1
Amanda Heinemann	289226	Emerald Hill	2380	NSW	Individuals	Object	-		1		1		1						1			
Amanda Hook	289381	Evelyn	4888	QLD	Individuals	Object	-															1
Amy McAllister	289652	Blue Vale	2380	NSW	Individuals	Object	-		1	1	1		1	1								
Andrew Darley	289476	Boggabri	2382	NSW	Individuals	Object	-			1	1		1	1					1	1		
Anita Maunder	288906	Boggabri	2382	NSW	Individuals	Object	-		1	1		1							1			
Anna Christie	289810	Maules Creek	2382	NSW	Individuals	Object	-		1		1		1			1		1	1		1	
Anne Rich	289230	Berry	2535	NSW	Individuals	Object	-															1
Annie Marlow	285457	Berkeley	2506	NSW	Individuals	Object	-							1			1		1			1
Anonymous	280440	Gunnedah	2380	NSW	Individuals	Comments	-												1			
Anonymous	287697	Mogo	2536	NSW	Individuals	Comments	-												1			
Anonymous	288198	Gunnedah	2380	NSW	Individuals	Comments	-												1			
Anonymous	289129	Boggabri	2382	NSW	Individuals	Comments	-												1			
Anonymous	289529	Boggabri	2382	NSW	Individuals	Comments	-												1			
Anonymous	284440	Rozelle	2039	NSW	Individuals	Object	-															1
Anonymous	284794	Queanbeyan	2620	NSW	Individuals	Object	-		1	1				1				1	1			
Anonymous	284818	Loftus	2232	NSW	Individuals	Object	-	1														
Anonymous	285447	Narrabri	2390	NSW	Individuals	Object	-		1	1				1			1					
Anonymous	285451	Rozelle	2039	NSW	Individuals	Object	-												1			
Anonymous	285786	Urila	2620	NSW	Individuals	Object	-															1
Anonymous	285810	Billys Creek	2453	NSW	Individuals	Object	-		1	1			1	1					1			1
Anonymous	285841	Tottenham	2873	NSW	Individuals	Object	-		1					1								
Anonymous	285971	Tamworth	2340	NSW	Individuals	Object	-		1					1				1	1			
Anonymous	288892	Emerald Hill	2380	NSW	Individuals	Object	-						1						1			
Anonymous	289112	Killabakh	2429	NSW	Individuals	Object	-									1						
Anonymous	289228	Bangalow	2479	NSW	Individuals	Object	-							1			1		1			
Anonymous	289249	Breeza	2381	NSW	Individuals	Object	-		1					1					1			
Anonymous	289255	Boggabri	2382	NSW	Individuals	Object	-		1	1	1	1	1	1					1			1
Anonymous	289271	Corndale	2480	NSW	Individuals	Object	-									1						
Anonymous	289273	Boggabri	2382	NSW	Individuals	Object	-		1					1				1	1			
Anonymous	289291	Armidale	2350	NSW	Individuals	Object	-															1
Anonymous	289296	Dubbo	2830	NSW	Individuals	Object	-			1						1			1			1

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Anonymous	289316	Boggabri	2382	NSW	Individuals	Object	-		1	1	1			1		1		1	1			1
Anonymous	289322	North Rocks	2151	NSW	Individuals	Object	-												1			1
Anonymous	289324	Glenning Valley	2261	NSW	Individuals	Object	-															1
Anonymous	289453	Gunnedah	2380	NSW	Individuals	Object	-		1	1				1			1		1			
Anonymous	289457	Narromine	2821	NSW	Individuals	Object	-				1					1				1		
Anonymous	289461	Subiaco	6008	WA	Individuals	Object	-									1						
Anonymous	289550	Boggabri	2382	NSW	Individuals	Object	-						1	1								
Anonymous	289594	Maules Creek	2382	NSW	Individuals	Object	-									1		1			1	1
Anonymous	289598	Armidale	2350	NSW	Individuals	Object	-			1						1						
Anonymous	289604	Maules Creek	2382	NSW	Individuals	Object	-												1			1
Anonymous	289640	Gunnedah	2380	NSW	Individuals	Object	-		1		1		1			1				1		
Anonymous	289658	Marrickville	2204	NSW	Individuals	Object	-															1
Anonymous	289664	Gunnedah	2380	NSW	Individuals	Object	-		1		1		1						1	1		1
Anonymous	289680	Bilgola Plateau	2107	NSW	Individuals	Object	-		1	1	1		1			1			1		1	
Anonymous	289767	Gunnedah	2380	NSW	Individuals	Object	-		1				1					1	1	1		
Anonymous	282282	Aberdare	2325	NSW	Individuals	Object	-												1			
Anonymous	282327	Killara	2071	NSW	Individuals	Object	-															1
Anthony Pickard	288932	Narrabri	2390	NSW	Individuals	Object	-		1							1						
Anthony Poutsma	285237	Albany Creek	4035	QLD	Individuals	Object	-		1					1					1			1
Anthony Wannan	289578	Gunnedah	2380	NSW	Individuals	Object	-		1	1			1			1			1	1	1	1
Audrey McLean	289808	East Lismore	2480	NSW	Individuals	Object	-		1	1			1					1	1			
Bea Bleile	289512	Armidale	2350	NSW	Individuals	Object	-															1
Bill Newell	289232	Narrabri	2390	NSW	Individuals	Object	-		1	1												
Brendan Shoebridge	289648	Alstonville	2477	NSW	Individuals	Object	-		1					1				1	1			1
Brian Keeler	289682	Blue Vale	2380	NSW	Individuals	Object	-				1		1			1			1	1		1
Bronwyn Vost	289057	Hurlstone Park	2193	NSW	Individuals	Object	-		1	1			1			1	1		1			1
Bruce Jarvis	285455	Teralba	2284	NSW	Individuals	Object	-		1		1			1				1	1			
Bruce McQueen	286009	Mount Burrell	2484	NSW	Individuals	Object	-															1
Carolyn Nancarrow	293410	Boggabri	2382	NSW	Individuals	Object	-		1	1	1	1	1	1					1			
Catherine Blakey	284753	Wollongong	2500	NSW	Individuals	Object	-							1			1		1			1
Catherine Collyer	289110	Boggabri	2382	NSW	Individuals	Object	-		1	1			1						1		1	
Christine Rumble	289474	Empire Bay	2257	NSW	Individuals	Object	-		1	1				1			1					

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Corinne Matri	289362	Wallarah	2259	NSW	Individuals	Object	-												1			
Craig Shaw	289432	Green Point	2251	NSW	Individuals	Object	-				1								1			
Daniel Endicott	289298	Islington	2296	NSW	Individuals	Object	-															
David Paull	288088	Coonabarabran	2357	NSW	Individuals	Object	-			1	1					1						
David Riley	288862	Boggabri	2382	NSW	Individuals	Object	-		1		1	1	1	1					1		1	
David Wellwood	289127	Emerald Hill	2380	NSW	Individuals	Comments	-												1			
Debbie MacDonald	289570	Rosanna	3084	VIC	Individuals	Object	-							1			1					
Denise Murray	286067	Narrabri	2390	NSW	Individuals	Object	-		1	1												
Dereka Ogden	285279	Tugun	4224	QLD	Individuals	Object	-		1		1			1				1	1			
Donna Beekwilder	284719	Croydon	2132	NSW	Individuals	Object	-		1		1			1				1	1			
Dorothee Babeck	289586	Randwick	2031	NSW	Individuals	Object	-				1			1			1		1			1
Dorte Planert	285579	Tathra	2550	NSW	Individuals	Object	-		1	1				1				1	1			
Elizabeth O'Hara	289644	Armidale	2350	NSW	Individuals	Object	-						1	1		1		1	1		1	1
Eric Hannan	289286	Blue Vale	2380	NSW	Individuals	Object	-												1			
Errol and Jennifer Darley	289620	Boggabri	2382	NSW	Individuals	Object	-			1	1		1				1	1	1			1
Felicity Cahill	285313	Drake	2469	NSW	Individuals	Object	-		1	1				1		1		1	1			
Francesca Smith	284983	Narrabri	2390	NSW	Individuals	Object	-							1			1					1
Gary Rennick	283400	Gunnedah	2380	NSW	Individuals	Object	-						1									
Gary Russell	285241	Sugarloaf	2420	NSW	Individuals	Object	-		1					1			1		1			
Geoff Hood	289494	Gunnedah	2380	NSW	Individuals	Comments	-												1			
Geoff Hood	289608	Gunnedah	2380	NSW	Individuals	Comments	-												1			
Geoff Hunter	289590	Boggabri	2382	NSW	Individuals	Object	-				1	1	1				1		1			
Georgia Harrington	289289	Killarney Vale	2261	NSW	Individuals	Object	-		1	1	1		1			1			1			
Grant Mcilveen	289684	Gunnedah	2380	NSW	Individuals	Object	-			1	1		1			1	1		1	1		1
Gus Sharpe	289346	Lyneham	2602	ACT	Individuals	Object	-															1
Harriet McCalman	289267	Emerald Hill	2380	NSW	Individuals	Object	-						1	1					1			1
Heather Ranclaud	288955	Willow Tree	2339	NSW	Individuals	Object	-		1				1					1	1			1
Heike Watson	289540	Boggabri	2382	NSW	Individuals	Object	-		1	1	1	1	1	1					1		1	1
Helen Quade	289281	Trundle	2875	NSW	Individuals	Object	-												1	1		1
Hugh Barrett	288910	Sanctuary Point	2540	NSW	Individuals	Object	-	1														
Hugh Price	289356	Quirindi	2343	NSW	Individuals	Object	-		1	1	1		1	1						1		
Ifeanna Tooth	287898	Woollahra	2025	NSW	Individuals	Object	-		1					1				1	1			1

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Jaben Golledge	289487	Helensburgh	2508	NSW	Individuals	Object	-															1
Jack Claff	285880	Clunes	2480	NSW	Individuals	Object	-		1	1	1	1							1			1
James and Nicole Barlow	289696	Boggabri	2382	NSW	Individuals	Object	-		1	1	1		1	1			1	1	1	1		1
Jamie Wheatland	281548	NSW	2380	NSW	Individuals	Comments	-												1			
Jane Judd	284655	Coonabarabran	2357	NSW	Individuals	Object	-		1	1	1					1			1			1
Janet Watt	289702	Boggabri	2382	NSW	Individuals	Object	-		1				1	1					1			
Jermy White	285746	North Casino	2470	NSW	Individuals	Object	-		1	1				1			1		1			1
Jim Morris	289592	Hurlstone Park	2193	NSW	Individuals	Object	-		1	1			1			1			1	1		1
Jocelyn Guy	285449	Manilla	2346	NSW	Individuals	Object	-		1	1				1						1		
Johanna Evans	289446	Kyogle	2474	NSW	Individuals	Object	-		1	1	1		1			1			1			1
Johannes Brits	289294	Glen Waverley	3150	VIC	Individuals	Object	-				1					1						
John L and Rosie Hayes	285275	Mayfield	2304	NSW	Individuals	Object	-		1	1				1	1			1	1			
Judith Leslie	289572	Bulga	2330	NSW	Individuals	Object	-															1
Julie Heiler	289234	Boggabri	2382	NSW	Individuals	Object	-		1	1				1					1			
Karen Barlow	284727	Cooks Hill	2300	NSW	Individuals	Object	-				1		1						1			1
Karen Pike	289306	Yessabah	2440	NSW	Individuals	Object	-									1						
Kate Mitchell	288417	Uralla	2358	NSW	Individuals	Object	-				1		1						1			
Kathy McKenzie	288970	Wilberforce	2756	NSW	Individuals	Object	-			1	1		1	1		1		1	1		1	
Keira Dott	289375	Tighes Hill	2297	NSW	Individuals	Object	-									1						1
Ken Crawford	284611	Boggabri	2382	NSW	Individuals	Object	-				1											
Lara Leonard	289610	Roseville	2069	NSW	Individuals	Object	-						1						1			
Liam Donaldson	289459	Boggabri	2382	NSW	Individuals	Object	-		1	1				1			1		1			1
Libby Laird	289253	Maules Creek	2382	NSW	Individuals	Object	-		1	1	1		1			1		1	1		1	1
Linda Connor	289336	Redhead	2290	NSW	Individuals	Object	-		1		1		1						1	1		
Lochie Leitch	294064	Boggabri	2382	NSW	Individuals	Object	-		1	1	1		1						1			
Louise Kirumba	289470	Wolli Creek	2205	NSW	Individuals	Object	-		1	1				1			1		1			1
Louise Somerville	289318	East Lismore	2480	NSW	Individuals	Object	-		1	1	1		1			1			1			
Lyle Sims	287087	Emerald Hill	2380	NSW	Individuals	Object	-		1		1								1			
Lyndell Crowley	289277	Boggabri	2382	NSW	Individuals	Object	-		1	1			1			1		1	1			1
Malcolm Donaldson	287423	Boggabri	2382	NSW	Individuals	Object	-		1	1	1			1		1		1	1			1
Marg McLean	289350	Singleton	2330	NSW	Individuals	Object	-															1
Margaret Wallace	285574	Balmain	2041	NSW	Individuals	Object	-		1					1			1					1

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Marie Flood	289275	Alexandria	2015	NSW	Individuals	Object	-			1	1		1			1		1	1		1	
Marie Rolfr	289300	Toronto	2283	NSW	Individuals	Object	-															1
Matthew Ciesiolka	288951	Wee Waa	2388	NSW	Individuals	Object	-			1	1		1	1		1			1		1	
Maureen Kingshott	289580	Surry Hills	2010	NSW	Individuals	Object	-		1	1	1		1			1		1	1		1	
Maurice Devine	289626	Boggabri	2382	NSW	Individuals	Object	-			1	1	1	1						1			
Michael Barakin	284741	Palmwoods	4555	QLD	Individuals	Object	-															1
Michaela Vaughan	289283	Stuart Park	0820	NT	Individuals	Object	-															1
Nanette Nicholson	286039	The Channon	2480	NSW	Individuals	Object	-		1	1									1			1
Naomi Hodgson	289224	HamiltonEast	2303	NSW	Individuals	Object	-		1	1								1	1			1
Naomi Hogan	289304	Petersham	2049	NSW	Individuals	Object	-		1	1				1				1	1			1
Neil Moore	286436	Candelo	2550	NSW	Individuals	Object	-															1
Nicola Chirlian	285544	Willow Tree	2339	NSW	Individuals	Object	-									1						
Oshadika Gunawardhana	289616	Boggabri	2382	NSW	Individuals	Object	-												1	1		1
Pamela Barrett	288908	Sanctuary Point	2540	NSW	Individuals	Object	-															1
Pat Murphy	289556	Baan Baa	2390	NSW	Individuals	Object	-				1		1			1			1			
Pat Schultz	289622	Armidale	2350	NSW	Individuals	Object	-		1	1			1	1		1			1			
Patst Asch	289093	Armidale	2350	NSW	Individuals	Object	-		1					1		1						
Paul McCabe	285239	Armidale	2350	NSW	Individuals	Object	-		1								1					1
Peta Craig	286638	Breeza	2381	NSW	Individuals	Object	-		1	1			1	1		1	1	1	1			
Peter Frere	289206	Toukley	2263	NSW	Individuals	Object	-			1	1					1						
Peter Small	285777	Coonabarabran	2357	NSW	Individuals	Object	-		1					1				1	1			
Peter Watson	289365	Boggabri	2382	NSW	Individuals	Object	-		1							1			1			
Peter Youll	289505	North Epping	2121	NSW	Individuals	Object	-		1	1			1	1								1
Phil Glover	289596	Gunnedah	2380	NSW	Individuals	Object	-				1											
Phil Laird	289202	Maules Creek	2382	NSW	Individuals	Object	-		1	1									1		1	1
Philip Spark	289688	Tamworth	2340	NSW	Individuals	Object	-		1	1	1		1			1			1			1
Philippa Murray	289125	Gunnedah	2380	NSW	Individuals	Object	-		1	1	1							1	1	1		1
Rachel Ryan	289479	New Lambton	2305	NSW	Individuals	Object	-															1
Renee Murphy	289552	Baan Baa	2390	NSW	Individuals	Object	-												1			
Richard Clarke	289236	Elanora Heights	2101	NSW	Individuals	Object	-				1					1						1
Richard Grant	287990	Paterson	2421	NSW	Individuals	Object	-		1	1												1
Robert and Rosemary Cock	289634	Boggabri	2382	NSW	Individuals	Object	-			1	1			1					1			

