HUMECOAL PROJECT

VOLUME 8

Hume Coal Project

Environmental Impact Statement

Appendices M to O

Prepared for Hume Coal Pty Limited
March 2017

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Appendix M

Traffic and Transport Assessment Report

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Prepared for Hume Coal Pty Limited | 7 March 2017

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Hume Coal Project

Final

Report J12055RP1 | Prepared for Hume Coal Pty Limited | 7 March 2017

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Executive Summary

The project area is approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre in the Wingecarribee LGA. The main project access is located via Mereworth Road, which is on the western side of the Hume Highway. The project involves developing and operating an underground coal mine and associated infrastructure over an estimated 23 year timeframe. Product coal will be transported by rail, primarily to Port Kembla terminal for the international market, and possibly other locations for the domestic market. Construction stage workforce accommodation is included for up to 400 persons.

The existing journey to work travel patterns in the Wingecarribee LGA show a high level of sub-regional self-containment. At the 2011 Census, 83.7% of all people working within the Wingecarribee LGA were residents and only 16.3% were travelling from outside the LGA. The travel patterns of the project's future workforce will include a similar percentage (about 15%) travelling by car from outside the LGA. Their daily travel distances will be limited to around 45 minutes commuting time each way. This policy will be enforced by Hume Coal to minimise the potential workforce traffic safety risk from longer distance commuting.

The project generated daily traffic movements have been calculated and assessed for three stages of the project (early stage construction, peal construction and project operations). The project would generate between 296 and 378 daily vehicle movements using the surrounding roads during each of these stages. No significant adverse traffic impacts have been identified for the future traffic movements generated by the project for either the road network traffic capacity, intersection traffic operations; the road network condition; road safety and the efficiency of operation of the road network as summarised in Table ES.1.

Table ES.1 Summary of the project traffic impacts assessment

Type of potential impact	Impacts to the local road network	Impacts to the state road network	Summary of Impact
Capacity	Minimal impacts are predicted to the local road network (Council controlled roads) for either mid block road capacity or the peak hour traffic capacity of intersections.	Minimal impacts are predicted to the state road network (Hume Highway and Illawarra Highway) for either mid block road capacity or the peak hour traffic capacity of intersections.	Low Impact
Condition	Minimal impacts are anticipated from the project truck traffic using roads which are maintained by the local Council.	Where access is proposed to the state road network during project construction, the access will be of short duration, of low traffic generation intensity and will be managed by standard RMS worksite traffic control plans prepared in accordance with RMS traffic control guidelines for worksites with access to major roads.	Low Impact
Safety	The current traffic safety record (accident history) for the local road network is good and safety will not be adversely affected by the additional project traffic.	The current traffic safety record (accident history) for the state road network is relatively good and safety will not be adversely affected by the additional project traffic.	Low impact
Efficiency	The project will not generate any significant road traffic increases which will adversely affect the efficiency of the local road network (Council controlled roads).	The project will not generate any significant road traffic increases which will adversely affect the efficiency of the local road network (Council controlled roads).	Low impact

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1 Introduction

1.1 Overview

Hume Coal Pty Limited (Hume Coal) proposes to develop and operate an underground coal mine and associated mine infrastructure (the 'Hume Coal Project') (the project) in the Southern Coalfield of New South Wales (NSW). Hume Coal holds exploration Authorisation 349 (A349) to the west of Moss Vale, in the Wingecarribee local government area (LGA). The underground mine will be developed within A349 and associated surface infrastructure facilities will be developed within and north of A349. The project area and its regional and local setting are shown in Figures 1.1 and 1.2.

The project has been developed following several years of technical investigations to define the mineable resource and identify and address potential environmental, social and economic constraints. Low impact mining methods will be used which will have negligible subsidence impacts and thereby protect the overlying aquifer and surface features, and therefore allow existing land uses to continue at the surface. Post-mining, all mine surface infrastructure will be decommissioned and areas rehabilitated to a state where they can support land uses similar to the current land uses.

Approval for the project is being sought under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An environmental impact statement (EIS) is a requirement of the approval processes. This traffic impact assessment report forms part of the EIS. It documents the assessment methods, results and the mitigation and management measures proposed to address residual traffic impacts which cannot be avoided.

1.2 Project description

The project involves developing and operating an underground coal mine and associated infrastructure over a total estimated project life of 23 years. Indicative mine and surface infrastructure plans are provided in Figure 1.3 and Figure 1.4. A full description of the project, as assessed in this report, is provided in Chapter 2 of the main EIS report (EMM 2017a).

In summary it involves:

- Ongoing resource definition activities, along with geotechnical and engineering testing, and other fieldwork to facilitate detailed design.
- Establishment of a temporary construction accommodation village.
- Development and operation of an underground coal mine, comprising of approximately two years of construction and 19 years of mining, followed by a closure and rehabilitation phase of up to two years, leading to a total project life of 23 years. Some coal extraction will commence during the second year of construction and hence there will be some overlap between the construction and operational phases.
- Extraction of approximately 50 million tonnes (Mt) of run-of-mine (ROM) coal from the Wongawilli Seam, at a rate of up to 3.5 million tonnes per annum (Mtpa). Low impact mining methods will be used, which will have negligible subsidence impacts.

- Following processing of ROM coal in the coal preparation plant (CPP), production of up to 3 Mtpa of metallurgical and thermal coal for sale to international and domestic markets.
- Construction and operation of associated mine infrastructure, mostly on cleared land, including:
  - one personnel and materials drift access and one conveyor drift access from the surface to the coal seam;
  - ventilation shafts, comprising one upcast ventilation shaft and fans, and up to two downcast shafts installed over the life of the mine, depending on ventilation requirements as the mine progresses;
  - a surface infrastructure area, including administration, bathhouse, washdown and workshop facilities, fuel and lubrication storage, warehouses, laydown areas, and other facilities. The surface infrastructure area will also comprise the CPP and ROM coal, product coal and emergency reject stockpiles;
  - surface and groundwater management and treatment facilities, including storages, pipelines, pumps and associated infrastructure;
  - overland conveyors;
  - rail load-out facilities;
  - a small explosives magazine;
  - ancillary facilities, including fences, access roads, car parking areas, helipad and communications infrastructure; and
  - environmental management and monitoring equipment.
- Establishment of site access from Mereworth Road, and construction of minor internal roads.
- Coal reject emplacement underground, in the mined-out voids.
- Peak workforces of approximately 414 full-time equivalent employees during construction and approximately 300 full-time equivalent employees during operations.
- Decommissioning of mine infrastructure and rehabilitating the area once mining is complete, so that it can support land uses similar to current land uses.

The project area, shown in Figure 1.2 is approximately 5,051 hectares (ha). Surface disturbance will mainly be restricted to the surface infrastructure areas shown indicatively on Figure 1.4 though will include some other areas above the underground mine, such as drill pads and access tracks. The project area generally comprises direct surface disturbance areas of up to approximately 117 ha, and an underground mining area of approximately 3,472 ha, where negligible subsidence impacts are anticipated.

A construction buffer zone will be provided around the direct disturbance areas. The buffer zone will provide an area for construction vehicle and equipment movements, minor stockpiling and equipment laydown, as well as allowing for minor realignments of surface infrastructure. Ground disturbance will generally be minor and associated with temporary vehicle tracks and sediment controls as well as minor works such as backfilled trenches associated with realignment of existing services. Notwithstanding, environmental features identified in the relevant technical assessments will be marked as avoidance zones so that activities in this area do not have an environmental impact.

Product coal will be transported by rail, primarily to Port Kembla terminal for the international market, and possibly to the domestic market depending on market demand. Rail works and use are the subject of a separate EIS and State significant development application for the Berrima Rail Project.

1.3 General site description

The project area is approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre in the Wingecarribee LGA (refer to Figure 1.3 and Figure 1.5). The nearest area of surface disturbance will be associated with the surface infrastructure area, which will be 7.2 km north-west of Moss Vale town centre. It is in the Southern Highlands region of NSW and the Sydney Basin Biogeographic Region.

The project area is in a semi-rural setting, with the wider region characterised by grazing properties, small-scale farm businesses, small scale farm business, natural areas, forestry, scattered rural residences, villages and towns, industrial activities such as the Berrima Cement work and Berrima Feedmill, and some extractive industry and major transport infrastructure such as the Hume Highway.