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Robert Doyle	285283	North Avoca	2260	NSW	Individuals	Object	-		1				1	1					1			
Robert Mansfield	288930	Emerald Hill	2380	NSW	Individuals	Object	-		1	1	1		1						1			
Robin Murray	289243	Springwood	2777	NSW	Individuals	Object	-		1	1	1		1			1			1			
Rod Jones	281454	Katoomba	2780	NSW	Individuals	Object	-															1
Rodney Yeo	289107	Kambah	2902	ACT	Individuals	Object	-		1	1												
Rolf Wood	285303	Galston	2159	NSW	Individuals	Object	-		1	1				1				1	1			1
Roselyn Druce	289690	Maules Creek	2382	NSW	Individuals	Object	-		1	1	1		1	1		1		1	1			1
Rosemary Vass	288811	Coonabarabran	2357	NSW	Individuals	Object	-		1	1	1					1		1	1			1
Ross Knowles	289334	St Ives	2075	NSW	Individuals	Object	-															1
Ross Urquhart	288269	Emerald Hill	2380	NSW	Individuals	Object	-				1		1						1	1		1
Rowena Macrae	289314	Coonamble	2829	NSW	Individuals	Object	-				1		1			1			1			
Sally Hunter	289535	Boggabri	2382	NSW	Individuals	Object	-		1	1			1			1		1	1			1
Sam Bragg	289101	Coonabarabran	2357	NSW	Individuals	Object	-		1	1				1		1						
Sarah Ciesiolka	288949	Wee Waa	2388	NSW	Individuals	Object	-			1	1		1	1		1			1		1	
Scott McCalman	288491	Ghoolendaadi	2380	NSW	Individuals	Object	-		1	1	1			1				1	1			1
Sharyn Munro	285285	Wingham	2429	NSW	Individuals	Object	-		1	1	1								1			
Simon Clough	289279	Lismore	2480	NSW	Individuals	Object	-			1						1	1	1	1			1
Stephanie Darley	289437	Boggabri	2382	NSW	Individuals	Object	-		1		1	1	1						1			
Stewart Ewen	289326	Fordwich	2330	NSW	Individuals	Object	-															1
Stuart Murray	285822	Narrabri	2390	NSW	Individuals	Object	-		1	1									1			
Suanne Riley	288289	Boggabri	2382	NSW	Individuals	Object	-			1	1		1	1			1		1			
Susan Jameson	284737	Bonnells Bay	2264	NSW	Individuals	Object	-												1			
Tania Marshall	289600	Tamworth	2340	NSW	Individuals	Object	-		1	1			1	1		1	1	1	1	1		1
Toby Croker	289245	Emerald Hill	2380	NSW	Individuals	Object	-		1	1	1		1	1					1			1
Tom Mullaney	289636	Kensington	2033	NSW	Individuals	Object	-		1				1	1					1			
Tracey Clancy	289638	Randwick	2031	NSW	Individuals	Object	-									1						
Wendy Bellamy	289238	Chester Hill	2162	NSW	Individuals	Object	-			1	1					1						1
Whitehaven	282510	Narrabri	2390	NSW	Individuals	Comments	-												1			
William Burgher	289088	Redbank Plains	4301	QLD	Individuals	Object	-															1
William Lord	287932	Quirindi	2343	NSW	Individuals	Object	-		1	1								1				
Adam Burley	282329	Gunnedah	2380	NSW	Individuals	Support	-												1			
Alan Robertson	280580	Sunnybank Hills	4109	QLD	Individuals	Support	-												1			

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Alistair Christie	289642	Gunnedah	2380	NSW	Individuals	Support	-												1			
Amanda Cooper	284499	Gunnedah	2380	NSW	Individuals	Support	-												1			
Andrew Cygan	286908	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anne Hicks	282257	Tamworth	2340	NSW	Individuals	Support	-												1			
Anonymous	280367	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280398	Melbourne	3000	VIC	Individuals	Support	-												1			
Anonymous	280436	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280455	Quirindi	2343	NSW	Individuals	Support	-												1			
Anonymous	280505	Westleigh	2120	NSW	Individuals	Support	-												1			
Anonymous	280558	Sydney	2000	NSW	Individuals	Support	-												1			
Anonymous	280578	Sydney	2000	NSW	Individuals	Support	-												1			
Anonymous	280698	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280706	Sydney	2000	NSW	Individuals	Support	-												1			
Anonymous	280710	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280730	Port Macquarie	2444	NSW	Individuals	Support	-												1			
Anonymous	280741	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280943	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280945	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280947	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	280982	Cobaki Lakes	2486	NSW	Individuals	Support	-												1			
Anonymous	281281	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	281778	Wamberal	2260	NSW	Individuals	Support	-												1			
Anonymous	282189	Sydney	2000	NSW	Individuals	Support	-												1			
Anonymous	282241	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	282245	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	282270	Moore Creek	2340	NSW	Individuals	Support	-												1			
Anonymous	282338	Narrabri	2390	NSW	Individuals	Support	-												1			
Anonymous	282360	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	282378	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	282490	Narrabri	2390	NSW	Individuals	Support	-												1			
Anonymous	282492	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	282498	Narrabri	2390	NSW	Individuals	Support	-												1			

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Anonymous	282502	Adamstown	2289	NSW	Individuals	Support	-												1			
Anonymous	282512	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	282526	Newcastle	2300	NSW	Individuals	Support	-												1			
Anonymous	282528	Muswellbrook	2333	NSW	Individuals	Support	-												1			
Anonymous	282535	Allambie Heights	2100	NSW	Individuals	Support	-												1			
Anonymous	282547	Lithgow	2790	NSW	Individuals	Support	-												1			
Anonymous	282618	Lindfield	2070	NSW	Individuals	Support	-												1			
Anonymous	282780	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	282864	Borenore	2800	NSW	Individuals	Support	-												1			
Anonymous	283003	Tamworth	2340	NSW	Individuals	Support	-												1			
Anonymous	283027	The Gap	4061	QLD	Individuals	Support	-												1			
Anonymous	283041	Baradine	2396	NSW	Individuals	Support	-												1			
Anonymous	283074	Newcastle	2300	NSW	Individuals	Support	-												1			
Anonymous	283142	Moore Creek	2340	NSW	Individuals	Support	-												1			
Anonymous	283175	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	283358	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	283418	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	283450	Newcastle	2300	NSW	Individuals	Support	-												1			
Anonymous	283632	Kingsford	2031	NSW	Individuals	Support	-												1			
Anonymous	283822	Coonabarabran	2357	NSW	Individuals	Support	-												1			
Anonymous	284046	The Gap	4061	QLD	Individuals	Support	-												1			
Anonymous	284244	Elermore Vale	2287	NSW	Individuals	Support	-												1			
Anonymous	284250	Moonbi	2353	NSW	Individuals	Support	-												1			
Anonymous	284258	Tamworth	2340	NSW	Individuals	Support	-												1			
Anonymous	284295	Narrabri	2390	NSW	Individuals	Support	-												1			
Anonymous	284491	Boggabri	2382	NSW	Individuals	Support	-												1			
Anonymous	284495	Hallsville	2340	NSW	Individuals	Support	-												1			
Anonymous	284667	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	284828	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	284830	West Tamworth	2340	NSW	Individuals	Support	-												1			
Anonymous	284938	Beresfield	2322	NSW	Individuals	Support	-												1			
Anonymous	285649	Quirindi	2343	NSW	Individuals	Support	-												1			

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Anonymous	285775	Cardiff	2285	NSW	Individuals	Support	-												1			
Anonymous	285993	NSW	2380	NSW	Individuals	Support	-												1			
Anonymous	286023	NSW		NSW	Individuals	Support	-												1			
Anonymous	286178	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286180	Waratah	2298	NSW	Individuals	Support	-												1			
Anonymous	286220	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286256	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286274	Tamworth	2340	NSW	Individuals	Support	-												1			
Anonymous	286406	Moonbi	2353	NSW	Individuals	Support	-												1			
Anonymous	286476	The Branch	2425	NSW	Individuals	Support	-												1			
Anonymous	286503	NSW		NSW	Individuals	Support	-												1			
Anonymous	286543	Brisbane	4000	QLD	Individuals	Support	-												1			
Anonymous	286549	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286551	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286561	Barnsley	2278	NSW	Individuals	Support	-												1			
Anonymous	286573	Narrabri	2390	NSW	Individuals	Support	-												1			
Anonymous	286577	Quirindi	2343	NSW	Individuals	Support	-												1			
Anonymous	286590	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286650	Charlestown	2290	NSW	Individuals	Support	-												1			
Anonymous	286719	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286775	New Lambton	2305	NSW	Individuals	Support	-												1			
Anonymous	286800	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286886	Quirindi	2343	NSW	Individuals	Support	-												1			
Anonymous	286893	Balmain	2041	NSW	Individuals	Support	-												1			
Anonymous	286900	Mudgeera	4213	QLD	Individuals	Support	-												1			
Anonymous	286920	Glen Iris	3146	VIC	Individuals	Support	-												1			
Anonymous	286924	Currabubula	2342	NSW	Individuals	Support	-												1			
Anonymous	286944	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286963	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	286969	Merewether	2291	NSW	Individuals	Support	-												1			
Anonymous	286971	Wallalong	2320	NSW	Individuals	Support	-												1			
Anonymous	286975	Gunnedah	2380	NSW	Individuals	Support	-												1			

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Anonymous	287007	Arana Hills	4054	QLD	Individuals	Support	-												1			
Anonymous	287035	Melbourne	3000	VIC	Individuals	Support	-												1			
Anonymous	287058	NSW		NSW	Individuals	Support	-												1			
Anonymous	287091	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	287093	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	287257	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	287275	Moore Creek	2340	NSW	Individuals	Support	-												1			
Anonymous	287393	Ryde	2113	NSW	Individuals	Support	-												1			
Anonymous	287397	Tarriaro	2390	NSW	Individuals	Support	-												1			
Anonymous	287469	Narrabri	2390	NSW	Individuals	Support	-												1			
Anonymous	288128	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	288137	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	288257	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	288273	Tingira Heights	2290	NSW	Individuals	Support	-												1			
Anonymous	288287	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	288449	Tamworth	2340	NSW	Individuals	Support	-												1			
Anonymous	289369	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anonymous	289574	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anthony Hall	280402	Quirindi	2343	NSW	Individuals	Support	-												1			
Anthony Le	283446	Merewether	2291	NSW	Individuals	Support	-												1			
Anthony Mingay	280647	Gunnedah	2380	NSW	Individuals	Support	-												1			
Anthony O'Connor	287406	Narrabri	2390	NSW	Individuals	Support	-												1			
Anthony Pollifrone	286529	East Tamworth	2340	NSW	Individuals	Support	-												1			
Aron Cane	284838	Moore Creek	2340	NSW	Individuals	Support	-												1			
Arshad Khan	282408	Warabrook	2304	NSW	Individuals	Support	-												1			
Arthur Hall	288604	Lake Cargelligo	2672	NSW	Individuals	Support	-												1			
Ben Ferrari	286533	The Junction	2291	NSW	Individuals	Support	-												1			
Ben Murray	288473	Muswellbrook	2333	NSW	Individuals	Support	-												1			
Brad Taylor	282541	Tamworth	2340	NSW	Individuals	Support	-												1			
Bradley Alvey	282550	Gunnedah	2380	NSW	Individuals	Support	-												1			
Bradley Stanton	284246	Rangari	2380	NSW	Individuals	Support	-												1			
Brian Cole	286706	Greenhills	2230	NSW	Individuals	Support	-												1			

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Brian Shimmen	282826	Blackburn	3130	VIC	Individuals	Support	-												1			
Brian Williams	280400	Gunnedah	2380	NSW	Individuals	Support	-												1			
Brodie Smith	282916	Gunnedah	2380	NSW	Individuals	Support	-												1			
Bruce Honeysett	286176	Muswellbrook	2333	NSW	Individuals	Support	-												1			
Charles Loxton	282703	Mosman	2088	NSW	Individuals	Support	-												1			
Charles Sturgess	287021	Gunnedah	2380	NSW	Individuals	Support	-												1			
Chloe Smith	280735	Hillvue	2340	NSW	Individuals	Support	-												1			
Chris Carleton	282910	Boggabri	2382	NSW	Individuals	Support	-												1			
Chris Chad	288265	Gunnedah	2380	NSW	Individuals	Support	-												1			
Chris Lauritzen	284501	Mackenzie	4156	QLD	Individuals	Support	-												1			
Christopher Colman	282522	Merewether	2291	NSW	Individuals	Support	-												1			
Colleen Loveridge	289140	Gunnedah	2380	NSW	Individuals	Support	-												1			
Craig Brackenbury	280331	Shell Cove	2529	NSW	Individuals	Support	-												1			
Craig Ellis	280841	Gunnedah	2380	NSW	Individuals	Support	-												1			
Craig Ifield	286166	NSW		NSW	Individuals	Support	-												1			
Craig Melmeth	286228	NSW	2320	NSW	Individuals	Support	-												1			
Craig Sullivan	289114	Boggabri	2382	NSW	Individuals	Support	-												1			
Cristian Duma	280739	Windella	2320	NSW	Individuals	Support	-												1			
Damien Ribaldone	286170	Wahroong	2076	NSW	Individuals	Support	-												1			
Daniel Lewer	280667	Gillieston Heights	2321	NSW	Individuals	Support	-												1			
Darin Knobbs	283502	Murrurundi	2338	NSW	Individuals	Support	-												1			
Darrell Campbell	284864	Narrabri	2390	NSW	Individuals	Support	-												1			
Darren Swain	286174	Carroll	2340	NSW	Individuals	Support	-												1			
David Hill	287305	Lake Macquarie	2265	NSW	Individuals	Support	-												1			
David Price	285755	Fern Bay	2295	NSW	Individuals	Support	-												1			
David Qi	286816	Sydney	2000	NSW	Individuals	Support	-												1			
David Renshaw	284248	Wickham	2293	NSW	Individuals	Support	-												1			
Dean Clarke	286902	Narrabri	2390	NSW	Individuals	Support	-												1			
Dean Lawrence	280712	Warners Bay	2282	NSW	Individuals	Support	-												1			
Dominic Meaney	280595	Gunnedah	2380	NSW	Individuals	Support	-												1			
Dylan Matheson	284486	North Tamworth	2340	NSW	Individuals	Support	-												1			
Gary Bywater	288411	Gunnedah	2380	NSW	Individuals	Support	-												1			

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Gavin Spohr	286933	Gunnedah	2380	NSW	Individuals	Support	-												1			
Gavin Wendt	280657	Abbotsford	2046	NSW	Individuals	Support	-												1			
Geoff Swain	282898	Carroll	2340	NSW	Individuals	Support	-												1			
George Williams	287359	Charlestown	2290	NSW	Individuals	Support	-												1			
Grant Hutchings	282262	Cardiff	2285	NSW	Individuals	Support	-												1			
Greg Mackay	284559	Gunnedah	2380	NSW	Individuals	Support	-												1			
Groundwater Imaging	284613	Dubbo	2830	NSW	Individuals	Support	-												1			
Gunnedah Locksmiths	286164	Gunnedah	2380	NSW	Individuals	Support	-												1			
Heath Mcilveen	286252	Gunnedah	2380	NSW	Individuals	Support	-												1			
Ian Douglas	283000	NSW		NSW	Individuals	Support	-												1			
Ian Lorenz	286575	New Lambton	2305	NSW	Individuals	Support	-												1			
Ian McAleese	282514	Kingsford	2032	NSW	Individuals	Support	-												1			
Ian Smith	286547	Cardiff	2285	NSW	Individuals	Support	-												1			
Independent Lighting	282912	Redcliffe North	4020	QLD	Individuals	Support	-												1			
Jack Campbell	280422	Narrabri	2390	NSW	Individuals	Support	-												1			
Jack Macpherson	286531	Cooks Hill	2300	NSW	Individuals	Support	-												1			
Jacob Dunkley	284705	Gunnedah	2380	NSW	Individuals	Support	-												1			
Jamie Frankcombe	287013	Pymble	2073	NSW	Individuals	Support	-												1			
Jamie Marchant	286777	Walcha	2354	NSW	Individuals	Support	-												1			
Jan Van	282555	NSW		NSW	Individuals	Support	-												1			
Jason Montgomery	280593	Baan Baa	2390	NSW	Individuals	Support	-												1			
Jason Nunn	280576	Stockton	2295	NSW	Individuals	Support	-												1			
Jason Waerea	286559	Gunnedah	2380	NSW	Individuals	Support	-												1			
Jeremy McWilliams	288271	Kingfisher Shores	2259	NSW	Individuals	Support	-												1			
Jeremy Taylor	280794	East Tamworth	2340	NSW	Individuals	Support	-												1			
Jesse Hicks	280428	Tamworth	2340	NSW	Individuals	Support	-												1			
Joel McKenty	282441	Gunnedah	2380	NSW	Individuals	Support	-												1			
John Granzow	286977	West Pennant Hills	2125	NSW	Individuals	Support	-												1			
John Piana	287351	Narrabri	2390	NSW	Individuals	Support	-												1			
John Saunders	280553	Avalon Beach	2107	NSW	Individuals	Support	-												1			
Jordan Randle	284260	Gunnedah	2380	NSW	Individuals	Support	-												1			
Joseph Dirou	280570	Cooks Hill	2300	NSW	Individuals	Support	-												1			