Surface infrastructure is proposed to be developed on predominately cleared land owned by Hume Coal or affiliated entities, or for which there are appropriate access agreements in place with the landowner. Over half of the remainder of the project area (principally land above the underground mining area) comprises cleared land that is, and will continue to be, used for livestock grazing, small-scale farm businesses and hobby farms. Belanglo State Forest covers the north-western portion of the project area and contains introduced pine forest plantations, areas of native vegetation and several creeks that flow through deep sandstone gorges. Native vegetation within the project area is largely restricted to parts of Belanglo State Forest and riparian corridors along some watercourses.

The project area is traversed by several drainage lines including Oldbury Creek, Medway Rivulet, Wells Creek, Wells Creek Tributary, Belanglo Creek and Longacre Creek, all of which ultimately discharge to the Wingecarribee River, located around 1.5 km north of the project area. The Wingecarribee River's catchment forms part of the broader Warragamba Dam and Hawkesbury-Nepean catchments. Medway Dam is also adjacent to the northern portion of the project area.

Most of the central and eastern parts of the project area have very low rolling hills with occasional elevated ridge lines. However, there are steeper slopes and deep gorges in the west in Belanglo State Forest.

Existing built features across the project area include scattered rural residences and farm improvements such as outbuildings, dams, access tracks, fences, yards and gardens, as well as infrastructure and utilities including roads, electricity lines, communications cables and water and gas pipelines. Key roads that traverse the project area are the Hume Highway and Golden Vale Road. The Illawarra Highway borders the south-east section of the project area.

Industrial and manufacturing facilities adjacent to the project area include the Berrima Cement Works and Berrima Feed Mill on the fringe of New Berrima. Berrima Colliery's mining lease (CCL 748) also adjoins the project area's northern boundary. Berrima colliery is currently not operating with production having ceased in 2013 after almost 100 years of operation. The mine is currently undergoing closure.

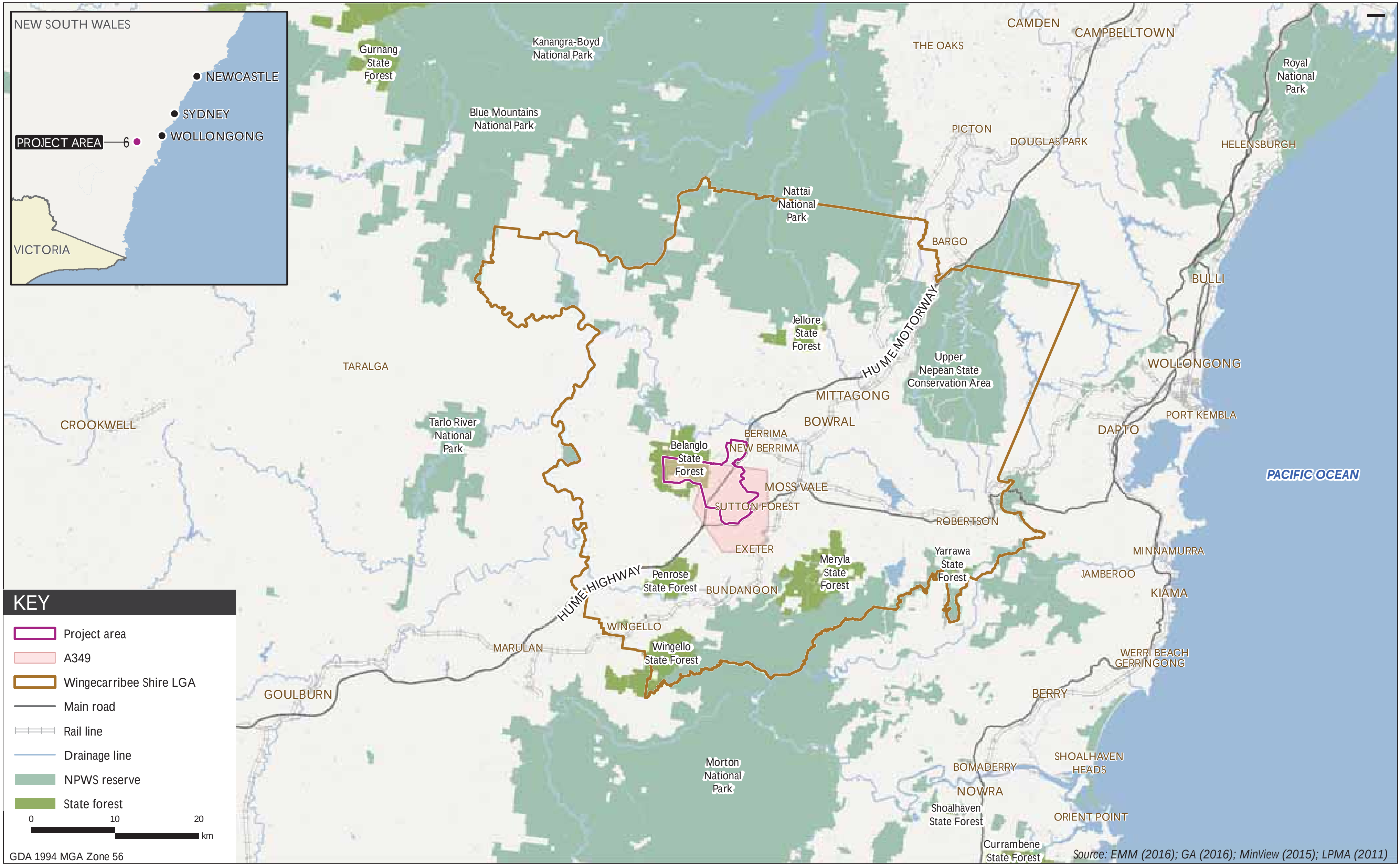
1.4 Project transport assessment details

Project related road traffic will be generated during the construction and operations stages by workers commuting, materials and equipment deliveries and maintenance/service provider traffic. The main surface access and surface infrastructure areas will be on the western side of the Hume Highway, approximately 1.5 km away from the Hume Highway and adjacent to the north-western corner of the mine lease area, as shown in Figure 1.4.

The existing journey to work travel patterns in the Wingecarribee LGA show a high level of sub-regional self-containment. At the 2011 Census, 83.7% of all people working within the Wingecarribee LGA were residents and only 16.3% were travelling from outside the LGA.

The future mine workforce residential catchment is shown on Figure 1.5. It will include some parts of the adjoining outer Sydney LGAs such as Wollondilly, but will generally exclude other Sydney LGAs further to the north. Similarly in the Wollongong/Nowra direction, some areas of the Kiama and (Upper) Shoalhaven LGAs will be included, but the main Wollongong and Shellharbour urban areas are excluded.

The travel patterns of the project's future workforce will include a similar percentage (about 15%) to what now occurs for the non-local workforce travelling by car from outside the LGA. Their daily travel distances will be limited to around 45 minutes commuting time each way. This policy will be enforced by Hume Coal to minimise the potential for fatigue-related traffic accidents.



Source: EMM (2016); GA (2016); MinView (2015); LPMA (2011)