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Joseph Kelly	286951	Gunnedah	2380	NSW	Individuals	Support	-												1			
Joshua Abberton	280410	Baulkham Hills	2153	NSW	Individuals	Support	-												1			
Justin Johnstone	285856	Narrabri	2390	NSW	Individuals	Support	-												1			
Karl Holmes	288135	Gunnedah	2380	NSW	Individuals	Support	-												1			
Keiron Rochester	284967	Newcastle	2300	NSW	Individuals	Support	-												1			
Ken Flower	281054	Narrabri	2390	NSW	Individuals	Support	-												1			
Kerry Brydon	288110	Wyong	2259	NSW	Individuals	Support	-												1			
Keryn Zambrowski	286527	Newcastle	2300	NSW	Individuals	Support	-												1			
Kevan O'Brien	282908	Morayfield	4506	QLD	Individuals	Support	-												1			
Kevin Ball	282268	Cremorne	2090	NSW	Individuals	Support	-												1			
Kris Vitnell	284511	New Lambton	2305	NSW	Individuals	Support	-												1			
Lachlan May	288120	Gunnedah	2380	NSW	Individuals	Support	-												1			
Lana Nelson	286555	Newcastle	2300	NSW	Individuals	Support	-												1			
Laurence Cohen	286426	Baan Baa	2390	NSW	Individuals	Support	-												1			
Lee Cousin	287076	Singleton	2330	NSW	Individuals	Support	-												1			
Lee Rose	281590	Gunnedah	2380	NSW	Individuals	Support	-												1			
Les Bonney	282918	Narrabri	2390	NSW	Individuals	Support	-												1			
Lucas Bubendey	282249	Fennell Bay	2283	NSW	Individuals	Support	-												1			
Luisa Williams	287343	Gunnedah	2380	NSW	Individuals	Support	-												1			
Luke Rawsthorne	282690	Gunnedah	2380	NSW	Individuals	Support	-												1			
Maggie Raguenes	280452	Gunnedah	2380	NSW	Individuals	Support	-												1			
Malcolm Blaik	284522	Peachester	4519	QLD	Individuals	Support	-												1			
Mark Banks	284242	Gunnedah	2380	NSW	Individuals	Support	-												1			
Mark Benson	282539	Gunnedah	2380	NSW	Individuals	Support	-												1			
Mark Hurst	286246	Gunnedah	2380	NSW	Individuals	Support	-												1			
Mark McKew	282762	Fernvale	4036	QLD	Individuals	Support	-												1			
Mark Shanahan	286702	NSW		NSW	Individuals	Support	-												1			
Mark Tindall	282302	Gunnedah	2380	NSW	Individuals	Support	-												1			
Matt Ryan	280792	New Farm	4005	QLD	Individuals	Support	-												1			
Matthew Launders	282239	NSW	2000	NSW	Individuals	Support	-												1			
Matthew Sparkes	287349	Gunnedah	2380	NSW	Individuals	Support	-												1			
Melissa Bradfield	282500	Gunnedah	2380	NSW	Individuals	Support	-												1			

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Michael Whitehurst	284472	Gunnedah	2380	NSW	Individuals	Support	-												1			
Mike Dear	286918	Moonbi	2353	NSW	Individuals	Support	-												1			
Mitchell Royall	286904	Gunnedah	2380	NSW	Individuals	Support	-												1			
Murray Fraser	283526	Yattalunga	2251	NSW	Individuals	Support	-												1			
Murray O'Keefe	286525	Gunnedah	2380	NSW	Individuals	Support	-												1			
Nathan Poy	284518	Maitland	2320	NSW	Individuals	Support	-												1			
Nathan Robinson	280560	Cameron Park	2285	NSW	Individuals	Support	-												1			
Nicholas Mcclure	283644	Narrabri	2390	NSW	Individuals	Support	-												1			
Nigel Wood	288227	Muswellbrook	2333	NSW	Individuals	Support	-												1			
Patrick Hanna	280510	Rose Bay	2029	NSW	Individuals	Support	-												1			
Patrick Hanna	282798	Rose Bay	2029	NSW	Individuals	Support	-												1			
Patrick Theuma	282520	Liverpool	2170	NSW	Individuals	Support	-												1			
Paul Barbagallo	282278	NSW		NSW	Individuals	Support	-												1			
Paul Mungoven	284975	NSW		NSW	Individuals	Support	-												1			
Paul Verner	282845	Woollahra	2025	NSW	Individuals	Support	-												1			
Peter Barnett	282253	Cardiff	2285	NSW	Individuals	Support	-												1			
Peter Jewell	280396	Queenscliff	3225	VIC	Individuals	Support	-												1			
Peter McLoughlin	280393	Singleton	2330	NSW	Individuals	Support	-												1			
Peter Sullivan	282920	Wamberal	2260	NSW	Individuals	Support	-												1			
Peter Wilkinson	284270	NSW		NSW	Individuals	Support	-												1			
Phil Maher	280964	Gunnedah	2380	NSW	Individuals	Support	-												1			
Rach Fulwood	282902	Muswellbrook	2333	NSW	Individuals	Support	-												1			
Rachel Millmore	282561	Narrabri	2390	NSW	Individuals	Support	-												1			
Rachel Moodie	288118	Gunnedah	2380	NSW	Individuals	Support	-												1			
Ray Wright	285854	Gunnedah	2380	NSW	Individuals	Support	-												1			
Richard Gavin	286617	Somerton	2340	NSW	Individuals	Support	-												1			
Richard Holland	280629	South Arm	7022	TAS	Individuals	Support	-												1			
Rick Chorley	280438	Gunnedah	2380	NSW	Individuals	Support	-												1			
Robert Eyre	288102	Gunnedah	2380	NSW	Individuals	Support	-												1			
Ross Munro	284184	Tamworth	2340	NSW	Individuals	Support	-												1			
Ross Preston	280726	Pymble	2073	NSW	Individuals	Support	-												1			
Ruveni Nakia	283521	Gunnedah	2380	NSW	Individuals	Support	-												1			

Submitter	Reference Number	Suburb	Postcode	State	Group	View	Form Letter / petition	Project Justification	Groundwater	Surface Water	Flooding	Water Balance	Noise and Blasting	Air Quality	Project Infrastructure	Biodiversity	Rehabilitation, Final Void and	Heritage	Social and Economic	Visual Amenity	Traffic and Transport	Public Interest
Sally Hewson	282533	Lower Belford	2335	NSW	Individuals	Support	-												1			
Sam Priest	282325	Narrabri	2390	NSW	Individuals	Support	-												1			
Sandra Donnelly	286517	Gunnedah	2380	NSW	Individuals	Support	-												1			
Sang Hwi	282573	Pennant Hills	2120	NSW	Individuals	Support	-												1			
Sarah Cooke	282243	Kelvin	2380	NSW	Individuals	Support	-												1			
Scott Ginnivan	286569	Narrabri	2390	NSW	Individuals	Support	-												1			
Scott Knights	280419	Cooks Hill	2300	NSW	Individuals	Support	-												1			
Sean Harris	286630	Tamworth	2340	NSW	Individuals	Support	-												1			
Sebastien Moreno	284484	Gunnedah	2380	NSW	Individuals	Support	-												1			
Selina Moulton	282851	Sydney	2000	NSW	Individuals	Support	-												1			
Shane Cox	282229	Swan Bay	2471	NSW	Individuals	Support	-												1			
Shane Smith	282713	Singleton	2330	NSW	Individuals	Support	-												1			
Sherry Russell	280970	Aberglasslyn	2320	NSW	Individuals	Support	-												1			
Shigenori Suzuki	288431	Chatswood	2067	NSW	Individuals	Support	-												1			
Simon Rock	283422	Marmong Point	2284	NSW	Individuals	Support	-												1			
Stephen Murray	289219	Hallidays Point	2430	NSW	Individuals	Support	-												1			
Stephen Shoobridge	286168	Tamworth	2340	NSW	Individuals	Support	-												1			
Steve McManus	289666	Wahroonga	2076	NSW	Individuals	Support	-												1			
Steve Williams	280696	Botany	2019	NSW	Individuals	Support	-												1			
Stuart Middleton	283131	Baan Baa	2390	NSW	Individuals	Support	-												1			
Sue Romeril	287413	Gunnedah	2380	NSW	Individuals	Support	-												1			
Susi Johnston	282390	Gunnedah	2380	NSW	Individuals	Support	-												1			
Tatsuya Sakaguchi	284355	Chiba	12100	Japan	Individuals	Support	-												1			
Timothy Britten	284507	Muswellbrook	2333	NSW	Individuals	Support	-												1			
Timothy Tunningley	282280	Gunnedah	2380	NSW	Individuals	Support	-												1			
Tony Lones	281894	Gunnedah	2380	NSW	Individuals	Support	-												1			
Tony Mitchell	280415	St Ives	2075	NSW	Individuals	Support	-												1			
Tony Roberts	284514	Millfield	2325	NSW	Individuals	Support	-												1			
Tsuyoshi Terada	288413	St Leonards	2065	NSW	Individuals	Support	-												1			
Warren Odgers	282843	Rylstone	2849	NSW	Individuals	Support	-												1			
Wayne Johnson	286539	Newcastle	2300	NSW	Individuals	Support	-												1			
Wayne Reilly	280503	Eight Mile Plains	4113	QLD	Individuals	Support	-												1			

Submitter	Reference Number	Suburb	Postcode	State	Group	View	Form Letter / petition	Project Justification	Groundwater	Surface Water	Flooding	Water Balance	Noise and Blasting	Air Quality	Project Infrastructure	Biodiversity	Rehabilitation, Final Void and	Heritage	Social and Economic	Visual Amenity	Traffic and Transport	Public Interest
Total								**2**	**108**	**94**	**76**	**15**	**79**	**78**	**2**	**64**	**34**	**50**	**491***	**24**	**25**	**97**
Government Agencies								0	3	3	2	2	2	2	0	2	2	2	3	1	2	0
Local Council								1	2	1	2	2	2	2	1	2	2	2	3	2	2	2
Special Interest Group								0	9	10	7	2	11	9	0	6	5	7	13	3	6	9
Business								0	0	0	0	0	0	0	0	0	0	0	58	0	0	1
Individual								1	94	80	65	9	64	65	1	54	25	39	414	18	15	85

* Note: the 491 submissions which mentioned social and economic components of the Project were comprised of 18 comments, 345 supports and 128 objections.

ATTACHMENT 2

REGISTER OF SUBMITTERS

Table A2-1
Register of Submitters

Group	Reference Number	Name	Where Comments are Addressed (Section)
Public Authorities	286507	Australian National University (Siding Springs Observatory)	6.13
	286351	Australian Rail Track Corporation	6.14
	289814	NSW Department of Industry - Lands and Water	6.2, 6.3, 6.4, 6.5, 6.10, 6.12
	290774	NSW Department of Planning - Resources Regulator	6.10
	288799	NSW Division of Resources and Geoscience	6.2, 6.9, 6.12
	291384	NSW Environment Protection Agency	6.2, 6.3, 6.5, 6.6, 6.7
	289564	NSW Health - Hunter New England Local Health District	6.3, 6.6, 6.7, 6.12
	286884	NSW Heritage Council	6.11
	289812	NSW Office of Environment and Heritage	6.4, 6.9, 6.11
	290819	NSW Roads and Maritime Services	6.14
	289894	NSW Rural Fire Service	6.9
Councils	287231	Gunnedah Shire Council	6.1, 6.2, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15
	289568	Liverpool Plains Shire Council	6.12
	291388	Narrabri Shire Council	6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15
Special Interest Groups	289779	Boggabri Business & Community Association	6.2, 6.3, 6.4, 6.6
	289704	Boggabri Farming and Community Group	6.2, 6.3, 6.4, 6.6, 6.7, 6.9, 6.10, 6.11, 6.12, 6.14, 6.15
	289179	Cotton Australia	6.3, 6.4, 6.6, 6.7, 6.10, 6.12
	289310	CountryMinded	6.2, 6.7, 6.12
	289199	Dorothea Mackellar Memorial Society	6.11, 6.13

Group	Reference Number	Name	Where Comments are Addressed (Section)
	283673	Emerald Hill Progress Association	6.2, 6.4, 6.6, 6.12, 6.15
	289670	Leard Forest Research Node	6.6
	289496	Lock the Gate Alliance	6.5, 6.10, 6.11, 6.12, 6.15
	289584	Maules Creek Branch of the Country Womens Association of NSW	6.3, 6.6, 6.9, 6.12, 6.14, 6.15
	289492	Maules Creek Community Council Inc	6.3, 6.7, 6.12, 6.15
	289517	Namoi Water	6.5
	289582 / 289612	National Park Association Armidale Branch	6.3, 6.6, 6.7, 6.9, 6.12, 6.14
	289265	New England Greens Armidale Tamworth	6.2, 6.3, 6.6, 6.7, 6.9, 6.11, 6.12, 6.14, 6.15
	289510	NSW Farmers' Association	6.2, 6.3, 6.4, 6.6, 6.7
	289527	people for the Plains	6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15
	289251	Red Chief Local Aboriginal Land Council	6.11
	289602	Sustainable Living Armidale	6.2, 6.3, 6.7, 6.12, 6.15
	289302	Upper Mooki Landcare Inc	6.9
	289692	Wando Conservation and Cultural Centre Inc	6.2, 6.4, 6.6, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15
	280899	Bilby Blooms	6.12
Businesses	284701	Top Caps	6.12, 6.15
	289588	Alexandra Stuart	6.15
Individuals	285243	Alicia Braithwaite	6.3, 6.7, 6.10, 6.15
	289630	Aliison Kelly	6.2, 6.4, 6.12, 6.15
	289226	Amanda Heinemann	6.2, 6.4, 6.6, 6.12
	289381	Amanda Hook	6.15

Group	Reference Number	Name	Where Comments are Addressed (Section)
	289652	Amy McAllister	6.2, 6.3, 6.4, 6.6, 6.7
	289476	Andrew Darley	6.3, 6.4, 6.6, 6.7, 6.12, 6.13
	288906	Anita Maunder	6.2, 6.3, 6.5, 6.12
	289810	Anna Christie	6.2, 6.4, 6.6, 6.9, 6.11, 6.12, 6.14
	289230	Anne Rich	6.15
	285457	Annie Marlow	6.7, 6.10, 6.12, 6.15
	284440	Anonymous	6.15
	284794	Anonymous	6.2, 6.3, 6.7, 6.11, 6.12
	284818	Anonymous	6.1
	285447	Anonymous	6.2, 6.3, 6.7, 6.10
	285451	Anonymous	6.12
	285786	Anonymous	6.15
	285810	Anonymous	6.2, 6.3, 6.6, 6.7, 6.12 ,6.15
	285841	Anonymous	6.2, 6.7
	285971	Anonymous	6.2, 6.7, 6.11, 6.12
	288892	Anonymous	6.6, 6.12
	289112	Anonymous	6.9
	289228	Anonymous	6.7, 6.10, 6.12
	289249	Anonymous	6.2, 6.7, 6.12
	289255	Anonymous	6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.12, 6.15
	289271	Anonymous	6.9

Group	Reference Number	Name	Where Comments are Addressed (Section)
	289273	Anonymous	6.2, 6.7, 6.11, 6.12
	289291	Anonymous	6.15
	289296	Anonymous	6.3, 6.9, 6.12, 6.15
	289316	Anonymous	6.2, 6.3, 6.4, 6.7, 6.9, 6.11, 6.12, 6.15
	289322	Anonymous	6.12, 6.15
	289324	Anonymous	6.15
	289453	Anonymous	6.2, 6.3, 6.7, 6.10, 6.12
	289457	Anonymous	6.4, 6.9, 6.13
	289461	Anonymous	6.9
	289550	Anonymous	6.6, 6.7
	289594	Anonymous	6.9, 6.11, 6.14, 6.15
	289598	Anonymous	6.3, 6.9
	289604	Anonymous	6.12, 6.15
	289640	Anonymous	6.2, 6.4, 6.6, 6.9, 6.13
	289658	Anonymous	6.15
	289664	Anonymous	6.2, 6.4, 6.6, 6.12, 6.13, 6.15
	289680	Anonymous	6.2, 6.3, 6.4, 6.6, 6.9, 6.12, 6.14
	289767	Anonymous	6.2, 6.6, 6.11, 6.12, 6.13
	282282	Anonymous	6.12
	282327	Anonymous	6.15
	288932	Anthony Pickard	6.2, 6.9

Group	Reference Number	Name	Where Comments are Addressed (Section)
	285237	Anthony Poutsma	6.2, 6.7, 6.12, 6.15
	289578	Anthony Wannan	6.2, 6.3, 6.6, 6.9, 6.12, 6.13, 6.14, 6.15
	289808	Audrey McLean	6.2, 6.3, 6.6, 6.11, 6.12
	289512	Bea Bleile	6.15
	289232	Bill Newell	6.2, 6.3
	289648	Brendan Shoebridge	6.2, 6.7, 6.11, 6.12, 6.15
	289682	Brian Keeler	6.4, 6.6, 6.9, 6.12, 6.13, 6.15
	289057	Bronwyn Vost	6.2, 6.3, 6.6, 6.9, 6.10, 6.12, 6.15
	285455	Bruce Jarvis	6.2, 6.4, 6.7, 6.11, 6.12
	286009	Bruce McQueen	6.15
	293410	Carolyn Nancarrow	6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.12
	284753	Catherine Blakey	6.7, 6.10, 6.12, 6.15
	289110	Catherine Collyer	6.2, 6.3, 6.6, 6.12, 6.14
	289474	Christine Rumble	6.2, 6.3, 6.7, 6.10
	289362	Corinne Matri	6.12
	289432	Craig Shaw	6.4, 6.12
	289298	Daniel Endicott	6.15
	288088	David Paull	6.3, 6.4, 6.9
	288862	David Riley	6.2, 6.4, 6.5, 6.6, 6.7, 6.12, 6.14
	289570	Debbie MacDonald	6.7, 6.10
	286067	Denise Murray	6.2, 6.3

Group	Reference Number	Name	Where Comments are Addressed (Section)
	285279	Dereka Ogden	6.2, 6.4, 6.7, 6.11, 6.12
	284719	Donna Beekwilder	6.2, 6.4, 6.7, 6.11, 6.12
	289586	Dorothee Babeck	6.4, 6.7, 6.10, 6.12, 6.15
	285579	Dorte Planert	6.2, 6.3, 6.7, 6.11, 6.12
	289644	Elizabeth O'Hara	6.6, 6.7, 6.9, 6.11, 6.12, 6.14, 6.15
	289286	Eric Hannan	6.12
	289620	Errol and Jennifer Darley	6.3, 6.4, 6.6, 6.10, 6.11, 6.12, 6.15
	285313	Felicity Cahill	6.2, 6.3, 6.7, 6.9, 6.11, 6.12
	284983	Francesca Smith	6.7, 6.10, 6.15
	283400	Gary Rennick	6.6
	285241	Gary Russell	6.2, 6.7, 6.10, 6.12
	289590	Geoff Hunter	6.4, 6.5, 6.6, 6.10, 6.12
	289289	Georgia Harrington	6.2, 6.3, 6.4, 6.6, 6.9, 6.12
	289684	Grant Mcilveen	6.3, 6.4, 6.6, 6.7, 6.9, 6.10, 6.12, 6.13, 6.15
	289346	Gus Sharpe	6.15
	289267	Harriet McCalman	6.6, 6.7, 6.12, 6.15
	288955	Heather Ranclaud	6.2, 6.6, 6.11, 6.12, 6.15
	289540	Heike Watson	6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.12, 6.14, 6.15
	289281	Helen Quade	6.12, 6.13, 6.15
	288910	Hugh Barrett	6.1
	289356	Hugh Price	6.2, 6.3, 6.4, 6.6, 6.7, 6.13

Group	Reference Number	Name	Where Comments are Addressed (Section)
	287898	Ifeanna Tooth	6.2, 6.7, 6.11, 6.12, 6.15
	289487	Jaben Golledge	6.15
	285880	Jack Claff	6.2, 6.3, 6.4, 6.5, 6.12, 6.15
	289696	James and Nicole Barlow	6.2, 6.3, 6.4, 6.6, 6.7, 6.10, 6.11, 6.12, 6.13, 6.15
	284655	Jane Judd	6.2, 6.3, 6.4, 6.9, 6.12, 6.15
	289702	Janet Watt	6.2, 6.6, 6.7, 6.12
	285746	Jermy White	6.2, 6.3, 6.7, 6.10, 6.12 ,6.15
	289592	Jim Morris	6.2, 6.3, 6.6, 6.9, 6.12, 6.13, 6.15
	285449	Jocelyn Guy	6.2, 6.3, 6.7, 6.13
	289446	Johanna Evans	6.2, 6.3, 6.4, 6.6, 6.9, 6.12, 6.15
	289294	Johannes Brits	6.4, 6.9
	285275	John L and Rosie Hayes	6.2, 6.3, 6.7, 6.11, 6.12
	289572	Judith Leslie	6.15
	289234	Julie Heiler	6.2, 6.3, 6.7, 6.12
	284727	Karen Barlow	6.4, 6.6, 6.12 ,6.15
	289306	Karen Pike	6.9
	288417	Kate Mitchell	6.4, 6.6, 6.12
	288970	Kathy McKenzie	6.3, 6.4, 6.6, 6.7, 6.9, 6.11, 6.12, 6.14
	289375	Keira Dott	6.9, 6.15
	284611	Ken Crawford	6.4
	289610	Lara Leonard	6.6, 6.12

Group	Reference Number	Name	Where Comments are Addressed (Section)
	289459	Liam Donaldson	6.2, 6.3, 6.7, 6.10, 6.12, 6.15
	289253	Libby Laird	6.2, 6.3, 6.4, 6.6, 6.9, 6.11, 6.12, 6.14, 6.15
	289336	Linda Connor	6.2, 6.4, 6.6, 6.12, 6.13
	294064	Lochie Leitch	6.2, 6.3, 6.4, 6.6, 6.12
	289470	Louise Kirumba	6.2, 6.3, 6.7, 6.10, 6.12, 6.15
	289318	Louise Somerville	6.2, 6.3, 6.4, 6.6, 6.9, 6.12
	287087	Lyle Sims	6.2, 6.4, 6.12
	289277	Lyndell Crowley	6.2, 6.3, 6.6, 6.9, 6.11, 6.12, 6.15
	287423	Malcolm Donaldson	6.2, 6.3, 6.4, 6.7, 6.9, 6.11, 6.12, 6.15
	289350	Marg McLean	6.15
	285574	Margaret Wallace	6.2, 6.7, 6.10, 6.15
	289275	Marie Flood	6.3, 6.4, 6.6, 6.9, 6.11, 6.12, 6.14
	289300	Marie Rolfr	6.15
	288951	Matthew Ciesiolka	6.3, 6.4, 6.6, 6.7, 6.9, 6.12, 6.14
	289580	Maureen Kingshott	6.2, 6.3, 6.4, 6.6, 6.9, 6.11, 6.12, 6.14
	289626	Maurice Devine	6.3, 6.4, 6.5, 6.6, 6.12
	284741	Michael Barakin	6.15
	289283	Michaela Vaughan	6.15
	286039	Nanette Nicholson	6.2, 6.3, 6.12, 6.15
	289224	Naomi Hodgson	6.2, 6.3, 6.11, 6.12, 6.15
	289304	Naomi Hogan	6.2, 6.3, 6.7, 6.11, 6.12, 6.15

Group	Reference Number	Name	Where Comments are Addressed (Section)
	286436	Neil Moore	6.15
	285544	Nicola Chirlian	6.9
	289616	Oshadika Gunawardhana	6.12 ,6.13, 6.15
	288908	Pamela Barrett	6.15
	289556	Pat Murphy	6.4, 6.6, 6.9, 6.12
	289622	Pat Schultz	6.2, 6.3, 6.6, 6.7, 6.9, 6.12
	289093	Patst Asch	6.2, 6.7, 6.9
	285239	Paul McCabe	6.2, 6.10, 6.15
	286638	Peta Craig	6.2, 6.3, 6.6, 6.7, 6.9, 6.10, 6.11, 6.12
	289206	Peter Frere	6.3, 6.4, 6.9
	285777	Peter Small	6.2, 6.7, 6.11, 6.12
	289365	Peter Watson	6.2, 6.9, 6.12
	289505	Peter Youll	6.2, 6.3, 6.6, 6.7, 6.15
	289596	Phil Glover	6.4
	289202	Phil Laird	6.2, 6.3, 6.12, 6.14, 6.15
	289688	Philip Spark	6.2, 6.3, 6.4, 6.6, 6.9, 6.12, 6.15
	289125	Philippa Murray	6.2, 6.3, 6.4, 6.11, 6.12, 6.13, 6.15
	289479	Rachel Ryan	6.15
	289552	Renee Murphy	6.12
	289236	Richard Clarke	6.4, 6.9, 6.15
	287990	Richard Grant	6.2, 6.3, 6.15

Group	Reference Number	Name	Where Comments are Addressed (Section)
	289634	Robert and Rosemary Cock	6.3, 6.4, 6.7, 6.12
	285283	Robert Doyle	6.2, 6.6, 6.7, 6.12
	288930	Robert Mansfield	6.2, 6.3, 6.4, 6.6, 6.12
	289243	Robin Murray	6.2, 6.3, 6.4, 6.6, 6.9, 6.12
	281454	Rod Jones	6.15
	289107	Rodney Yeo	6.2, 6.3
	285303	Rolf Wood	6.2, 6.3, 6.7, 6.11, 6.12, 6.15
	289690	Roselyn Druce	6.2, 6.3, 6.4, 6.6, 6.7, 6.9, 6.11, 6.12, 6.15
	288811	Rosemary Vass	6.2, 6.3, 6.4, 6.9, 6.11, 6.12, 6.15
	289334	Ross Knowles	6.15
	288269	Ross Urquhart	6.4, 6.6, 6.12, 6.13, 6.15
	289314	Rowena Macrae	6.4, 6.6, 6.9, 6.12
	289535	Sally Hunter	6.2, 6.3, 6.6, 6.9, 6.11, 6.12, 6.15
	289101	Sam Bragg	6.2, 6.3, 6.7, 6.9
	288949	Sarah Ciesiolka	6.3, 6.4, 6.6, 6.7, 6.9, 6.12, 6.14
	288491	Scott McCalman	6.2, 6.3, 6.4, 6.7, 6.11, 6.12, 6.15
	285285	Sharyn Munro	6.2, 6.3, 6.4, 6.12
	289279	Simon Clough	6.3, 6.9, 6.10, 6.11, 6.12, 6.15
	289437	Stephanie Darley	6.2, 6.4, 6.5, 6.6, 6.12
	289326	Stewart Ewen	6.15
	285822	Stuart Murray	6.2, 6.3, 6.12

Group	Reference Number	Name	Where Comments are Addressed (Section)
	288289	Suanne Riley	6.3, 6.4, 6.6, 6.7, 6.10, 6.12
	284737	Susan Jameson	6.12
	289600	Tania Marshall	6.2, 6.3, 6.6, 6.7, 6.9, 6.10, 6.11, 6.12, 6.13, 6.15
	289245	Toby Croker	6.2, 6.3, 6.4, 6.6, 6.7, 6.12, 6.15
	289636	Tom Mullaney	6.2, 6.6, 6.7, 6.12
	289638	Tracey Clancy	6.9
	289238	Wendy Bellamy	6.3, 6.4, 6.9, 6.15
	289088	William Burgher	6.15
	287932	William Lord	6.2, 6.3, 6.11

ATTACHMENT 3

IPC CONSIDERATIONS – TABLE OF COMMITMENTS

IPC Consideration	Whitehaven Commitment	Section of RTS
1 PROJECT JUSTIFICATION		
• *whether there are limitations imposed by the conditions of consent for the Approved Project, and the Tarrawonga and Rocglen Mines which are located near the Project site (see Figure 1);*	Additional information provided (no commitment required). The economic benefit of the Project extensions to Whitehaven, NSW and the local economy is evident, considering the Project would result in an additional $500 million in net benefits to NSW (compared to the Approved Mine) and result in approximately 200 additional employment opportunities during operations and 450 additional employment opportunities during construction.	Section 6.1.3
• *any need for a CHPP and rail load out facility at the Project site itself;*		
• *the economic impacts of any limitations imposed by the current consents which prevent maximum production for the Approved Project, Tarrawonga and Rocglen Mines, and the Gunnedah CHPP and train load out facility;*		
• *the economic evidence for an annual production threshold sufficient to support a viable new CHPP and rail loop;*		
• *details of the additional resources secured within the Vickery South tenements, timing and why these were not included in the Approved Project application; and*		
• *details of the additional resources confirmed within the northern area of the Approved Project tenements, timing and why these were not included in the Approved Project application.*		
2 GROUNDWATER		
• *the Applicant's groundwater model and surface water assessment, including by reference to the information requirements highlighted by government agencies and the IESC and Additional Material provided by the Applicant to the Commission. The Department may wish to consider obtaining further information from the Applicant in this regard, including a meaningful discussion of the impacts of both the Approved Project and the Project;*	Additional information provided (no commitment required).	Section 6.2.3.
• *the adequacy of the Applicant's justification and costing of a no void option for consideration. The justification should reflect the requirements in the EP&A Act to ensure intergenerational equity and should appropriately incorporate the cost of the long-term management of the void, including the loss of the water resources to the void;*	Additional sensitivity analysis provided to demonstrate the model has negligible uncertainty. To protect groundwater quality post-mining, Whitehaven commits to the following in regard to the final landform: • One final void that acts as a permanent groundwater sink (in addition to the existing Blue Vale void which would be retained). • Conducting ongoing review of the mine plan during operations such that the size of the final void (depth and area) and catchment area reporting to the final void is minimised as far as is reasonable and feasible. In this regard it is noted the Project final void would be an improvement in comparison to the Approved Mine, for which two final voids are approved at the completion of mining (in addition to the existing Blue Vale void). Whitehaven commits to holding sufficient water licences to account for any post-mining take.	
• *the Applicant's consideration of long-term groundwater and water quality models for a no void option to assess the potential impacts of groundwater flow through such a rehabilitated Project site;*		
• *post-mining studies, which should provide details of the groundwater flows to the east of the site and how they interact with drawdowns from the Rocglen Mine site including any potential impacts on the water sharing plan catchment to the east;*		

IPC Consideration	Whitehaven Commitment	Section of RTS
• *a more extensive sensitivity study of the groundwater model be undertaken by the Applicant, or any explanation be given by the Applicant for its absence;*	To confirm the accuracy of groundwater modelling predictions, Whitehaven commits to ongoing groundwater monitoring with the results of this monitoring to be used to confirm any residual uncertainty and inform ongoing licensing requirements. The groundwater monitoring results would be compared to model predictions, with the model revised and recalibrated every 5 years as required.	
• *the provision of maps that illustrate the potential distribution of GDEs, as indicated by the IESC in paragraph 84; and* • *a risk analysis as indicated by the IESC in paragraph 84.*	Additional information provided (no commitment required). There are no high priority GDE's identified in the Upper Namoi Groundwater Sources or Porous Rock Groundwater Sources in the vicinity of the Project. The Project's predicted impacts to groundwater are effectively limited to the Maules Creek Formation and, as such, potential impacts to GDEs associated with the Namoi River are predicted to be negligible.	
3 & 4 SURFACE WATER AND FLOODING		
• *how the Applicant proposes to ensure that the walls of sedimentation dams and other site water storages are constructed to the appropriate standard of impermeability;*	Whitehaven commits to constructing water storages to permeability standards specified in any Development Consent or EPL conditions, with all storages constructed for the Project to be engineered structures built as designed.	Section 6.3.3.
• *the commitment of the Applicant to an appropriate water quality monitoring program for water contained in sediment basins and other mine storages. Detail of any such program should include whether it includes a full range of analytes, including those outlined in paragraph 137, that will aid in its meeting discharge standards consistently with the quality of target watercourses and, by pre-commencement monitoring, sets up appropriate trigger values for acceptable discharge;*	Whitehaven commits to monitoring of water quality in sediment dams capturing runoff from the waste emplacement, which would include monitoring of the following parameters: pH, EC, total alkalinity/acidity, sulphate, aluminium, arsenic, molybdenum and selenium (in addition to total suspended solids [TSS]). The suite of parameters would be reviewed after a period of two years and adjusted according to the variability detected. In addition, and consistent with contemporary EPL conditions, the following parameters would be monitored during a controlled discharge from a sediment dam (i.e. when releases to restore the capacity of the dam are required following a rainfall event that exceeds the dam design capacity, and when there is insufficient storage available in other on-site storages): pH, EC, TSS, oil and grease and total organic carbon. Whitehaven commits to ongoing monitoring in the receiving environment to establish water quality trigger levels in accordance with ANZECC, which would be described in any Water Management Plan for the Project.	
• *whether the flood study could be performed for the Namoi, Stratford and South Creeks alone, and also for the combination of them occurring simultaneously unless the Applicant can show that the extreme floods on the smaller tributaries are not embedded in the storms that cause the larger floods in the Namoi;*	Additional information provided (no commitment required). The change in peak flood levels (compared to the 1% AEP design event) is imperceptible.	Section 6.4.3.
• *whether this flood study could also be carried out for any alternative infrastructure options suggested elsewhere in this report (e.g. CHPP in the SE corner, and any other location option investigated);*	Additional information provided (no commitment required). Relocation of infrastructure is not considered to be reasonable.	Section 6.8.3.