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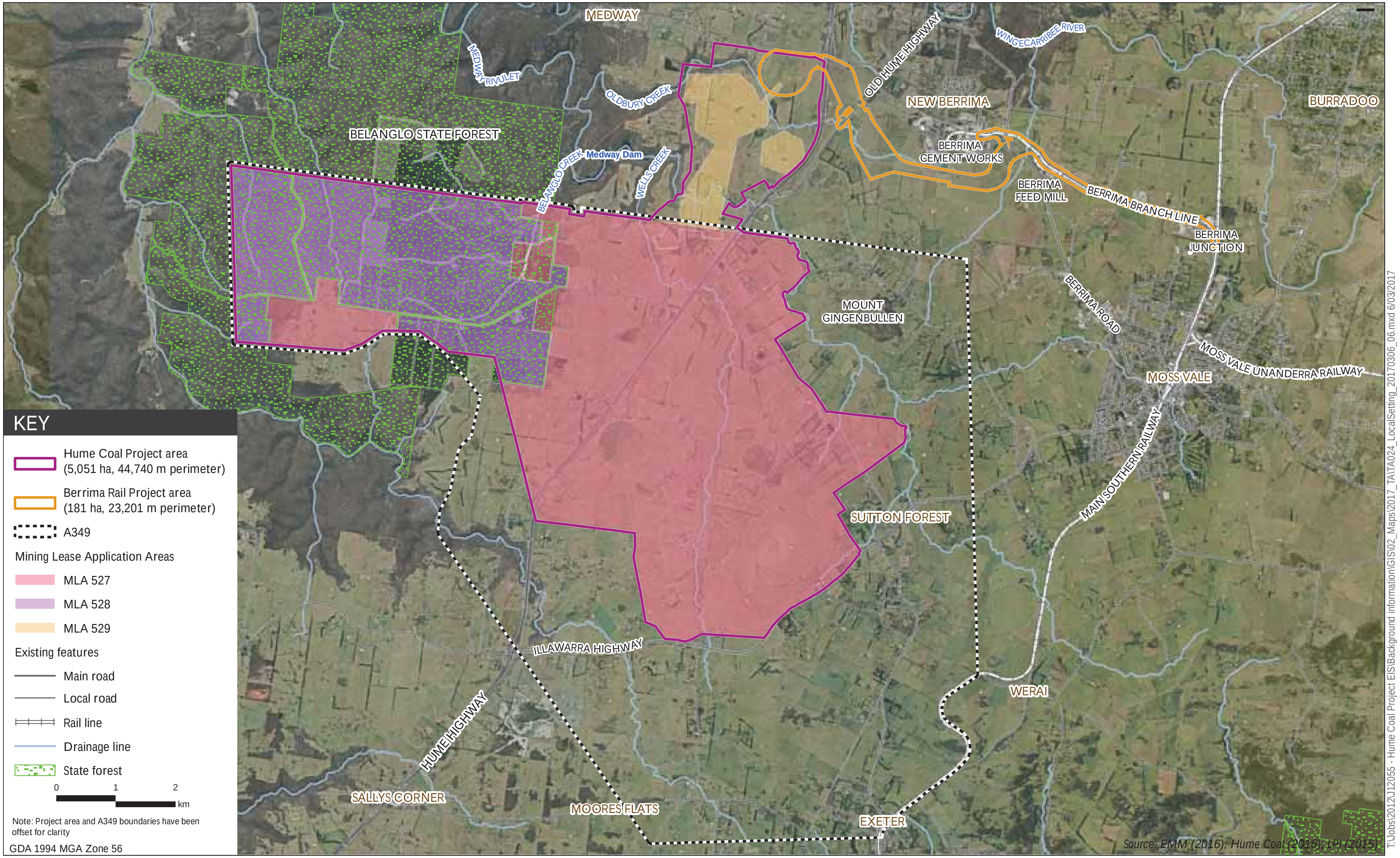
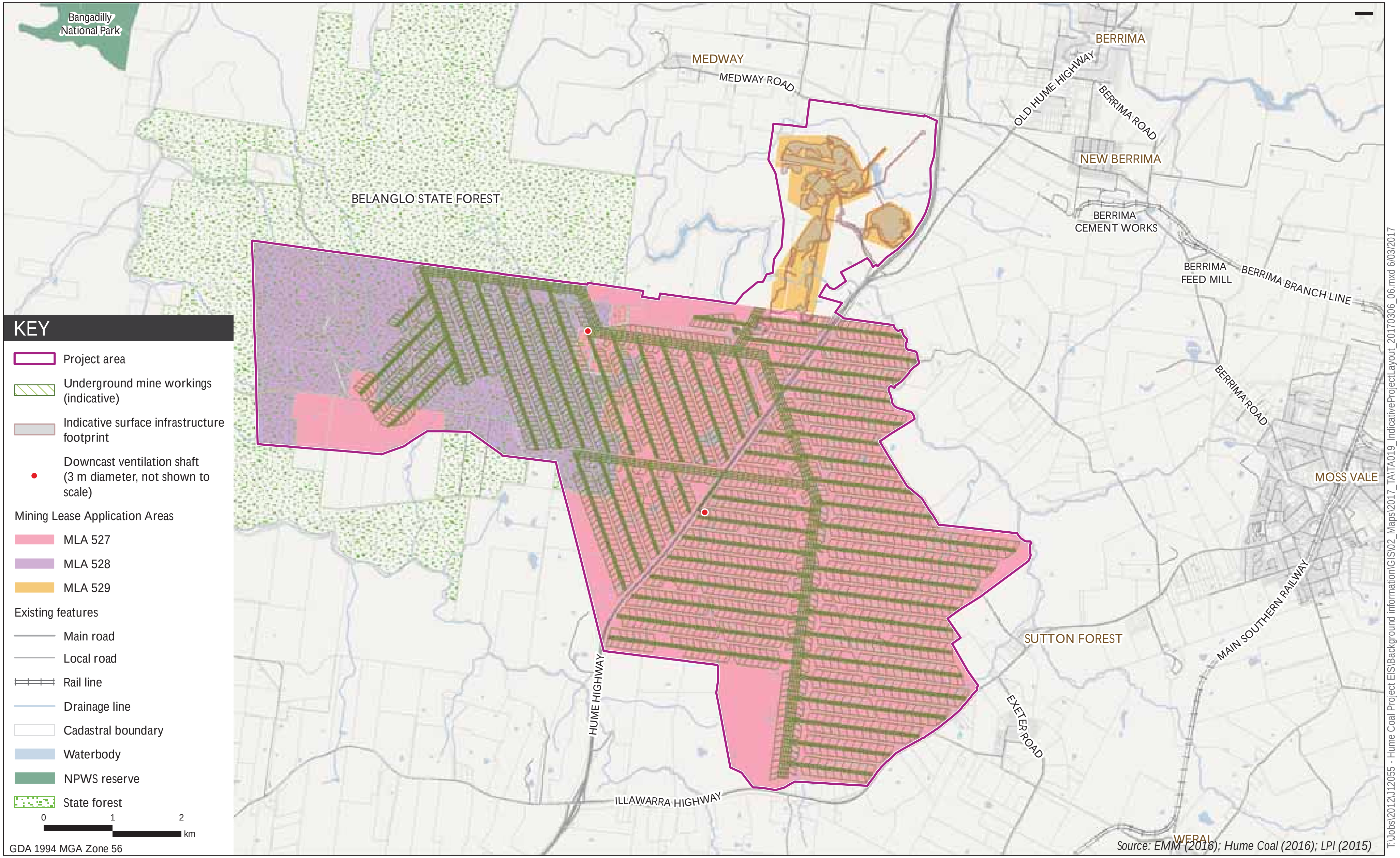
Regional context

Hume Coal Project
Traffic Impact Assessment
Figure 1.1



Local context

Hume Coal Project
Traffic Impact Assessment
Figure 1.2



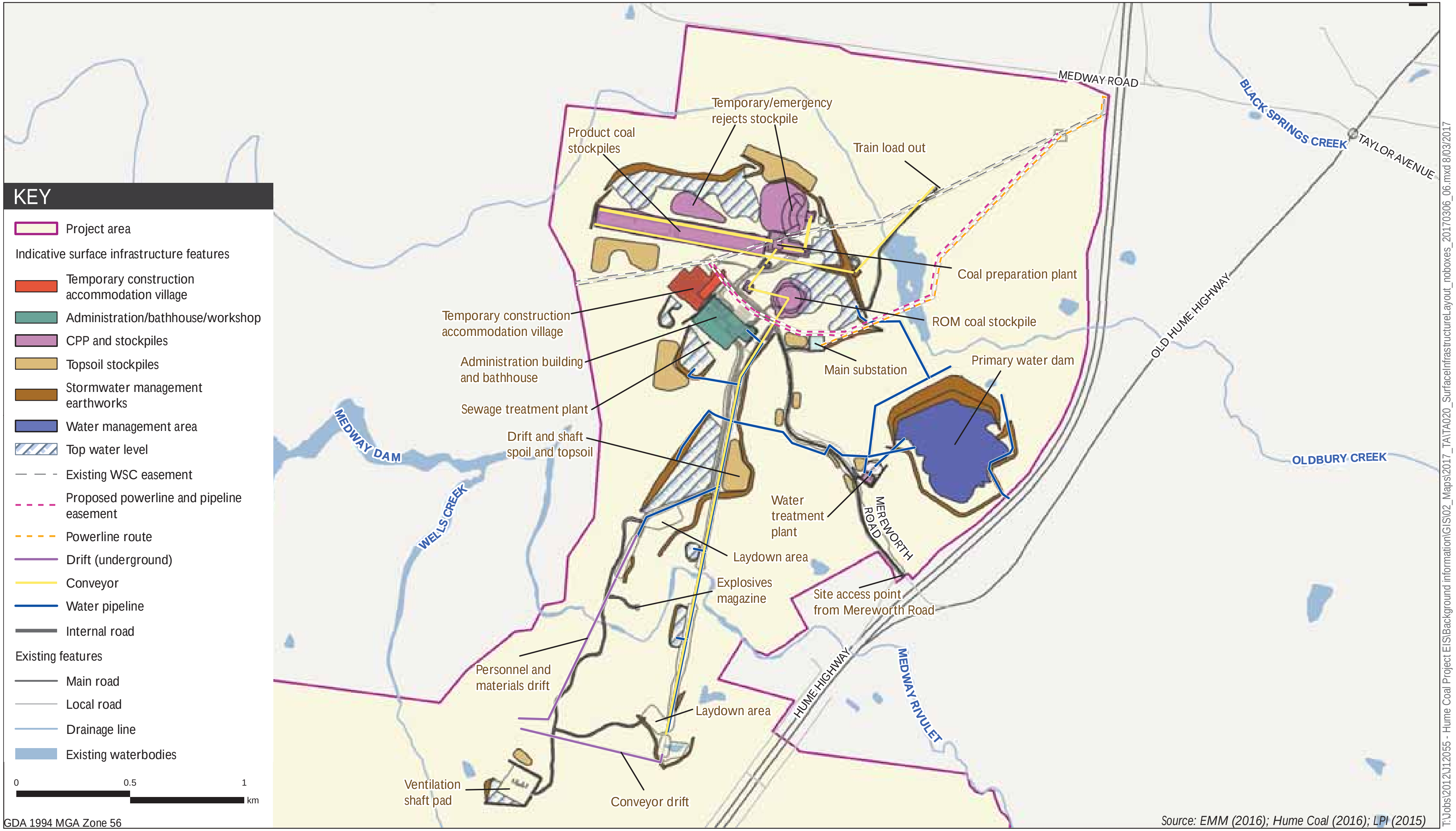
Source: EMM (2016); Hume Coal (2016); LPI (2015)