IPC Consideration	Whitehaven Commitment	Section of RTS
• *whether the flood studies around the rail loader, final void, and CHPP which were done using an empirical factor for the probable maximum flood (PMF) estimating the PMF discharge to be 3 x the 1% AEP flood could instead be done using either:* ▪ *the GSDM method for PMF estimation developed by the Bureau of Meteorology; or* ▪ *the PMF methodology recommended in Australian Rainfall and Runoff; and*	Additional information provided (no commitment required). The difference in the extent of floodprone land between the PMF methods is negligible and does not impact on the flood risk assessment for the site.	Section 6.4.3.
• *whether a QRA of the off-site water quality consequences of flood exceedances of the on-site infrastructure (i.e. dams, stockpiles, CHPP) could be carried out.*	To prevent and minimise the potential for downstream water quality impacts, Whitehaven commits to bunding of infrastructure areas (to avoid flood inundation up to at least the 1% AEP event) and constructing water storages with design capacities in accordance with any Development Consent and EPL conditions and appropriate standards.	Section 6.3.3.
5 WATER BALANCE		
• *the water balance for the Project site while operational and whether the Applicant holds sufficient water extraction licences in the event of restrictions on extraction during drought, as has occurred in the Zone 4 alluvial aquifers and Namoi River in the past, and methods for addressing any water shortfall; and*	Whitehaven commits to holding sufficient water licences to meet operational water demands for the Project.	Section 6.5.3.
• *a water balance model for the two final void lakes, which should include an assessment of the uncertainties in inflow rates, infiltration, evaporation, and sensitivity studies of the long-term trajectory to equilibrium (i.e. duration of recovery, salinity trends, rate of lake rise relative to groundwater recovery rates).*	Additional information provided, which shows inflows to the void are not sensitive to assumed infiltration and that the void will remain a permanent groundwater sink, To protect groundwater quality post-mining, Whitehaven commits to the following in regard to the final landform: • One final void that acts as a permanent groundwater sink (in addition to the existing Blue Vale void which would be retained). • Conducting ongoing review of the mine plan during operations such that the size of the final void (depth and area) and catchment area reporting to the final void is minimised as far as is reasonable and feasible. In this regard it is noted the Project final void would be an improvement in comparison to the Approved Mine, for which two final voids are approved at the completion of mining (in addition to the existing Blue Vale void).	Section 6.2.3.
6 NOISE AND BLASTING		
• *the Applicant's demonstration of which years are the 'worst case' years for operations and any articulation of what impacts are predicted for nearby residents. Predicted noise emissions and impacts at sensitive receptors for all years of operation may be of assistance in this regard;*	Additional information provided to demonstrate the years modelled are representative of maximum emissions. Whitehaven commits to implementing all reasonable and feasible measures in meeting Development Consent and EPL noise limits at all relevant receiver locations in all years of the Project life.	Section 6.6.3.

IPC Consideration	Whitehaven Commitment	Section of RTS
• *the Applicant's justification for the construction hours being beyond what is set out in the ICNG;*	Whitehaven commits to maintaining construction noise levels such that they would comply with the 'Noise Affected' noise management level in accordance with the Interim Construction Noise Guideline outside of recommended standard construction hours, unless a negotiated agreement is entered into with the owners of the relevant properties.	
• *the Applicant's monitoring data of trains, both loaded and empty, travelling across the Maules Creek viaduct, which will provide the stakeholders with a sense of the noise level that could be expected from the project's viaduct. The Department should also give detailed consideration to noise modelling across the floodplain based on this monitoring data and other appropriate data for resonance emissions of the viaduct superstructure;*	Additional information provided, with data from the Maules Creek viaduct supporting the predictions of rail noise in the EIS. Whitehaven commits to incorporating all reasonable and feasible noise mitigation measures in the detailed rail spur design, commission a suitably qualified and experienced person to review the detailed rail spur design and undertake commissioning trials to determine optimum train speeds to minimise noise impacts.	
• *details on the investigation of noise and blast exceedances at Maules Creek, Rocglen and Tarrawonga Coal Mines in the past 5 years, including the findings of the investigations by the regulatory authorities; and*	Additional information provided. The overwhelming majority of noise monitoring results from Whitehaven's other operations demonstrate compliance with noise limits. Whitehaven commits to implementing all reasonable and feasible measures in meeting Development Consent and EPL noise limits at all relevant receiver locations in all years of the Project life.	
• *whether any of the recommendations made in the report summarising Whitehaven's 2016 Mandatory Noise Management Audit will be implemented on this Project; and*	Additional information provided (no commitment required). Some recommendations of the audit have already been incorporated into the Project, including consideration of low sound power level equipment during procurement, enclosure/shrouding of the coal preparation plant and consideration of low frequency noise in selection and/or design of equipment and mitigation measures.	
• *whether the blasting criteria determined for the Kurrumbede Homestead will protect the Homestead from damage due to blasting.*	To avoid physical damage to the Kurrumbede Homestead, Whitehaven commits to meeting building damage blast criteria (10 mm/s [vibration] and 133 dB [air blast], or alternative limits if determined to be suitable via engineering inspection).	
7 AIR QUALITY		
• *why the dust levels of the Project are predicted to be lower than those for the Approved Project, even though the Project will be extracting and handling more coal, will have a higher production rate and includes operating a CHPP and rail load out facility;*	Additional information provided (no commitment required). The key difference in emission inventories is associated with the Project adopting a higher control efficiency for dust generate from haul roads, based on current leading practice and as supporting by measured performance from other mining operations across NSW.	Section 6.7.3.
• *any comparison of modelling assumptions used for the Approved Project and the Project provided by the Applicant to demonstrate how the changes in technology and practices impact the results; and*	Additional information provided. Whitehaven commits to implementing all reasonable and feasible dust management measures to meet Development Consent and EPL air quality criteria at relevant receivers.	

IPC Consideration	Whitehaven Commitment	Section of RTS
• *which years are the 'worst case' years for operations from the perspective of air quality emissions and identify what are the impacts predicted for nearby residents. The Department may be assisted in this regard by the Applicant providing annual predicted air quality emissions and impacts at sensitive receptors for each year of operation.*	Whitehaven commits to implementing all reasonable and feasible measures in meeting Development Consent and EPL air quality criteria at all relevant receiver locations in all years of the Project life.	
8 PROJECT INFRASTRUCTURE AREA		
• *any noise modelling results provided by the Applicant for alternative rail spur and CHPP locations. Specifically, the Department should consider noise modelling results for the siting of the CHPP approximately 400 m east to enable a noise bund to be located on the western side of the plant, and quantifying any impacts from a loss of reserves. In addition, the Department should consider noise modelling of an alternative site for the CHPP and rail spur located within the infrastructure area allocated for the Approved Project in the south east;*	Additional information provided. Relocation of the CHPP, rail loop and rail spur is not considered reasonable for the Project. To minimise noise emissions from the CHPP, Whitehaven commits to implement cladding of the CHPP including the use of HushClad (or equivalent) acoustic lining.	Section 6.8.3.
• *any details of the comparative noise impacts from the construction of an alternative rail spur in the south east, including but not limited to the intensity and duration of construction of the rail spur;*		
• *any assessment provided by the Applicant as to the potential for locating the CHPP and rail spur in the south-eastern portion of the Project provided by the Applicant including, in particular, a comparison of the impacts of the CHPP and rail spur in the proposed location and the south-eastern location, including flooding, noise, air quality and economic impacts; and*		
• *the Applicant's justification as to why the CHPP cannot be fitted with acoustic cladding to reduce the noise of the CHPP, given the apparent constraints on bunding the CHPP.*		
9 BIODIVERSITY		
• *the Commonwealth Matters;*	Additional information provided. Whitehaven commits to satisfying the Project offset requirement through retiring the number and type of offset credits applicable to the Project (as determined by the OEH *Credit Calculator for Major Projects and BioBanking*).	Section 6.9.3.
• *any quantification of the potential impact to the local Koala population and measures to avoid impacts and offset to any impacts to Koalas, within the Koala Plan of Management;*		
• *any evidence-based feasibility assessment provided by the Applicant for establishing self-sustaining woodland communities to a standard to satisfy the biodiversity offset requirements;*		
• *any offsetting approach provided by the Applicant, which may include, if necessary, details of how its approach will be staged, the timing, offset value and how it could be successfully undertaken, as well as alternative measures to meet the credit requirements if rehabilitation is not considered achievable; and*		
• *the Applicant's BARBOS and, in particular, whether its BARBOS addresses the information requirements set out by OEH, including agreed upon credit calculations, and provides adequate supporting information in relation to the use of mine rehabilitation.*		

IPC Consideration	Whitehaven Commitment	Section of RTS
10 REHABILITATION, FINAL VOID AND FINAL LANDFORM		
• *how areas of existing rehabilitated soils would be effectively used for further rehabilitation in other areas of the proposed mine;*	To manage soil resources to meet rehabilitation objectives, Whitehaven commits to implementing soil monitoring, management and amelioration measures for the Project as recommended by SESL (2018) and to be described in Mining Operations Plans (or equivalent).	Section 6.10.3.
• *how the final landform (including the outer batters) would be designed using both macro and micro relief to ensure that the final landform is consistent with and ties into the surrounding landscape;*	To maximise opportunities for micro-relief in the Project landform and to minimise the need for bench drains on the outer batters of the Western Emplacement, Whitehaven commits to landform review using GeoFluv™ software or similar during the life of the Project. Whitehaven commits to establishing a waste rock emplacement that incorporates natural landform design features that reflect characteristics of the topography found in the adjacent Vickery State Forest (e.g. elevated landforms with steeper slopes in some areas relative to the surrounding plains).	
• *if the final landform would be suitable for other land uses. For instance, the rehabilitated area could be classed as Class 2 or Class 3 Agricultural Land;*	Whitehaven commits to implementing a rehabilitation strategy that enhances the cover and connectivity of native woodland on the final landform between the Vickery State Forest and the Namoi River, maximises the ability to meet Federal and State biodiversity offset requirements, and returns some relatively flat areas of the final landform to agricultural land capable of supporting grazing. Whitehaven commits to developing a Mine Closure Plan (or equivalent) three to five years in advance of the Project's anticipated closure date, which would describe any beneficial uses of the post-mining landform.	
• *agricultural land versus offset (rehabilitation to woodland communities) for the final land use;*		
• *if the definition of the long-term sediment and chemical consequences of runoff from the external batters should be better defined. For instance, at what date would the sediment basins fill with sediment and what would the sediment loads be that subsequently drain offsite; and*	To minimise the risk of downstream water quality impacts, Whitehaven commits to maintaining sediment dams designed in accordance with Landcom (2004) and any Development Consent and EPL conditions until such time as runoff from rehabilitated areas reporting to the sediment dam has similar water quality characteristics to areas that are undisturbed by mining activities.	
• *if the Applicant should revise the Rehabilitation Strategy to include additional detailed information around the final void water levels and water quality, including an assessment of any potential beneficial uses for the water that could be considered following closure of the mine.*		
• *if the Applicant should quantify the water quality impacts offsite of the surface runoff (and any groundwater seeps) from the rehabilitated landform. This would include an assessment of the potential impact of the type of ecosystem to be developed on the site (e.g. woodland versus agriculture will have different implications for sediment delivery and thus transport of sorbed pollutants);*		

IPC Consideration	Whitehaven Commitment	Section of RTS
• *the Applicant's evidence of the trials that were taken for three different spoil properties that demonstrate that the change in spoil properties did not have an impact on the groundwater inflows;*	Additional information provided (no commitment required). The trials demonstrate there is predicted groundwater inflows to the final void are insensitive to adopted spoil properties.	
• *any available evidence (including such evidence as the Applicant may provide) to support final voids as a preferred landform outcome versus infill, and evidence of all risks associated with each landform outcome; and*	Additional information provided. The Project final void is considered to be environmentally and economically superior to alternative final landform options. Whitehaven commits to the following in regard to the final landform: • One final void that acts as a permanent groundwater sink (in addition to the existing Blue Vale void which would be retained). • Conducting ongoing review of the mine plan during operations such that the size of the final void (depth and area) and catchment area reporting to the final void is minimised as far as is reasonable and feasible. In this regard it is noted the Project final void would be an improvement in comparison to the Approved Mine, for which two final voids are approved at the completion of mining (in addition to the existing Blue Vale void).	Section 6.2.3.
• *the definition of the incremental long-term deep hard rock (i.e. non-alluvial) groundwater impacts (both head and flow) over the long-term (at least to the 300 years that it takes for the final void water levels to stabilise), particularly to the east of the Project where drawdowns interact with the drawdowns from the Rocglen Mine site.*	Additional information provided. Whitehaven commits to holding sufficient water licences to account for any post-mining take.	
11 HERITAGE		
• *the deficiencies identified by the Commission in the Applicant's engagement with the local traditional owners and the Aboriginal surveys; and*	Additional information provided (no commitment required). There were no deficiencies in the consultation conducted for the ACHA. The scarred tree reassessment reports prepared by Kamminga and Lance (2016) and Burns (2016) concluded that none of the identified scarred trees were of Aboriginal cultural origin. These reports were appended to the draft (and final) ACHA, which was provided to the Registered Aboriginal Parties (RAPs) for comment during each of the consultation periods as well as during the EIS public exhibition. The scarred tree reassessment reports, which concluded none of the identified scarred trees were of Aboriginal cultural origin, do not need to be provided to the AHIMS Registrar as there are no AHIMS site cards to be updated.	Section 6.11.3
• *how the Kurrumbede Homestead could be protected from the impacts of the Project, and details of the proposed Kurrumbede Homestead Management Plan, including timing and funding, to be provided by the Applicant.*	Whitehaven commits to avoiding direct adverse impacts to the Kurrumbede Homestead, with management and monitoring measures to be described in a Heritage Management Plan.	

IPC Consideration	Whitehaven Commitment	Section of RTS
12 SOCIAL AND ECONOMIC		
• *the impacts of a 'mining' based economy on that section of the community that does not receive 'mining' income;*	To minimise potential adverse socio-economic impacts to non-mining sections of the economy, Whitehaven commits to implement the strategies recommended by specialist social impact practitioner Elliot Whiteing (2018) in regard to: • maximising benefits to non-mining local business; • minimising the potential for labour shortages in other sectors; and • minimising potential impacts on housing availability and affordability.	Section 6.12.3.
• *all matters relevant to the economic contribution of the Project, including but not limited to:* – *assumptions used in the CBA in comparing the Approved Project to the Project, particularly in regard to the current consent conditions for the Approved Project relating to total combined output of the three mines (i.e. Approved Project, Tarrawonga and Rocglen Mines);* – *economic impact of the Approved Project scenario after accounting for the restrictions on output from the Rocglen and Tarrawonga Mines and current approval limitation of the Gunnedah CHPP;* – *incremental economic impact of the Project compared to the Approved Project, after taking account of the Approved Project 2014 consent conditions for combined mine output and the CHPP;* – *comparative economic assessment of the relocation of the CHPP 400 m east to accommodate a bund to the west of the CHPP, including impact on sterilisation of coal resources;* – *comparative economic assessment of the relocation of the CHPP and rail loop, to an alternative location in the south east (secondary infrastructure area); and*	Additional information provided (no commitment required). Key inputs to the Economic Assessment were independently reviewed by DPIE's Independent Peer Reviewer and DRG, who considered the analysis to be within expectations (or conservatively low) and prepared in accordance with relevant guidelines.	
• *the SIA risk assessment for post mining impacts could be expanded to provide more detail, particularly focused on transitional strategies for impacted communities such as Boggabri.*	Whitehaven commits to developing a Mine Closure Plan (or equivalent) three to five years in advance of the Project's anticipated closure date, which would inform mine closure planning and management of potential social impacts.	
13 VISUAL AMENITY		
• *mitigation options for those residences forecast to experience high visual impact, particularly from the waste emplacement areas during the mine's operation;*	At privately-owned residences where the Project would have a high visual impact, Whitehaven commits to implementing reasonable and feasible visual mitigation measures in consultation with the landowner.	Section 6.13.3.
• *requesting the Applicant to provide montages showing the proposed infrastructure and waste and coal handling areas superimposed on photographs of existing land forms, to be done from a number of vantage points;*		
• *the Applicant's ongoing consultation with the Siding Spring Observatory; and*	Whitehaven commits to implementing all reasonable and feasible measures to mitigate potential impacts from night-lighting (including sky glow) in consideration of the lighting principles outlined in the *Dark Sky Planning Guideline*.	
• *the potential night-time lighting impact on the Siding Spring Observatory, in line with the Department's Dark Sky Planning Guideline.*		

IPC Consideration	Whitehaven Commitment	Section of RTS
14 TRAFFIC AND TRANSPORT		
• *whether it would be appropriate to require that once the CHPP and rail spur is operational, all movement of product coal must be via the Project's rail spur; and*	Whitehaven commits to the movement of all product coal from the site via the Project rail spur once the rail spur and CHPP is fully commissioned (except in extraordinary circumstances, such as bushfire, with agreement from the Secretary).	Section 6.14.3
• *the available information/data on road and rail capacities and wait times at level crossings, and whether or not further information is required from the Applicant in this regard.*	Additional information provided (no commitment required). While the total delay per hour experienced by road traffic as a result of level crossing closures would increase due to the Project rail movements, the average delay experienced by an individual driver would not be changed, nor would the length of queues formed at level crossings.	
15 PUBLIC INTEREST		
• *how the Project adheres to the objects of the EP&A Act, in particular the principles of ESD;*	Additional information provided (no commitment required). Whitehaven considers that the consent authority can comfortably reach a conclusion that the benefits of the Project outweigh its impacts.	Section 6.15.3
• *the assessments which have been completed for the Project in relation to the forecast of direct and indirect GHG emissions (i.e. Scope 1, Scope 2 and Scope 3 emissions);*		
• *GHG emission forecasts provided by the Applicant having regard to current relevant climate change policy frameworks (e.g. NSW Climate Change Policy Framework and the Paris Agreement); and*		
• *the demand for product coal from the Project and whether its sale will be to a country that is a signatory to the Paris Agreement.*		