Indicative project layout

Hume Coal Project

Traffic Impact Assessment

Figure 1.3



GDA 1994 MGA Zone 56

Source: EMM (2016); Hume Coal (2016); LPI (2015)

Indicative surface infrastructure layout

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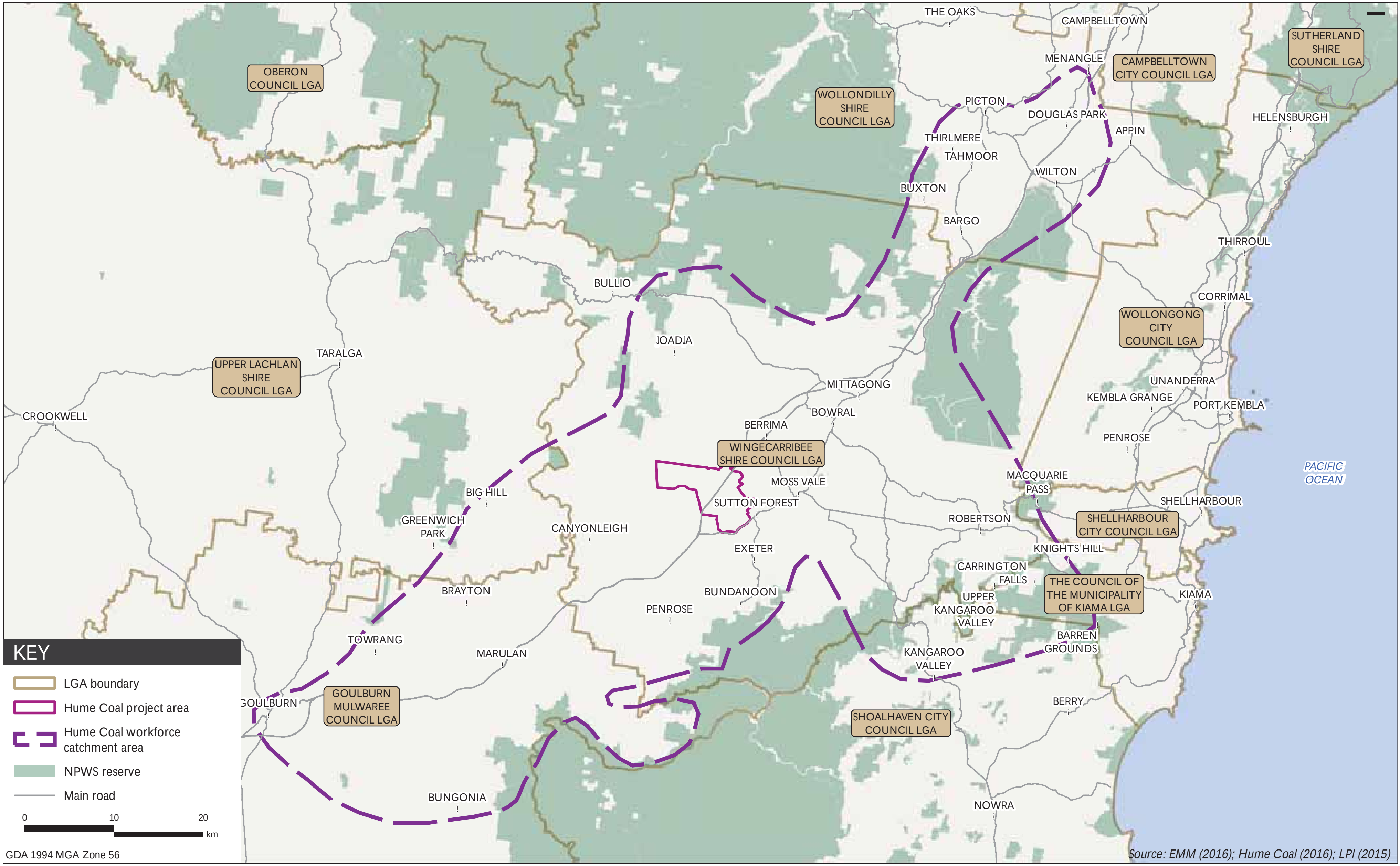
Traffic Impact Assessment

Figure 1.4



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Workforce catchment area
Hume Coal Project
Traffic Impact Assessment
Figure 1.5

1.5 Assessment requirements

This assessment has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies. Guidelines and policies considered are as follows:

The SEARs for the project were issued by the NSW Department of Planning and Environment (DP&E) on 20 August 2015. They contained the requirements listed in Table 1.1 for assessment of the project's road transport impacts. Transport for NSW and RMS also added a number of requests, which are given in Table 1.1.

Table 1.1 Road transport SEARs and other agency requests

Requirement	Where assessed
DP&E	
An assessment of likely impacts on the capacity, condition, safety and efficiency of the local and state road networks, having regard for TfNSW and RMS requirements.	In Chapters 4 and 5, including a summary table of the assessed impacts in Chapter 7
Other agency requests	
TfNSW requests dated 8 August 2015	
A traffic impact study prepared in accordance with the methodology set out in Section 2 of the RTA Guide to Traffic Generating Developments including the following details:	In all chapters of this report and in the summary transport assessment in Chapter 15 of the EIS
• Accurate daily and peak traffic forecasts generated during construction and operation including details of transport route, types of vehicles likely to be used and expected ramp up periods. Forecasts are to include anticipated service vehicle movements, including service vehicle type and arrival and departure times.	In Chapter 3
• Details of the proposed staging of the project construction and operations.	In Chapter 1 and Chapter 3
• Details of the proposed access to the site from the road network during construction and operation of the project, including hours of operation, days of construction and operation for each stage of the project, intersection location, design and sight distances.	In Chapter 3. No new intersections are proposed for the project access which would require consideration of sight distances and other intersection design requirements.
• Detailed assessment of the impact of the proposed project on the capacity, safety and efficiency of the road networks during construction and operation. The assessment should consider the cumulative impacts of the project on current road users and should also include the contribution of mining inputs, having regard to the transportation of dangerous goods (explosives, fuel and chemicals) to be utilised during the construction and operational phases of the project. A risk assessment should be undertaken to identify management measures that will be implemented to ensure that dangerous goods are safely transported.	In Chapters 4, 5 and 6 (hazardous materials). Project hazard and risk assessment in Chapter 18 and Appendix Q of the EIS.