ATTACHMENT 4

PROJECT EMISSIONS INVENTORIES

Vickery Extension - Year 3 TSP emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	2,213	76,315	t/y	0.029	kg/t	11	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	20	76,315	t/y	0.0003	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling	817	76,315	t/y	0.107	kg/t	220	t/load	274	Vehicle gross mass (t)	5	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
	Unloading trucks	20	76,315	t/y	0.0003	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	21,447	36,350	holes/y	0.59	kg/hole												
	Blasting	17,277	169	blast/y	102.2	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	88,462	78,200,000	t/y	0.0006	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3	2	times re-handled						
	Hauling	465,876	78,200,000	t/y	0.060	kg/t	315	t/load	371	Vehicle gross mass (t)	3	km/return trip	5.8	kg/VKT	4	% silt content	90	watering
	Unloading trucks	44,231	78,200,000	t/y	0.0006	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	62,417	28,476	h/y	2.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	20,806	9,492	h/y	2.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	276,735	23,730	h/y	11.7	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	240,278	2,653,409	t/y	0.0906	kg/t	4.7	moisture content in %										
	Hauling	86,654	2,653,409	t/y	0.327	kg/t	220	t/load	274	Vehicle gross mass (t)	14	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	868	2,653,409	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	9,992	2,856	h/y	11.7	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	1,592	2,653,409	t/y	0.0006	kg/t												controlled EF (wet supression)
	Screening	2,919	2,653,409	t/y	0.0011	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	2,045	1,459,375	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	167	1,194,034	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	325	1,215,254	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	558	1,194,034	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	644	2,409,288	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	644	2,409,288	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Tarrawonga coal	Unload to hopper / ROM pad	981	3,000,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	1,800	3,000,000	t/y	0.0006	kg/t												controlled EF (wet supression)
	Screening	3,300	3,000,000	t/y	0.0011	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	2,313	1,650,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	189	1,350,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	354	1,324,950	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	631	1,350,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	715	2,674,950	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	715	2,674,950	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Rocglen coal	Unload to hopper / ROM pad	213	650,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	390	650,000	t/y	0.0006	kg/t												controlled EF (wet supression)
	Screening	715	650,000	t/y	0.0011	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	501	357,500	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	41	292,500	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	77	287,073	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	137	292,500	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	155	579,573	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	155	579,573	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	95,064	14,238	h/y	6.7	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	22,106	244,121	t/y	0.0906	kg/t	4.7	moisture content in %										
	Hauling	7,972	244,121	t/y	0.327	kg/t	220	t/load	274	Vehicle gross mass (t)	14	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
	Unload to dump	114	244,121	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	9,401	11	ha	850	kg/ha/yr												
	Active pit	41,824	49	ha	850	kg/ha/yr												
	Active dump	292,507	344	ha	850	kg/ha/yr												
	Inactive dump	0	0	ha	850	kg/ha/yr											85	crusting
	Active rehab	0	0	ha	850	kg/ha/yr											95	seeding
	Soil stockpiles	1,832	6	ha	850	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	255,442	12	ha	4.86	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	170,294	8	ha	4.86	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	58,420	189,840	km	0.615	kg/km	8	speed of graders in km/h	23,730	grader hours							50	watering
	Total (kg/yr)	**2,315,367**																

Vickery Extension - Year 3 PM_{10} emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	1,107	76,315	t/y	0.015	kg/t	11	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	9	76,315	t/y	0.0001	kg/t	7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling (controlled wheel generated emis	207	76,315	t/y	0.026	kg/t	220	t/load	273.5	Vehicle gross mass (t	4.6	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
	Unloading trucks	9	76,315	t/y	0.0001	kg/t	7	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	11,152	36,350	holes/y	0.31	kg/hole	0											
	Blasting	8,984	169	blast/y	53.2	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	41,840	78,200,000	t/y	0.0003	kg/t	4	moisture content in %	1.3	(wind speed/2.2)^1.3	2	times re-handled						
	Hauling (controlled wheel generated emis	120,271	78,200,000	t/y	0.015	kg/t	315	t/load	370.5	Vehicle gross mass (t	3.2	km/return trip	1.44	kg/VKT	4	% silt content	90	watering
	Unloading trucks	20,920	78,200,000	t/y	0.0003	kg/t	4	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	10,665	28,476	h/y	0.4	kg/h	4	moisture content in %	4.0	silt content in %								
	Dozers - Dump	3,555	9,492	h/y	0.4	kg/h	4	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	63,985	23,730	h/y	2.7	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	29,459	2,653,409	t/y	0.0111	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	21,491	2,653,409	t/y	0.080	kg/t	220.0	t/load	273.5	Vehicle gross mass (t	14.1	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	410	2,653,409	t/y	0.00022	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	2,310	2,856	h/y	2.7	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	716	2,653,409	t/y	0.00027	kg/t												controlled EF (wet supression)
	Screening	982	2,653,409	t/y	0.00037	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	967	1,459,375	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	79	1,194,034	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	154	1,215,254	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	264	1,194,034	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	305	2,409,288	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	305	2,409,288	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Tarrawonga coal	Unload to hopper / ROM pad	464	3,000,000	t/y	0.00022	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	810	3,000,000	t/y	0.00027	kg/t												controlled EF (wet supression)
	Screening	1,110	3,000,000	t/y	0.00037	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	1,094	1,650,000	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	89	1,350,000	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	168	1,324,950	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	298	1,350,000	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	338	2,674,950	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	338	2,674,950	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Rocglen coal	Unload to hopper / ROM pad	101	650,000	t/y	0.00022	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	176	650,000	t/y	0.00027	kg/t												controlled EF (wet supression)
	Screening	241	650,000	t/y	0.00037	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	237	357,500	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	19	292,500	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	36	287,073	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	65	292,500	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	73	579,573	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	73	579,573	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	21,980	14,238	h/y	1.5	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	2,710	244,121	t/y	0.0111	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	1,977	244,121	t/y	0.080	kg/t	220.0	t/load	273.5	Vehicle gross mass (t	14.1	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
	Unload to dump	54	244,121	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	4,701	11	ha	425	kg/ha/yr												
	Active pit	20,912	49	ha	425	kg/ha/yr												
	Active dump	146,254	344	ha	425	kg/ha/yr												
	Inactive dump	0	0	ha	425	kg/ha/yr											85	crusting
	Active rehab	0	0	ha	425	kg/ha/yr											95	seeding
	Soil stockpiles	916	6	ha	425	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	127,721	12	ha	2.43	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	85,147	8	ha	2.43	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	20,412	189,840	km	0.215	kg/km	8	speed of graders in km	23,730	grader hours							50	watering
	Total (kg/yr)	**778,661**																

Vickery Extension - Year 3 $PM_{2.5}$ emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	232	76,315	t/y	0.003	kg/t	11	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	1	76,315	t/y	0.0000	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling (controlled wheel generated emis	25	76,315	t/y	0.003	kg/t	220	t/load	274	Vehicle gross mass (t	4.6	km/return trip	0.13	kg/VKT	4	% silt content	90	watering
	Unloading trucks	1	76,315	t/y	0.0000	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	643	36,350	holes/y	0.02	kg/hole												
	Blasting	518	169	blast/y	3.1	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	6,336	78,200,000	t/y	0.0000	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3	2	times re-handled						
	Hauling (controlled wheel generated emis	17,062	78,200,000	t/y	0.001	kg/t	315	t/load	371	Vehicle gross mass (t	3.2	km/return trip	0.14	kg/VKT	4	% silt content	90	watering
	Unloading trucks	3,168	78,200,000	t/y	0.0000	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	6,554	28,476	h/y	0.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	2,185	9,492	h/y	0.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	6,088	23,730	h/y	0.3	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	4,565	2,653,409	t/y	0.0017	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	2,320	2,653,409	t/y	0.008	kg/t	220	t/load	274	Vehicle gross mass (t	14.1	km/return trip	0.13	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	62	2,653,409	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	220	2,856	h/y	0.3	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	133	2,653,409	t/y	0.00005	kg/t												controlled EF (wet supression)
	Screening	66	2,653,409	t/y	0.00003	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	146	1,459,375	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water spray
	Transfer 45% to Bypass circuit	12	1,194,034	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water spray
	Loading product stockpile from CHPP	23	1,215,254	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	40	1,194,034	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	46	2,409,288	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	46	2,409,288	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Tarrawonga coal	Unload to hopper / ROM pad	70	3,000,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	150	3,000,000	t/y	0.00005	kg/t												controlled EF (wet supression)
	Screening	75	3,000,000	t/y	0.00003	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	166	1,650,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water spray
	Transfer 45% to Bypass circuit	14	1,350,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water spray
	Loading product stockpile from CHPP	25	1,324,950	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	45	1,350,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	51	2,674,950	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	51	2,674,950	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Rocglen coal	Unload to hopper / ROM pad	15	650,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	33	650,000	t/y	0.00005	kg/t												controlled EF (wet supression)
	Screening	16	650,000	t/y	0.00003	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	36	357,500	t/y	0.00003	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water spray
	Transfer 45% to Bypass circuit	3	292,500	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water spray
	Loading product stockpile from CHPP	5	287,073	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	10	292,500	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	11	579,573	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	11	579,573	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	2,091	14,238	h/y	0.1	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	420	244,121	t/y	0.0017	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	213	244,121	t/y	0.008	kg/t	220	t/load	274	Vehicle gross mass (t	14.1	km/return trip	0.13	kg/VKT	4	% silt content	90	watering
	Unload to dump	8	244,121	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	705	11	ha	64	kg/ha/yr												
	Active pit	3,137	49	ha	64	kg/ha/yr												
	Active dump	21,938	344	ha	64	kg/ha/yr												
	Inactive dump	0	0	ha	64	kg/ha/yr											85	crusting
	Active rehab	0	0	ha	64	kg/ha/yr											95	seeding
	Soil stockpiles	137	6	ha	64	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	19,158	12	ha	0.36	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	12,772	8	ha	0.36	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	1,811	189,840	km	0.019	kg/km	8	speed of graders in km	23,730	grader hours							50	watering
	Total PM (kg/yr)	**113,675**																

Vickery Extension - Year 7 TSP emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	1,437	49,547	t/y	0.029	kg/t	7	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	13	49,547	t/y	0.0003	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling	1,849	49,547	t/y	0.373	kg/t	220	t/load	274	Vehicle gross mass (t	16	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
	Unloading trucks	13	49,547	t/y	0.0003	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	56,139	95,152	holes/y	0.59	kg/hole												
	Blasting	45,225	442	blast/y	102.2	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	231,562	204,700,000	t/y	0.0006	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3	2	times re-handled						
	Hauling	2,314,846	204,700,000	t/y	0.113	kg/t	315	t/load	371	Vehicle gross mass (t	6	km/return trip	5.8	kg/VKT	4	% silt content	90	watering
	Unloading trucks	115,781	204,700,000	t/y	0.0006	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	83,223	37,968	h/y	2.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	31,209	14,238	h/y	2.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	332,082	28,476	h/y	11.7	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	757,695	8,367,274	t/y	0.0906	kg/t	4.7	moisture content in %										
	Hauling	211,996	8,367,274	t/y	0.253	kg/t	220	t/load	274	Vehicle gross mass (t	11	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	2,736	8,367,274	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	9,992	2,856	h/y	11.7	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	5,020	8,367,274	t/y	0.0006	kg/t												controlled EF (wet supression)
	Screening	9,204	8,367,274	t/y	0.0011	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	6,450	4,602,001	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water spray
	Transfer 45% to Bypass circuit	528	3,765,273	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water spray
	Loading product stockpile from CHPP	1,017	3,802,493	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	1,759	3,765,273	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	2,024	7,567,766	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	2,024	7,567,766	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Tarrawonga coal	Unload to hopper / ROM pad	981	3,000,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	1,800	3,000,000	t/y	0.0006	kg/t												controlled EF (wet supression)
	Screening	3,300	3,000,000	t/y	0.0011	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	2,313	1,650,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water spray
	Transfer 45% to Bypass circuit	189	1,350,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water spray
	Loading product stockpile from CHPP	354	1,324,950	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	631	1,350,000	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	715	2,674,950	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	715	2,674,950	t/y	0.0003	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	95,064	14,238	h/y	6.7	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	79,299	875,705	t/y	0.0906	kg/t	4.7	moisture content in %										
	Hauling	22,187	875,705	t/y	0.253	kg/t	220	t/load	274	Vehicle gross mass (t	11	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
	Unload to dump	409	875,705	t/y	0.0005	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	6,104	7	ha	850	kg/ha/yr												
	Active pit	144,919	170	ha	850	kg/ha/yr												
	Active dump	367,009	432	ha	850	kg/ha/yr												
	Inactive dump	82,577	648	ha	850	kg/ha/yr											85	crusting
	Active rehab	1,056	25	ha	850	kg/ha/yr											95	seeding
	Soil stockpiles	2,400	8	ha	850	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	255,442	12	ha	4.86	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	170,294	8	ha	4.86	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	70,104	227,808	km	0.615	kg/km	8	speed of graders in km	28476	grader hours							50	watering
	Total (kg/yr)	**5,531,688**																

Vickery Extension - Year 7 PM_{10} emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	718	49,547	t/y	0.015	kg/t	7	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	6	49,547	t/y	0.0001	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling (controlled wheel generated emis	459	49,547	t/y	0.092	kg/t	220	t/load	274	Vehicle gross mass (t	16.1	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
	Unloading trucks	6	49,547	t/y	0.0001	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	29,193	95,152	holes/y	0.31	kg/hole												
	Blasting	23,517	442	blast/y	53.2	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	109,523	204,700,000	t/y	0.0003	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3	2.0	times re-handled						
	Hauling (controlled wheel generated emis	586,966	204,700,000	t/y	0.028	kg/t	315	t/load	371	Vehicle gross mass (t	6.1	km/return trip	1.44	kg/VKT	4	% silt content	90	watering
	Unloading trucks	54,761	204,700,000	t/y	0.0003	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	14,219	37,968	h/y	0.4	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	5,332	14,238	h/y	0.4	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	76,783	28,476	h/y	2.7	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	92,897	8,367,274	t/y	0.0111	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	52,836	8,367,274	t/y	0.062	kg/t	220	t/load	274	Vehicle gross mass (t	10.9	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	1,294	8,367,274	t/y	0.00022	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	2,310	2,856	h/y	2.7	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	2,259	8,367,274	t/y	0.00027	kg/t												controlled EF (wet supression)
	Screening	3,096	8,367,274	t/y	0.00037	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	3,051	4,602,001	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	250	3,765,273	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	481	3,802,493	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	832	3,765,273	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	957	7,567,766	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	957	7,567,766	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Tarrawonga coal	Unload to hopper / ROM pad	464	3,000,000	t/y	0.00022	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	810	3,000,000	t/y	0.00027	kg/t												controlled EF (wet supression)
	Screening	1,110	3,000,000	t/y	0.00037	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	1,094	1,650,000	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	89	1,350,000	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	168	1,324,950	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	298	1,350,000	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	338	2,674,950	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	338	2,674,950	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	21,980	14,238	h/y	1.54	kg/h	7	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	9,722	875,705	t/y	0.0111	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	5,530	875,705	t/y	0.062	kg/t	220	t/load	274	Vehicle gross mass (t	10.9	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
	Unload to dump	193	875,705	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	3,052	7	ha	425	kg/ha/yr												
	Active pit	72,460	170	ha	425	kg/ha/yr												
	Active dump	183,504	432	ha	425	kg/ha/yr												
	Inactive dump	41,288	648	ha	425	kg/ha/yr											85	crusting
	Active rehab	528	25	ha	425	kg/ha/yr											95	seeding
	Soil stockpiles	1,200	8	ha	425	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	127,721	12	ha	2.43	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	85,147	8	ha	2.43	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	24,494	227,808	km	0.215	kg/km	8	speed of graders in km	28,476	grader hours							50	watering
	Total (kg/yr)	**1,644,234**																