Table 1.1 Road transport SEARs and other agency requests

Requirement	Where assessed
• Any over size or over mass vehicles and loads expected for the construction, operation or decommissioning of the project should be identified, including the shortest and least trafficked route having been given priority for the movement of construction materials and machinery to minimise the risk and impact to other motorists.	In Chapter 6
• A description of the measures that would be implemented to maintain and/or improve the capacity, safety and efficiency of the road network for the construction and over the life of the project.	In Chapter 6
• Detailed plans of the proposed layout of the internal access roads and on-site parking in accordance with relevant Australian standards.	In Chapter 1 of this report and in Chapter 2 of the EIS under 'Project Description'.
RMS requests	
The effect on traffic volumes and roadway configurations associated with entry to and exit from the mine during construction and operation from vehicles associated with the mine. RMS will not accept any direct access to the Hume Highway. If significant road works are proposed to accommodate any changes to the traffic regime, then the EA will need to be expanded to address these proposals.	In Chapter 4 and 5.
The movement of overweight and oversize vehicles on the Hume Highway associated with the mine.	In Chapter 6
The visual amenity impact of the mine works with regard to driver behaviour.	Visual impacts have been assessed and mitigation measures provided in Chapter 16 and Appendix O of the EIS. Extensive tree planting is proposed to screen visually sensitive areas of the project from the surrounding roads.
The impact of dust pollution on the travelling public.	Air quality impacts have been assessed and mitigation measures provided in Chapter 12 and Appendix L of the EIS. The air quality impact assessment has determined there will be minimal dust related impacts from the project for areas in the vicinity of the Hume Highway and further east. It is noted the project is an underground mine which will have far lower dust generation potential than an open cut mine.
The impact of dust pollution or the deposition of fines on the functioning of reflective signs, pavement markers and pavement line marking.	As above.
The impacts of noise and vibration of the mine and rail line operations, including undermining or destabilisation of the Hume Highway through coal extraction operations or otherwise; and vibration impacts on the Hume Highway through mine construction and mine operation.	This requirement is addressed in Section 3.6 and Section 5.8 in The Noise and Vibration Impact Assessment (Appendix K of the EIS). It is highly unlikely that vibration levels will cause structural vibration impacts on the Hume Highway.
The impacts on the groundwater flows, including: changes in the water table configuration through such things as new dam construction, re-routing of water ways, groundwater behaviour changes, and changes to the catchment areas that feed to or away from the Hume Highway. Any change in the water table has the potential to affect the structural integrity of the Hume Highway.	This requirement is addressed in Chapter 11 of the Water Assessment (Appendix F of the EIS). The project impact will be less than 10 m drawdown in the Hume Highway area, which is considered small. Additionally, the Subsidence Impact Assessment (Appendix M of the EIS) concludes that subsidence impacts to surface features will be negligible or imperceptible.

2 Existing road network and traffic conditions

2.1 Key transport routes

The transport investigations undertaken during early project planning identified a number of vehicular access constraints and options. It was determined that nearly all project traffic would use access routes that do not require right turn access at any intersections on the Hume Highway south of the Mereworth Road (Old Hume Highway) interchange.

The Hume Highway has three grade separated interchanges that provide major road access into and around the project area. These are shown on Figure 2.1. The two northern interchanges at Mereworth Road (Old Hume Highway) and Medway Road are both outside the mine lease area boundary. The southern interchange, at the Illawarra Highway and Canyonleigh Road, is on the south-western boundary of the mine lease area.

Between the Mereworth Road (Old Hume Highway) and Illawarra Highway interchanges, the Hume Highway is dual carriageway with a wide central median, but is not classified as a motorway. It has a number of intersections with private property driveways and local roads, including Belanglo Road and Golden Vale Road.

The project's construction and operations traffic will generally use either the Medway or Mereworth Road interchanges (which are about 3 km apart) to provide the northbound and southbound access onto the Hume Highway respectively. The road will be upgraded to link with a new link road that will be built to access the mine infrastructure area from Mereworth Road.

The existing Hume Highway ramp access interchanges will provide appropriate access for all regionally based mine traffic approaching or departing from the area. Other locally based project traffic (which will be travelling to and from nearby locations such as Moss Vale, Mittagong and Berrima) will generally use other routes, such as the Old Hume Highway, which connects via Taylor Avenue and Berrima Road to Moss Vale and the Illawarra Highway.

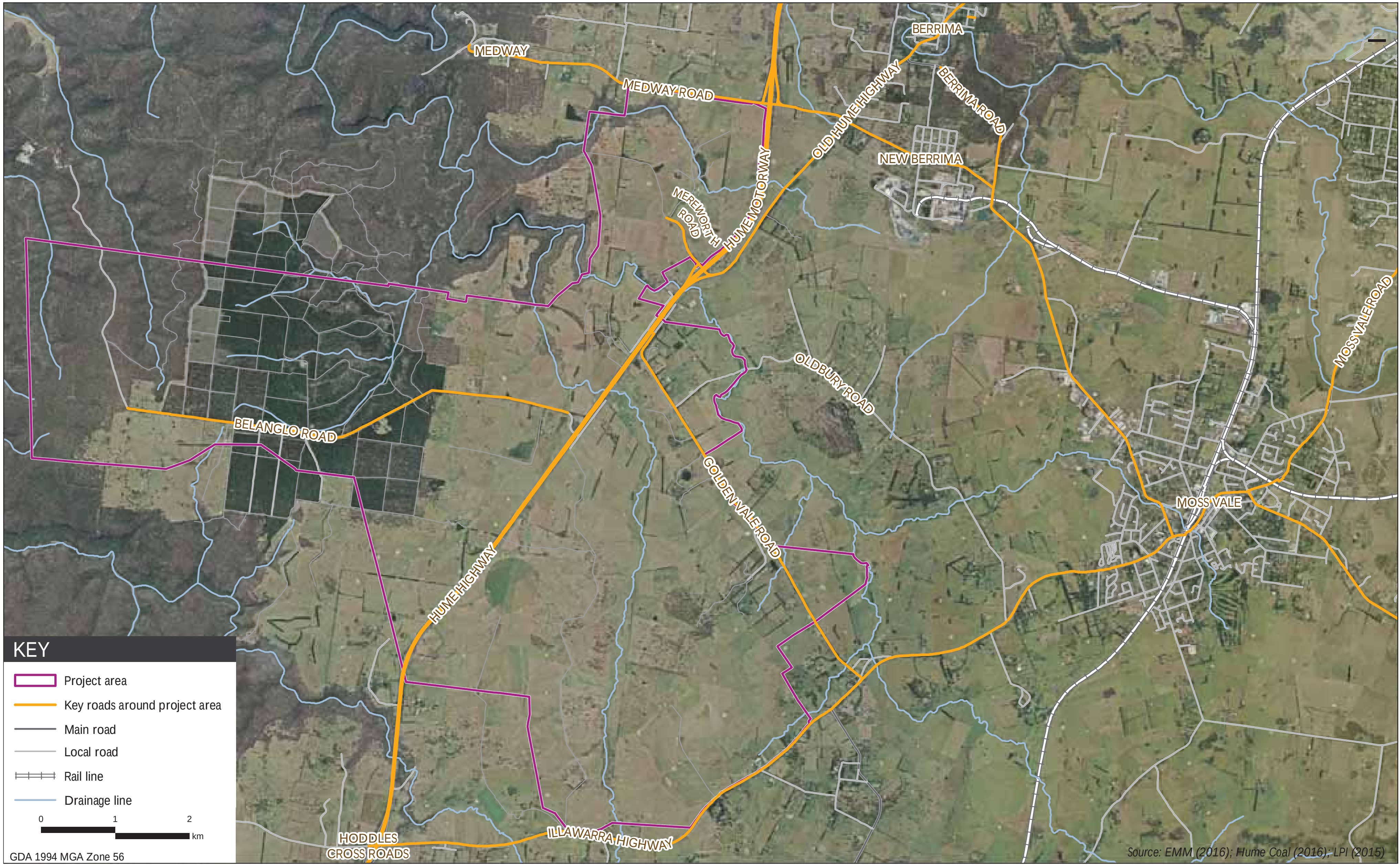
The Old Hume Highway between Mereworth Road and Medway Road/Taylor Avenue has substantial heavy vehicle traffic from the major industries located between Moss Vale and Berrima (including the Berrima Cement Works).

2.2 Road network

The main vehicular access routes and intersections the project traffic will use are shown on Figures 2.2, 2.3 and 2.4.

Most of the project's traffic will use the upgraded link road from Mereworth Road, which will be built on the western side of the Hume Highway. Some project construction stage traffic may also use Medway Road for access to and from the north.

Access off the Hume Highway at the Carlisle Downs property will be required during construction and operation of a ventilation shaft. This will not require significant road works and will be subject to traffic control plans prepared in accordance with the RMS procedure for traffic control at work sites.