Vickery Extension - Year 7 $PM_{2.5}$ emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	151	49,547	t/y	0.003	kg/t	7	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	1	49,547	t/y	0.0000	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling (controlled wheel generated emis	50	49,547	t/y	0.009	kg/t	220	t/load	274	Vehicle gross mass (t	16.1	km/return trip	0.13	kg/VKT	4	% silt conten	90	watering
	Unloading trucks	0.9	49,547	t/y	0.0000	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	1,684	95,152	holes/y	0.02	kg/hole												
	Blasting	1,357	442	blast/y	3.1	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	16,585	204,700,000	t/y	0.0000	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3	2	times re-handled						
	Hauling (controlled wheel generated emis	74,463	204,700,000	t/y	0.003	kg/t	315	t/load	371	Vehicle gross mass (t	6.1	km/return trip	0.14	kg/VKT	4	% silt conten	90	watering
	Unloading trucks	8,292	204,700,000	t/y	0.0000	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	8,738	37,968	h/y	0.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	3,277	14,238	h/y	0.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	7,306	28,476	h/y	0.3	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	14,396	8,367,274	t/y	0.0017	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	5,928	8,367,274	t/y	0.006	kg/t	220	t/load	274	Vehicle gross mass (t	10.9	km/return trip	0.13	kg/VKT	4	% silt conten	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	196	8,367,274	t/y	0.00003	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	220	2,856	h/y	0.3	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	418	8,367,274	t/y	0.00005	kg/t												controlled EF (wet supression)
	Screening	209	8,367,274	t/y	0.00003	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	462	4,602,001	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water spra
	Transfer 45% to Bypass circuit	38	3,765,273	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water spra
	Loading product stockpile from CHPP	73	3,802,493	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	126	3,765,273	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	145	7,567,766	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	145	7,567,766	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
Tarrawonga coal	Unload to hopper / ROM pad	70	3,000,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Crushing	150	3,000,000	t/y	0.00005	kg/t												controlled EF (wet supression)
	Screening	75	3,000,000	t/y	0.00003	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	166	1,650,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water spra
	Transfer 45% to Bypass circuit	14	1,350,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water spra
	Loading product stockpile from CHPP	25	1,324,950	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	45	1,350,000	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	51	2,674,950	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	51	2,674,950	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	2,091	14,238	h/y	0.1	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	1,507	875,705	t/y	0.0017	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	620	875,705	t/y	0.006	kg/t	220	t/load	274	Vehicle gross mass (t	10.9	km/return trip	0.13	kg/VKT	4	% silt conten	90	watering
	Unload to dump	29	875,705	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	458	7	ha	64	kg/ha/yr												
	Active pit	10,869	170	ha	64	kg/ha/yr												
	Active dump	27,526	432	ha	64	kg/ha/yr												
	Inactive dump	6,193	648	ha	64	kg/ha/yr											85	crusting
	Active rehab	79	25	ha	64	kg/ha/yr											95	seeding
	Soil stockpiles	180	8	ha	64	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	19,158	12	ha	0.36	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	12,772	8	ha	0.36	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	2,173	227,808	km	0.019	kg/km	8	speed of graders in km	28,476	grader hours							50	watering
	Total (kg/yr)	**228,564**																

Vickery Extension - Year 21 TSP emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	6,395	220,516	t/y	0.029	kg/t	32	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	58	220,516	t/y	0.0003	kg/t	7.1	moisture content in %	1.305	(wind speed/2.2)^1.3								
	Hauling	4,059	220,516	t/y	0.184	kg/t	220	t/load	274	Vehicle gross mass (t	8	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
	Unloading trucks	58	220,516	t/y	0.0003	kg/t	7.1	moisture content in %	1.305	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	59,924	101,566	holes/y	0.59	kg/hole												
	Blasting	48,274	472	blast/y	102.2	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	247,173	218,500,000	t/y	0.0006	kg/t	4.1	moisture content in %	1.31	(wind speed/2.2)^1.3	2	times re-handled						
	Hauling	1,986,030	218,500,000	t/y	0.091	kg/t	315	t/load	371	Vehicle gross mass (t	5	km/return trip	5.8	kg/VKT	4	% silt content	90	watering
	Unloading trucks	123,587	218,500,000	t/y	0.0006	kg/t	4.1	moisture content in %	1.31	(wind speed/2.2)^1.3								
	Dozers - Pit	83,223	37,968	h/y	2.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	31,209	14,238	h/y	2.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	332,082	28,476	h/y	11.7	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	892,481	9,855,724	t/y	0.0906	kg/t	4.7	moisture content in %										
	Hauling	139,170	9,855,724	t/y	0.141	kg/t	220	t/load	274	Vehicle gross mass (t	6	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	3,223	9,855,724	t/y	0.0005	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	9,992	2,856	h/y	11.7	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	5,913	9,855,724	t/y	0.0006	kg/t												controlled EF (wet supression)
	Screening	10,841	9,855,724	t/y	0.0011	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	7,597	5,420,648	t/y	0.0005	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	622	4,435,076	t/y	0.0005	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	1,167	4,361,337	t/y	0.0003	kg/t	7.0	moisture content in %	1.31	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	2,072	4,435,076	t/y	0.0005	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3								
	Product coal transfer station	2,353	8,796,413	t/y	0.0003	kg/t	7.0	moisture content in %	1.31	(wind speed/2.2)^1.3								
	Loading trains	2,353	8,796,413	t/y	0.0003	kg/t	7.0	moisture content in %	1.31	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	95,064	14,238	h/y	6.7	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	95,926	1,059,311	t/y	0.0906	kg/t	4.7	moisture content in %										
	Hauling	14,958	1,059,311	t/y	0.141	kg/t	220	t/load	274	Vehicle gross mass (t	6	km/return trip	5.1	kg/VKT	4	% silt content	90	watering
	Unload to dump	495	1,059,311	t/y	0.0005	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	27,165	32	ha	850	kg/ha/yr												
	Active pit	168,968	199	ha	850	kg/ha/yr												
	Active dump	329,610	388	ha	850	kg/ha/yr												
	Inactive dump	74,162	582	ha	850	kg/ha/yr											85	crusting
	Active rehab	5,985	141	ha	850	kg/ha/yr											95	seeding
	Soil stockpiles	2,400	8	ha	850	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	255,442	12	ha	4.86	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	170,294	8	ha	4.86	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	70,104	227,808	km	0.615	kg/km	8	speed of graders in km	28,476	grader hours							50	watering
	Total (kg/yr)	**5,310,428**																

Vickery Extension - Year 21 PM_{10} emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	3,197	220,516	t/y	0.015	kg/t	32	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	27	220,516	t/y	0.0001	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling (controlled wheel generated emis	1,019	220,516	t/y	0.045	kg/t	220	t/load	274	Vehicle gross mass (t	7.9	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
	Unloading trucks	27	220,516	t/y	0.0001	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	31,161	101,566	holes/y	0.31	kg/hole												
	Blasting	25,103	472	blast/y	53.2	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	116,906	218,500,000	t/y	0.0003	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3	2.0	times re-handled						
	Hauling (controlled wheel generated emis	509,274	218,500,000	t/y	0.022	kg/t	315	t/load	371	Vehicle gross mass (t	4.9	km/return trip	1.44	kg/VKT	4	% silt content	90	watering
	Unloading trucks	58,453	218,500,000	t/y	0.0003	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	14,219	37,968	h/y	0.4	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	5,332	14,238	h/y	0.4	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	76,783	28,476	h/y	2.7	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	109,423	9,855,724	t/y	0.0111	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	35,157	9,855,724	t/y	0.035	kg/t	220	t/load	274	Vehicle gross mass (t	6.1	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	1,524	9,855,724	t/y	0.00022	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	2,310	2,856	h/y	2.7	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	2,661	9,855,724	t/y	0.00027	kg/t												controlled EF (wet supression)
	Screening	3,647	9,855,724	t/y	0.00037	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	3,593	5,420,648	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	294	4,435,076	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	552	4,361,337	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	980	4,435,076	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	1,113	8,796,413	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	1,113	8,796,413	t/y	0.0001	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	21,980	14,238	h/y	1.5	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	11,761	1,059,311	t/y	0.0111	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	3,779	1,059,311	t/y	0.035	kg/t	220	t/load	274	Vehicle gross mass (t	6.1	km/return trip	1.25	kg/VKT	4	% silt content	90	watering
	Unload to dump	234	1,059,311	t/y	0.0002	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	13,583	32	ha	425	kg/ha/yr												
	Active pit	84,484	199	ha	425	kg/ha/yr												
	Active dump	164,805	388	ha	425	kg/ha/yr												
	Inactive dump	37,081	582	ha	425	kg/ha/yr											85	crusting
	Active rehab	2,992	141	ha	425	kg/ha/yr											95	seeding
	Soil stockpiles	1,200	8	ha	425	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	127,721	12	ha	2.43	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	85,147	8	ha	2.43	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	24,494	227,808	km	0.215	kg/km	8	speed of graders in km	28,476	grader hours							50	watering
	Total (kg/yr)	**1,583,130**																

Vickery Extension - Year 21 $PM_{2.5}$ emission estimates

Pit	Activity	Emission estimate (kg/year)	Intensity	Units	Emission Factor	Units	Variable 1		Variable 2		Variable 3		Variable 4		Variable 5		Control %	Control
Topsoil Stripping																		
Vickery OC	Stripping	671	220,516	t/y	0.003	kg/t	32	area in ha	0.3	depth stripped in m								
	Ex/FEL loading trucks	4	220,516	t/y	0.0000	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Hauling (controlled wheel generated emis	121	220,516	t/y	0.005	kg/t	220	t/load	274	Vehicle gross mass (t	7.9	km/return trip	0.13	kg/VKT	4	% silt content	90	watering
	Unloading trucks	4	220,516	t/y	0.0000	kg/t	7.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
Overburden removal and dumping																		
Vickery OC	Drilling	1,798	101,566	holes/y	0.02	kg/hole												
	Blasting	1,448	472	blast/y	3.1	kg/blast	6,000	Area of blast (m2)										
	Ex/FEL loading trucks	17,703	218,500,000	t/y	0.0000	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3	2	times re-handled						
	Hauling (controlled wheel generated emis	69,400	218,500,000	t/y	0.002	kg/t	315	t/load	371	Vehicle gross mass (t	4.9	km/return trip	0.14	kg/VKT	4	% silt content	90	watering
	Unloading trucks	8,851	218,500,000	t/y	0.0000	kg/t	4.1	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Dozers - Pit	8,738	37,968	h/y	0.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
	Dozers - Dump	3,277	14,238	h/y	0.2	kg/h	4.1	moisture content in %	4.0	silt content in %								
Coal removal																		
Vickery OC	Dozer ripping	7,306	28,476	h/y	0.3	kg/h	4.7	moisture content in %	2.4	silt content in %								
	Ex/FEL loading trucks	16,957	9,855,724	t/y	0.0017	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	4,349	9,855,724	t/y	0.003	kg/t	220	t/load	274	Vehicle gross mass (t	6.1	km/return trip	0.13	kg/VKT	4	% silt content	90	watering
Coal processing																		
Vickery coal	Unload to hopper / ROM pad	231	9,855,724	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							30	minimise drop ht (10m to 5m)
	Rehandle - ROM to hopper	220	2,856	h/y	0.3	kg/h	4.7	moisture content in %	2.4	silt content in %							70	enclosure (3 sides and roof)
	Crushing	493	9,855,724	t/y	0.00005	kg/t												controlled EF (wet supression)
	Screening	246	9,855,724	t/y	0.00003	kg/t												controlled EF (wet supression)
	Transfer 55% to processing plant (CHPP)	544	5,420,648	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3	10	transfer points					70	40% for wind shielding plus 50% for water sprays
	Transfer 45% to Bypass circuit	45	4,435,076	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3							70	40% for wind shielding plus 50% for water sprays
	Loading product stockpile from CHPP	84	4,361,337	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading product stockpile from Bypass	148	4,435,076	t/y	0.00003	kg/t	4.7	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Product coal transfer station	169	8,796,413	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
	Loading trains	169	8,796,413	t/y	0.00002	kg/t	7.0	moisture content in %	1.3	(wind speed/2.2)^1.3								
All coal	Product stockpile reclaim (dozers)	2,091	14,238	h/y	0.1	kg/h	7.0	moisture content in %	2.4	silt content in %								
Coarse rejects																		
Coarse rejects	Ex/FEL loading trucks	1,823	1,059,311	t/y	0.0017	kg/t	4.7	moisture content in %										
	Hauling (controlled wheel generated emis	467	1,059,311	t/y	0.003	kg/t	220	t/load	274	Vehicle gross mass (t	6.1	km/return trip	0.13	kg/VKT	4	% silt content	90	watering
	Unload to dump	35	1,059,311	t/y	0.00003	kg/t	4.7	moisture content in %	1.31	(wind speed/2.2)^1.3								
Wind erosion of exposed ground																		
Vickery OC	Pre-strip	2,037	32	ha	64	kg/ha/yr												
	Active pit	12,673	199	ha	64	kg/ha/yr												
	Active dump	24,721	388	ha	64	kg/ha/yr												
	Inactive dump	5,562	582	ha	64	kg/ha/yr											85	crusting
	Active rehab	449	141	ha	64	kg/ha/yr											95	seeding
	Soil stockpiles	180	8	ha	64	kg/ha/yr											65	crusting
Stockpile wind erosion and maintenance																		
	ROM stockpiles	19,158	12	ha	0.36	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
	Product Stockpiles	12,772	8	ha	0.36	kg/ha/h	8,760	h/y	2.7	ave wind speed (m/s)							50	watering
Miscellaneous																		
	Grading roads	2,173	227,808	km	0.019	kg/km	8	speed of graders in km	28,476	grader hours							50	watering
	Total (kg/yr)	**227,117**																

ATTACHMENT 5

SOIL TEST PIT RESULTS

Table A5-1
Overview Data

Field site #	Map site #	Site description	Land use/vegetation type	Landscape features	Easting, m WGS84	Northing, m WGS84	Australian Soil Classification	Depth to rock (cm)	Depth to permeable gravel/sand (cm)	TAW (0-100 cm), (mm)	Depth to mottled layer (cm)	Other comments
43	2	Canyon rehab	Sparse pasture	Upper slope	56228952	6595283	Spolic Anthroposol	140		94		Crust 7mm thick; pale fine sand; disp.=1; S'pak 0.3
42	3	Canyon rehab	Vigorous tropical grasses	Plateau on ridge	56229730	6595620	Spolic Anthroposol	>140		109	45	90-120 = 108-120 sample
41	4	Canyon rehab	Sparse pasture	Mid-slope	56229807	6595049	Spolic Anthroposol	>140		95		Upper 25 cm contour bank; ant activity at 1 m
70	30	Vickery	Good pasture cover on disturbed land	Near dam.	56230470	6593056	Spolic Anthroposol	>140		100	25	Bags of soil; 0-10, 10-25, 25-40, 60-90
35	31	Vickery - rehab	Pasture	Upper slope	56231120	6593221	Spolic Anthroposol	>140		44		
36	35	Vickery - rehab	Pasture	Lower slope	56229421	6592500	Spolic Anthroposol	25		24		Coal/chitter layer 25+
17	36	Vickery (in valley)	Excellent pasture cover (90%)	Flat alluvial terrace	56230159	6592483	Red Ferrosol	>140		121	85	Numerous biopores 35-60 cm
34	37	Vickery - rehab	Pasture	Plateau on ridge	56230894	6592596	Spolic Anthroposol	>140		75		Ant activity
37	41	Vickery - rehab	Pasture	Mid slope	56229854	6591803	Spolic Anthroposol	18		24		
69	42	Vickery	Poor quality sown pasture (Rhodes grass *[chloris gayana]*) near box and ironbark trees; 50% stones on surface	Mid-slope	56230477	6592112	Red Dermosol	60		49	35	Parent material = conglomerate
33	43	Vickery - rehab near sheds	Pasture	Upper slope	56231054	6591910	Spolic Anthroposol	>140		69		Strongly compacted 25-30 cm
38	51	Vickery - rehab	Sparse tropical grass; weeds dominant	Upper slope	56231291	6591330	Spolic Anthroposol	15		17		

Source: Mackenzie Soil Management (2012).
m = metres; cm = centimetres; mm = millimetres; TAW = TAW = Total Available Water; % = percent; dS/m = deciSiemens per metre

Table A5-2
Layer Data

Pit	Horizon	Lower Depth (cm)	Texture	pH Water	Moist Soil Colour (Munsell)	Colour	Mottles	SOILpak Compaction Score	Gravel (%)	Dispersion 10 min.	Moisture	Lime %	Lime Type	Root Score
2	A1	20	Light medium clay	8.0	7.5YR4/2	Brown		1.1	1	1	Slight			2
2	2B	40	Light clay	9.0	7.5YR5/4	Brown		0.4	1	1	Slight	2	N	1
2	3B	58	Sandy light clay	9.5	7.5YR5/4	Brown		1.0	2	1	Slight	5	N	1
2	4B	140	Sandy light clay	8.0	10YR6/4	Light yellowish brown		1.2	2	0	Slight	5	D	1 (75)
2	5BC	150+	Gravel						99					
3	A11	10	Light medium clay	9.0	5YR4/4	Reddish brown		1.8	2	2	Moist	2	D	3
3	A12	35	Heavy clay	9.5	5YR4/6	Yellowish red		1.4	1	3	Moist	4	D	4
3	2B	45	Medium heavy clay	10.0	10YR7/3	Very pale brown		1.5	2	3	Moist	8	D	4
3	3B	108	Medium clay	10.0	10YR6/3	Pale brown	Yellow	1.4	15	3	Moist	5	D	2
3	4A	120	Sandy light clay	9.5	5YR5/6	Yellowish red		1.6	10	0	Moist	2	D	2
3	5BC	140+	Sandy light clay	9.0	10YR5/2	Greyish brown		1.4	30	0	Slight/Moist	2	D	2
4	A1	45	Medium clay	10.0	7.5YR4/4	Brown		1.6	2	3	Moist	5	D	3
4	2A	60	Light medium clay	10.0	7.5YR5/6	Strong brown		0.7	4	1	Slight/Moist	3	D	2
4	3BC1	80	Sandy clay loam	10.0	10YR6/3	Pale brown		1.2	20	1	Slight/Moist	1	D	1
4	3BC2	140+	Sandy clay loam	10.0	10YR7/3	Very pale brown		1.0	15	1	Moist	1	D	1
30	A11	10	Sandy clay loam	6.0	5YR3/2	Dark reddish brown		1.8	10	0	Slight/Moist			3
30	A12	25	Sandy clay loam	6.5	7.5YR4/3	Brown		1.4	15	0	Slight/Moist			1
30	B2	40	Heavy clay	7.5	10YR5/4	Strong grey	Grey	0.5	2	3	Moist			0.5 (100)
30	2B21	75	Light clay	9.0	5YR5/6	Yellowish red		0.7	5	2	Slight			0
30	2B22	140+	Light medium clay	9.5	10YR5/6	Yellowish brown		0.5	2	0	Slight	2	N	0

Pit	Horizon	Lower Depth (cm)	Texture	pH Water	Moist Soil Colour (Munsell)	Colour	Mottles	SOILpak Compaction Score	Gravel (%)	Dispersion 10 min.	Moisture	Lime %	Lime Type	Root Score
31	A1	15	Sandy clay loam	7.5	7.5YR4/4	Brown		1.3	25	0	Moist			3
31	2B	60	Sandy clay loam	8.5	10YR5/4	Yellowish brown		1.2	90	0	Slight	5	D	2
31	3B	140+	Sandy clay loam	10.0	10YR7/3	Very pale brown		1.3	70	2	Slight/Moist	2	D	1
35	A11	10	Sandy loam	6.0	7.5YR4/3	Brown		1.2	20		Slight/Moist			4
35	A12	25	Sandy loam	6.0	7.5YR4/6	Strong brown		1.2	40		Slight			3
35	C	140+	COAL/COARSE MATERIAL											1 (40)
36	A1	12	Sandy clay loam	6.0	7.5YR3/3	Dark brown		1.6	1	0	Slight			2
36	B21	60	Light clay	7.0	2.5YR4/6	Red		1.3	1	0	Slight			2
36	B22	85	Light clay	7.0	7.5YR5/6	Strong brown		1.6	3	0	Slight/Moist			2
36	B23	140+	Light medium clay	7.0	7.5YR5/8	Strong brown	Slight grey & yellow	1.0	10	0	Slight/Moist			1 (110)
37	A11	18	Sandy light clay	8.0	7.5YR4/4	Brown		1.7	2	0	Moist			4
37	A12	28	Sandy clay loam	7.5	7.5YR4/4	Brown		0.2	10	0	Slight			0.5
37	2B	90	Light medium clay	10.0	10YR5/1	Grey		1.3	50	1	Slight			1
37	3B	120	Loamy sand	10.0	10YR7/6	Yellow		1.3	70	0	Slight/Moist			0
37	4B	140+	Loamy sand	10.0	10YR7/2	Light grey			8	0	Slight/Moist			0
41	A	18	Sandy loam	7.0	7.5YR5/4	Brown		1.5	15		Slight/Moist	5	D	4
41	B/C	140+	Sandy loam	10.0	10YR6/3	Pale brown		1.2	98		Slight/Moist			1
42	A1	10	Sandy loam	5.5	5YR3/2	Dark reddish brown		1.3	40	1	Slight/Moist			2
42	A3	35	Sandy loam	6.0	5YR5/4	Reddish brown		1.0	30	2	Slight			2
42	B2	60	Sandy clay loam	7.5	5YR4/6	Yellowish red	Strong yellow grey	1.1	60	0	Slight/Moist			2

Pit	Horizon	Lower Depth (cm)	Texture	pH Water	Moist Soil Colour (Munsell)	Colour	Mottles	SOILpak Compaction Score	Gravel (%)	Dispersion 10 min.	Moisture	Lime %	Lime Type	Root Score
42	C	80+							CONGLO-MERATE					0
43	A1	15	Sandy light clay	7.0	5YR3/3	Dark reddish brown		1.6	3	2	Moist			4
43	B31	30	Sandy light clay	9.5	10YR6/4	Light yellowish brown		0.4	40	1	Slight/Moist			3
43	B32	60	Sandy clay loam	9.0	10YR7/4	Very pale brown		1.3	70	0	Slight	2	D	1
43	B33	140+	Sandy light clay	7.5	10YR5/4	Yellowish brown		1.1	40	0	Moist	4	D	1 (130)
51	A	15	Light medium clay	8.5	7.5YR3/3	Dark brown		1.7	15		Slight/Moist	1	D	4
51	B/C	80							98					1 (80)

Source: Mackenzie Soil Management (2012).

Table A5-3
Layer Data – Soil Structure Details

Pit	Depth (cm)	Pedality			Fabric	Consistence	SOILpak Score
		Grade	Type	Size (mm)			
2	20	S	PO	12	RP	4	1.1
2	40	M	LE	15	RP	6	0.4
2	58	S	LE	10	RP	4	1
2	140	W	LE	15	RP	3	1.2
2	150+						0
3	10	S	SB	7	RP	2	1.8
3	35	M	SB	10	RP	3	1.4
3	45	M	PO	7	RP	2	1.5
3	108	M	LE	10	RP	3	1.4
3	120	M	PO	5	RP	2	1.6
3	140+	W	LE	7	E	3	1.4
4	45	M	SB	5	E	2	1.6
4	60	M	LE	15	RP	5	0.7
4	80	W	PO	8	E	2	1.2
4	140+	W	LE	10	RP	3	1
30	10	S	SB	3	E	1	1.8
30	25	M	PO	5	E	2	1.4
30	40	S	LE	15	RP	5	0.5
30	75	S	LE	7	RP	6	0.7
30	140+	S	LE	15	RP	6	0.5
31	15	M	PO	8	RP	3	1.3
31	60	W	PO	7	E	2	1.2
31	140+	W	PO	5	E	1	1.3
35	10	W	PO	3	E	1	1.2
35	25	W	PO	3	E	1	1.2
35	140+						0
36	12	M	SB	7	E	2	1.6

Pit	Depth (cm)	Pedality			Fabric	Consistence	SOILpak Score
		Grade	Type	Size (mm)			
36	60	M	PO	10	RP	3	1.3
36	85	S	PO	7	RP	3	1.6
36	140+	W	LE	15	RP	4	1
37	18	S	SB	5	RP	2	1.7
37	28	W	LE	15	RP	6	0.2
37	90	M	PO	8	RP	2	1.3
37	120	M	PO	8	RP	3	1.3
37	140+	structureless sand					0
41	18	M	PO	10	E	2	1.5
41	140+	W	PO	5	E	2	1.2
42	10	W	B	8	E	2	1.3
42	35	M	PO	7	E	2	1
42	60	M	LE	8	RP	3	1.1
42	80+						0
43	15	S	SB	5	RP	2	1.6
43	30	W	PO	3	E	4	0.4
43	60	M	PO	8	E	2	1.3
43	140+	M	PO	10	E	3	1.1
51	15	S	SB	5	RP	2	1.7
51	80						0

Source: Mackenzie Soil Management (2012).

Table A5-4
Laboratory Data

Site	Depth (cm)	pH ($CaCl_2$)	EC 1:5 (dS/m)	ECe (dS/m)	Chloride (mg/kg)	Exchangeable cations (meq/100g)						ESP	ESI	Ca/ Mg	ASWAT score	NO_3-N (mg/kg)	Colwell-P (mg/kg)	SO_4-S (mg/kg)	DTPA-Zn (mg/kg)	DTPA-Cu (mg/kg)	Boron (mg/kg)	Org. C (%)
						Ca	Mg	K	Na	Al	CEC											
2	0-15	7.5	0.21	1.81	40	11.0	6.0	0.4	3.0	0.0	20.4	14.7	0.01	1.83	9	7	15	8	0.08	0.66	1.40	0.41
2	15-30	8.1	0.26	2.24	91	11.0	6.7	0.4	3.6	0.0	21.7	16.6	0.02	1.64	7	1	5	9	0.03	0.76	1.88	0.24
2	30-60	8.3	0.36	3.10	91	14.0	8.1	0.5	4.4	0.0	27.0	16.3	0.02	1.73	6	1	6	7	0.05	0.73	2.00	0.15
2	60-90	8.3	0.28	2.41	83	10.0	7.4	0.5	4.8	0.0	22.7	21.1	0.01	1.35	10	2	6	8	0.03	0.49	1.70	0.15
3	0-15	8.1	0.17	1.46	10	21.0	12.0	0.8	0.6	0.0	34.4	1.7	0.10	1.75	2	1	5	2	0.16	0.65	2.20	0.47
3	15-30	8.1	0.21	1.22	10	19.0	9.9	0.6	1.6	0.0	31.1	5.1	0.04	1.92	14	1	5	4	0.10	0.74	2.50	0.62
3	30-60	8.7	0.24	1.80	15	9.5	9.9	0.5	3.0	0.0	22.9	13.1	0.02	0.96	13	1	5	7	2.70	1.00	1.30	0.46
3	60-90	8.7	0.29	2.49	46	8.0	11.0	0.4	3.1	0.0	22.5	13.8	0.02	0.73	15	1	5	30	4.50	1.20	0.77	0.47
3	90-120	8.5	0.35	3.01	13	9.0	14.0	0.5	3.3	0.0	26.8	12.3	0.03	0.64	11	1	5	78	1.10	0.57	1.00	0.17
4	0-15	8.2	0.17	1.28	10	16.0	8.2	0.6	1.1	0.0	25.9	4.2	0.04	1.95	11	2	9	2	0.07	0.39	1.40	0.18
4	15-30	8.3	0.22	1.65	13	14.0	9.1	0.6	2.1	0.0	25.8	8.1	0.03	1.54	11	1	41	5	0.08	0.38	1.40	0.23
4	30-60	8.4	0.33	2.48	10	16.0	12.0	0.6	4.0	0.0	32.6	12.3	0.03	1.33	13	1	5	9	0.04	0.44	3.20	0.15
4	60-90	8.8	0.45	3.87	72	12.0	9.9	0.6	7.8	0.0	30.3	25.7	0.02	1.21	14	1	5	20	0.05	0.23	0.37	0.15
4	90-120	8.7	0.59	5.07	360	10.0	8.2	0.5	7.4	0.0	26.1	28.4	0.02	1.22	14	1	5	47	0.04	0.22	0.39	0.15
30	0-15	5.3	0.02	0.17	10	3.8	1.4	0.6	0.0	0.1	6.0	0.5	0.04	2.71	11	2	5	1	0.19	0.46	0.27	0.84
30	15-30	5.6	0.02	0.17	10	2.5	1.0	0.3	0.1	0.0	3.9	2.3	0.01	2.53	13	2	5	1	0.05	0.23	0.21	0.23
30	30-60	6.8	0.06	0.45	27	6.5	6.3	0.5	1.2	0.0	14.5	8.3	0.01	1.03	16	1	5	1	0.03	0.34	0.94	0.21
30	60-90	8.2	0.26	2.24	37	9.5	12.0	0.6	3.2	0.0	25.3	12.6	0.02	0.79	13	1	5	3	0.08	0.37	3.30	0.15
31	0-15	5.0	0.07	0.60	10	6.0	2.3	1.1	0.0	0.1	9.5	0.1	0.67	2.61	5	24	37	2	0.66	0.66	0.57	1.20
31	15-30	8.1	0.10	0.86	10	8.0	6.3	0.4	0.2	0.0	14.8	1.1	0.09	1.27	4	1	5	2	0.15	0.09	0.20	0.15
31	30-60	8.7	0.18	1.55	230	10.0	6.4	0.4	1.6	0.0	18.4	8.7	0.02	1.56	7	1	5	2	0.13	0.09	0.33	0.15
31	60-90	8.6	0.18	1.55	10	6.5	5.0	0.4	1.5	0.0	13.4	11.2	0.02	1.30	7	1	5	4	0.19	0.22	0.38	0.15
35	0-15	5.6	0.10	1.38	35	4.0	2.1	1.1	0.0	0.0	7.2	0.4	0.24	1.90	4	19	54	8	0.90	0.30	0.47	1.00

Site	Depth (cm)	pH ($CaCl_2$)	EC 1:5 (dS/m)	ECe (dS/m)	Chloride (mg/kg)	Exchangeable cations (meq/100g)						ESP	ESI	Ca/ Mg	ASWAT score	NO_3-N (mg/kg)	Colwell-P (mg/kg)	SO_4-S (mg/kg)	DTPA-Zn (mg/kg)	DTPA-Cu (mg/kg)	Boron (mg/kg)	Org. C (%)
						Ca	Mg	K	Na	Al	CEC											
35	15-30	5.4	0.10	1.38	10	3.5	2.1	0.4	0.1	0.1	6.1	0.8	0.12	1.67	11	2	17	52	0.35	0.29	0.43	0.81
36	0-15	5.1	0.03	0.26	10	3.4	1.0	0.8	0.0	0.1	5.3	0.6	0.05	3.43	6	4	8	2	0.28	0.59	0.39	0.80
36	15-30	5.5	0.01	0.09	10	3.9	1.5	0.5	0.0	0.0	5.9	0.3	0.03	2.60	7	1	5	1	0.03	0.56	0.40	0.33
36	30-60	6.0	0.02	0.18	10	4.6	2.6	0.5	0.1	0.0	7.7	0.6	0.03	1.77	7	1	6	1	0.03	0.34	0.60	0.18
36	60-90	5.9	0.03	0.26	10	6.0	4.3	0.6	0.3	0.0	11.2	2.4	0.01	1.40	7	1	6	2	0.05	0.27	1.40	0.15
37	0-15	7.3	0.15	1.29	10	12.0	3.6	1.4	0.1	0.0	17.1	0.4	0.37	3.33	4	18	140	4	0.69	0.33	0.83	0.93
37	15-30	6.8	0.06	0.52	10	6.0	3.7	0.6	0.1	0.0	10.4	1.1	0.06	1.62	10	2	15	2	0.38	0.49	0.60	0.45
37	30-60	8.5	0.15	1.29	10	7.5	8.0	0.3	0.7	0.0	16.6	4.5	0.03	0.94	11	1	5	5	0.85	0.77	0.25	1.20
37	60-90	8.5	0.22	1.89	18	6.5	6.8	0.3	1.4	0.0	15.0	9.3	0.02	0.96	14	1	5	23	0.78	0.61	0.25	2.20
37	90-120	8.5	0.27	6.13	74	8.5	4.4	0.4	1.4	0.0	14.7	9.5	0.03	1.93	1	1	20	81	0.86	0.09	0.15	0.15
41	0-15	6.0	0.07	0.97	13	5.0	1.9	0.9	0.1	0.0	7.9	0.8	0.09	2.63	6	7	19	2	0.21	0.27	0.56	0.76
42	0-15	4.6	0.03	0.41	10	2.8	1.2	0.7	0.0	0.3	5.1	0.8	0.04	2.33	4	5	34	2	0.22	0.29	0.35	1.90
42	15-30	4.9	0.01	0.14	16	1.9	1.1	0.3	0.0	0.1	3.4	0.9	0.01	1.73	12	1	5	2	0.02	0.14	0.16	0.34
42	30-60	6.3	0.04	0.34	18	4.3	4.5	0.6	0.2	0.0	9.6	2.1	0.02	0.96	13	1	5	2	0.04	0.18	0.48	0.19
43	0-15	7.4	0.13	1.12	22	10.0	5.4	0.8	0.3	0.0	16.5	1.7	0.08	1.85	4	3	46	2	0.25	0.69	0.90	0.58
43	15-30	8.9	0.20	1.72	10	12.0	5.4	0.3	2.0	0.0	19.7	10.2	0.02	2.22	12	1	5	3	0.51	0.45	0.52	0.19
43	30-60	9.0	0.25	2.15	35	8.0	4.5	0.3	2.7	0.0	15.6	17.4	0.01	1.78	13	1	5	10	0.74	0.27	0.29	0.30
43	60-90	8.9	0.28	2.41	110	10.0	5.0	0.4	2.9	0.0	18.3	15.9	0.02	2.00	12	1	5	17	0.66	0.25	0.23	0.19
43	90-120	8.8	0.37	3.18	260	8.5	5.9	0.3	3.3	0.0	18.0	18.3	0.02	1.44	12	1	5	39	0.63	0.22	0.27	0.15
51	0-15	7.7	0.18	1.55	10	16.0	5.6	1.0	0.1	0.0	22.7	0.4	0.41	2.86	1	24	31	5	1.10	0.40	0.86	1.10

Source: Mackenzie Soil Management (2012).