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Regional road network

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Figure 2.1

Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Local road network and intersections - Project area south

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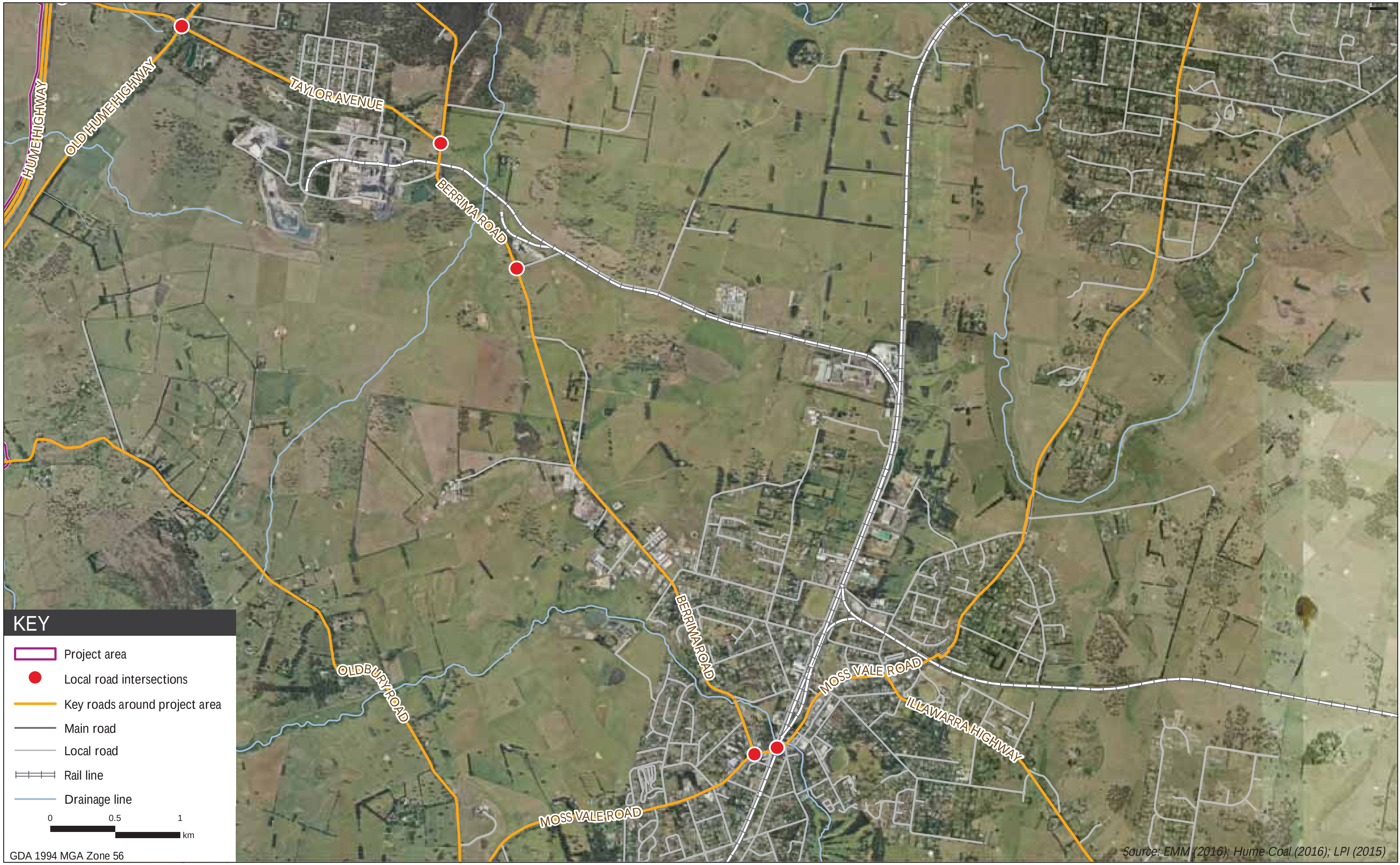
Traffic Impact Assessment

Figure 2.2

Source: EMM (2016); Hume Coal (2016); LPI (2015)

Local road network and intersections - Project area north
Hume Coal Project
Traffic Impact Assessment
Figure 2.3



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Local road network and intersections - Berrima to Moss Vale

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Traffic Impact Assessment

Figure 2.4

The three main areas of the mine where traffic movements will occur during both construction and operations will be at:

- the main surface access construction compound and surface infrastructure area, which will mostly be accessed via the upgraded road from Mereworth Road, as well as some vehicular access from the south via a secondary access road on the western side of the Hume Highway, near Golden Vale Road;

- the rail spur line loading and CHPP area where access will mostly be from Mereworth Road and also potentially from the north, directly from Medway Road on the western side of the Hume Highway; and

- access to ventilation shafts and other services located on the eastern side of the Hume Highway (Carlisle Downs property).

The major roads most likely to be used by project's traffic are:

- the Hume Highway (SH 2);

- the Illawarra Highway (SH 25), which passes through Moss Vale and Sutton Forest continuing to access the Illawarra and South Coast via Robertson and other routes towards Kangaroo Valley, Kiama and Nowra;

- the Old Hume Highway, which passes through Berrima and Mittagong and intersects with the Hume Highway about 5 km south of Berrima, 3 km west of Mittagong and 6 km north of Mittagong; and

- the Berrima Road–Taylor Avenue–Medway Road route, which connects from the Illawarra Highway at Moss Vale to the Old Hume Highway and the Hume Highway about 2 km south of Berrima.

2.3 Width and condition of existing roads

The road network evaluated in this assessment comprises the two state highways (the Hume Highway and the Illawarra Highway), the Old Hume Highway and the Berrima Road–Taylor Avenue–Medway Road route. These roads are all likely to be used by the mine-related traffic during both the project's construction and operations stages.

The standards to which these roads have been constructed are based on historic standards which generally meet or exceed the current functional requirements of the routes, in particular for the Old Hume Highway route.

The physical condition of the affected roads in the project area has been determined by field inspections and detailed dilapidation surveys will be undertaken before construction starts on the project.

2.3.1 Hume Highway

The Hume Highway (SH 2) provides a continuous high standard connection between Sydney and Melbourne, (873 km). It is suitable for use by most vehicle types up to and including the largest B-double trucks, but excluding other larger road train-type vehicles. In the Berrima locality the road has a continuous four-lane dual carriageway cross-section. It has been built to motorway standard (with no surface access intersections) to the north of the Old Hume Highway (Mereworth Road) interchange, where the dual carriageway road was originally built as the Hume Highway bypass of Berrima.

Additional slow vehicle lanes are provided on some steeper sections of the highway between Berrima and Mittagong, providing six lanes of traffic capacity at these locations. The road surface along all sections of the highway is maintained to a high standard to provide safe and comfortable travel conditions for all types of vehicles.

2.3.2 Illawarra Highway

The Illawarra Highway (SH 25) provides the main arterial road connection between the Illawarra and Southern Highlands. It has generally been designed and constructed as a high standard, two-lane rural highway with generous traffic lane and sealed shoulder widths, but has only limited overtaking opportunities in the Moss Vale and Sutton Forest areas. The road is suitable for most types of larger trucks but only permits B-double vehicles to travel as far as Robertson.

Trucks larger than semi-trailers are not allowed to use the Macquarie Pass section east of Robertson, which connects to Wollongong and the coastal Illawarra region. Within urban areas, where the road passes through the townships of Sutton Forest, Moss Vale and Robertson, it uses a range of urban type road cross-sections and lower speed limits generally apply, including 40 km/hr 'school zone' limits. The road surface is generally maintained in good condition with few visible surface defects. There is one railway level crossing just west of Robertson.

Through Moss Vale, the Illawarra Highway is known as Argyle Street, and has urban intersections with major local roads, including Berrima Road, which is known as Waite Street in Moss Vale.

2.3.3 Old Hume Highway

The Old Hume Highway, north of Mereworth Road, provides local access and distribution through the Berrima area as well as a non-motorway connection between Berrima and Mittagong, which has substantial local traffic usage. To the south of Mereworth Road, the Old Hume Highway ceases to exist but some sections have effectively been incorporated into the four-lane dual carriageway alignment of the Hume Highway. Other isolated sections remain as service roads providing local access to properties, such as near the Golden Vale Road intersection. There is a former railway level crossing on the Old Hume Highway, south of Medway Road, where the former private railway branch line operated between Berrima and the Medway Village. The line has been closed for many years, but much of the track remains.

2.3.4 Taylor Avenue, Berrima Road and Medway Road

These roads provide an east-west major road connection between the Hume Highway, the Old Hume Highway and Moss Vale. The route provides vehicular access to a number of major industrial sites which are located between Moss Vale and Berrima and also to residential areas in New Berrima and in the south and west of Moss Vale.

The speed limit is generally 80 km/hr but is reduced to 50 km/hr near residential areas. There is one railway level crossing east of the Berrima Cement Works, which is used by a relatively small number of trains each day travelling to and from the cement works.

2.3.5 Mereworth Road

Mereworth Road, west of the Hume Highway is the main local road that mine-related traffic will use for future access. The existing daily traffic volumes using the roads are generally low as the road is mainly only used for access to the Mereworth property.

2.3.6 Other local roads

Medway Road (west of the Hume Highway), Golden Vale Road, Oldbury Road and Belanglo Road are other local roads that mine-related traffic could use for some future access. The existing daily traffic volumes using these roads are generally low, as the farming properties in the area are relatively large and the rural residential population is low. Future usage of these roads by project traffic is expected to be minimal.

2.4 Traffic volumes and heavy vehicle usage

Existing daily traffic volumes on the major roads in the project area were determined from historic RTA and RMS tube traffic counts from the years 2005 and 2012. The counts are summarised in Table 2.1.

Table 2.1 Existing major road daily traffic volumes

Road name	Average daily traffic (2005 vehicles)	Average daily traffic (2012 vehicles)*	% per annum growth in vehicles
Hume Highway (Menangle)	33,112		
Hume Highway (Pheasants Nest)	29,660	34,000	+2.1%
Hume Highway (Mittagong Bypass)	16,969	19,700	+2.3%
Hume Highway (Penrose)	20,029	21,300	+0.9%
Hume Highway (Marulan Bypass)	20,113		
Hume Highway (South of Federal Highway)	6,434		
Illawarra Highway (Sutton Forest)	3,204		
Illawarra Highway (east of Robertson)	2,940	3,400	+2.2%

*Note: * Daily Traffic Volumes are from RTA (2005) and RMS (2012) where survey data is available.*

On the Hume Highway over the past ten years, the prevailing annual traffic growth rate has been about 2%. On the other routes in the local Berrima and Moss Vale areas, annual traffic growth rates have been lower, typically around 1%.

Existing peak hour traffic volumes on major and local roads in the Berrima and Moss Vale localities were determined from intersection counts made during June 2015 and February 2016. The intersection traffic count survey results are given in Appendix A and summarised in Table 2.2 and Table 2.3. Key features are as follows:

- the morning ‘peak hour’ period is generally 8.00–9.00 am, but at some of the intersections it occurs between 7.45 am and 8.45 am;
- the afternoon ‘peak hour’ is generally between 3.30–4.30 pm, but varies between 3.00 pm and 4.00 pm and 4.00 pm and 5.00 pm at the range of intersections considered;
- on major roads, the proportion of heavy vehicle traffic is highest on the Hume Highway, where it is typically between 17% and 18%;
- on the local roads, Douglas Road has the highest proportion of heavy vehicles at 29%; and
- on other routes, the proportions of heavy vehicle traffic vary widely, between 1% and 14%.

Table 2.2 Summary of surveyed peak hour traffic volumes on roads near the project area

Road name	am peak hourly volume	am peak hourly volume	am peak hourly combined	pm peak hourly volume	pm peak hourly volume	pm peak hourly combined	Per cent heavy vehicles*
	North- or east-bound	South- or west-bound	Both directions	North- or east-bound	South- or west-bound	Both directions	
Hume Highway south of Golden Vale Road	451	585	1,036	664	525	1,191	18
Hume Highway south of Mereworth Road	490	581	1,071	687	524	1,211	18
Hume Highway north of Medway Road	501	664	1,165	750	551	1,301	17
Golden Vale Road east of Hume Highway	29	45	74	47	27	74	3
Mereworth Road west of Hume Highway	2	0	2	2	0	2	0
Old Hume Highway south of Medway Road	67	32	99	38	48	86	8
Old Hume Highway north of Medway Road	107	44	151	51	79	130	5
Medway Road west of Old Hume Highway	112	73	185	72	121	193	14
Medway Road west of Hume Highway	24	7	31	19	20	39	4
Taylor Avenue east of Old Hume Highway	126	115	241	98	129	227	14
Taylor Avenue west of Berrima Road	131	70	201	112	139	251	9

Note: **Per cent heavy vehicles is the average percentage recorded from both the morning and afternoon peak hour traffic surveys.*

Table 2.3 Summary of surveyed peak hour traffic volumes on Berrima Road to Moss Vale route

Road name	am peak hourly volume	am peak hourly volume	am peak hourly combined	pm peak hourly volume	pm peak hourly volume	pm peak hourly combined	Per cent heavy vehicles*
	North- or east-bound	South- or west-bound	Both directions	North- or east-bound	South- or west-bound	Both directions	
Berrima Road south of Taylor Avenue	181	130	311	223	180	403	6
Berrima Road north of Douglas Road	195	139	334	250	190	440	10
Berrima Road south of Douglas Road	127	170	297	200	177	377	7
Douglas Road east of Berrima Road	33	20	53	21	58	79	29
Waite Street north of Argyle Street	343	267	610	327	330	657	4
Lackey Road north of Argyle Street	213	215	428	264	225	489	3
Argyle Street west of Waite Street	606	260	866	507	408	915	3
Argyle Street east of Waite Street	785	515	1,300	749	647	1,396	3
Argyle Street east of Lackey Road	895	694	1,589	815	905	1,720	3

Note: *Per cent heavy vehicles is the average percentage recorded from both the morning and afternoon peak hour traffic surveys.*

2.5 Levels of service

2.5.1 Standards

The daily and peak hourly traffic volume standards for major rural roads are set by the RTA Guide to Traffic Generating Developments (RTA 2002). The RTA defines six levels of service for rural roads (A, B, C, D, E and F), as described below:

- **Level of Service A**
  - The top level is a free-flow condition in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high and the general level of comfort and convenience provided to traffic is excellent.
- **Level of Service B**
  - This level is termed stable flow in which drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience for traffic is a little less than that of Level of Service A.

- **Level of Service C**
  - This level is also in the stable flow zone, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience for traffic declines noticeably at this level.
- **Level of Service D**
  - This level is close to the limit of stable flow, approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor and small increases in traffic flow will generally cause operational problems.
- **Level of Service E**
  - This level occurs when traffic volumes are at or close to capacity and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause a traffic-jam.
- **Level of Service F**
  - This level is termed forced flow where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs and queuing and delays result.

In most cases, there is little practical difference between the traffic operating conditions for levels of service A and B on two-lane major roads and motorways. The maximum hourly traffic volume standards are defined in the RTA guide (RTA 2002) for two-lane rural roads for levels of service B to E.

More detailed calculations for the levels of service on two-lane rural roads and motorways can be made by reference to the Austroads Guide to Traffic Engineering Practice–Part 2 Roadway Capacity (Austroads 1988). For the Hume Highway which is a four lane dual carriageway major road and the other major roads, which have generally been built to a two-lane rural highway standard, the hourly traffic volume ranges for levels of service are defined by the following route characteristics described below:

Hume Highway (four-lane divided road or motorway):

- typical lane width is 3.5 metres (m);
- typical sealed shoulder width is 3 m;
- typical terrain is rolling (with additional climbing lanes on steeper sections);
- typical peak hourly directional distribution of traffic (north/south) is 55%/45%;
- about 17.5% of traffic is heavy vehicles; and
- weekday peak hour traffic is around 6.5% of average daily traffic.

Old Hume Highway, Medway Road, Taylor Avenue and Berrima Road (two-lane rural highways):

- typical lane width is 3.5 m;
- typical shoulder width is 2 m (0.5 m sealed);
- typical terrain is rolling, with no overtaking for 40% of route length;
- about 10% of traffic is heavy vehicles; and
- weekday peak hour traffic is around 9% of average daily traffic.

The defined hourly and daily traffic volumes ranges for levels of service for roads with these design traffic characteristics have been calculated using the prescribed RTA method and are as given below.

On the Hume Highway (for hourly volumes in the peak direction of traffic flow*) the daily volumes are:

- Level of Service A, up to 900* vehicles per hour = up to 25,200 vehicles per day;
- Level of Service B, range 900 to 1,400* vehicles per hour (25,200–39,200 vehicles per day);
- Level of Service C, range 1,400-1,800* vehicles per hour (39,200–50,400 vehicles per day);
- Level of Service D, range 1,800-2,200* vehicles per hour (50,400–61,500 vehicles per day);
- Level of Service E, range 2,200-2,800* vehicles per hour (61,500–78,300 vehicles per day); and
- Level of Service F, over 2,800* vehicles per hour (78,300 vehicles per day).

On other major rural roads, such as the Old Hume Highway, Medway Road, Taylor Avenue and Berrima Road (for the combined hourly traffic volumes in both directions), the daily traffic volumes and levels of service are:

- Levels of Service A or B, up to 360 vehicles per hour = 4,000 vehicles per day;
- Level of Service C, range 360–650 vehicles per hour (4,000–7,220 vehicles per day);
- Level of Service D, range 650–970 vehicles per hour (7,220–10,780 vehicles per day);
- Level of Service E, range 970–1,720 vehicles per hour (10,780–19,110 vehicles per day); and
- Level of Service F, over 1,720 vehicles per hour (19,110 vehicles per day).

On two-lane urban roads, such as the Illawarra Highway route (Argyle Street) through the centre of Moss Vale, the levels of service for the hourly volumes in the peak direction of traffic flow* and the corresponding daily volumes as defined by the RTA guide (RTA 2002) are effectively:

- Level of Service A, up to 200* vehicles per hour = up to 4,000 vehicles per day;
- Level of Service B, range 200 to 380* vehicles per hour (4,000–7,700 vehicles per day);
- Level of Service C, range 380–600* vehicles per hour (7,700–12,100 vehicles per day);

- Level of Service D, range 600–900* vehicles per hour (12,100–18,200 vehicles per day);
- Level of Service E, range 900–1,400* vehicles per hour (18,200–28,300 vehicles per day); and
- Level of Service F, over 1,400* vehicles per hour (28,300 vehicles per day).

2.5.2 Current levels of service

On the Hume Highway near the project area, the surveyed peak hourly directional volumes (Table 2.2) are up to 750 vehicles per hour. These hourly volumes are within the range for Level of Service A for a dual carriageway road, where all traffic is free flowing and drivers have a high degree of freedom to travel at their desired speed, subject to the applicable maximum speed limit for the route.

On the other rural roads listed in Table 2.2, which are either two-lane local roads or rural highways, the peak hourly two-way traffic volumes are all lower than 360 vehicles per hour, which corresponds to the two highest levels of service (A or B) and unconstrained traffic flow for these routes.

On the rural and urban roads listed in Table 2.3, which include Berrima Road and Argyle Street and their major connecting roads, the combined peak hourly two-way traffic volumes for Berrima Road are up to 440 vehicles per hour at certain locations. This corresponds to Level of Service C, where the traffic flow is ‘stable’ but most drivers are restricted in their freedom to select their desired travel speed.

On Argyle Street within Moss Vale, the surveyed peak hourly directional traffic volumes are up to 905 vehicles per hour. These hourly volumes correspond to the transition stage between the levels of service D to E, where the traffic flow is highly constrained, all drivers are generally restricted in their ability to travel at their desired speed and the traffic flow is subject to frequent interruptions.

2.6 Intersections

2.6.1 Design standards

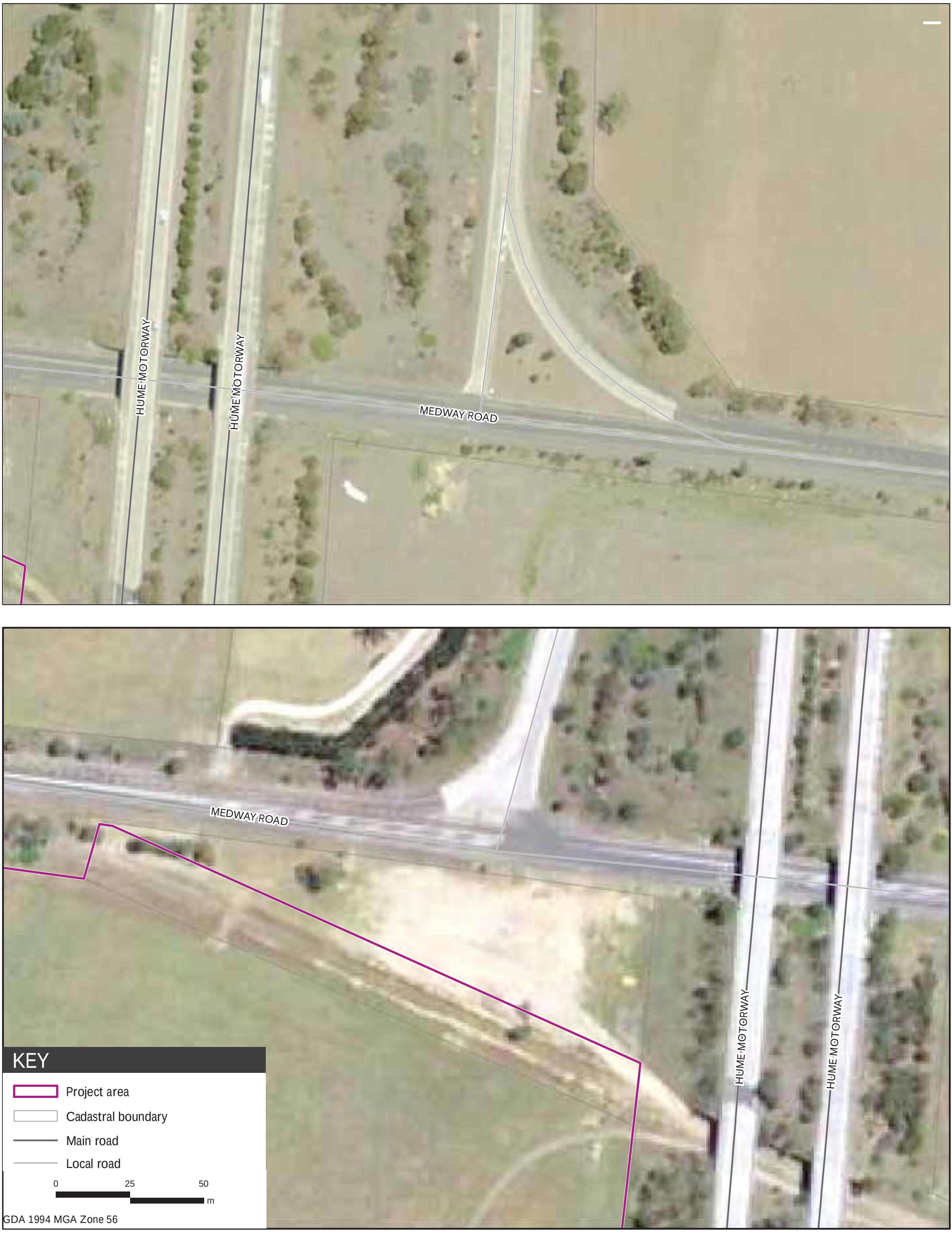
The nearest major road intersections that will be most used by project traffic are the two grade separated interchanges on the Hume Highway at Medway Road and at the Old Hume Highway (Mereworth Road).

The other nearby major road intersections that could also be affected are at Hume Highway/Golden Vale Road and Old Hume Highway/Medway Road, where there is a roundabout.

On the Berrima Road and Argyle Street routes, which connect towards and within Moss Vale, there are a number of other intersections that could also be affected, at Berrima Road/Taylor Avenue, Berrima Road/Douglas Road, Argyle Street/Waite Street and Argyle Street/Lackey Road.

The current design standard of these intersections is illustrated by Figures 2.5 to 2.9 and each intersection is described in Table 2.4. Some of these intersections have additional turning lanes. The requirements for turning and deceleration lanes at rural intersections are specified in Austroads (2010).

Where new intersections are proposed to include a left or right turning deceleration lane, the Austroads intersection design standard (Austroads 2010) is normally used to design the lane. The SIDRA intersection analysis program is also used to assess the intersection traffic delay and other operating performance, such as the maximum traffic queue length for any left or right turn deceleration/storage movement.



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Hume Highway and Medway Road ramp intersection
east side (top) and west side (bottom)
Hume Coal Project
Traffic Impact Assessment
Figure 2.5

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Hume Highway and Mereworth Road ramp intersection
east side (top) and west side (bottom)
Hume Coal Project
Traffic Impact Assessment
Figure 2.6

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Hume Highway and Golden Vale Road access intersection (top) and
Old Hume and Highway Medway Road roundabout intersection (bottom)
Hume Coal Project
Traffic Impact Assessment
Figure 2.7

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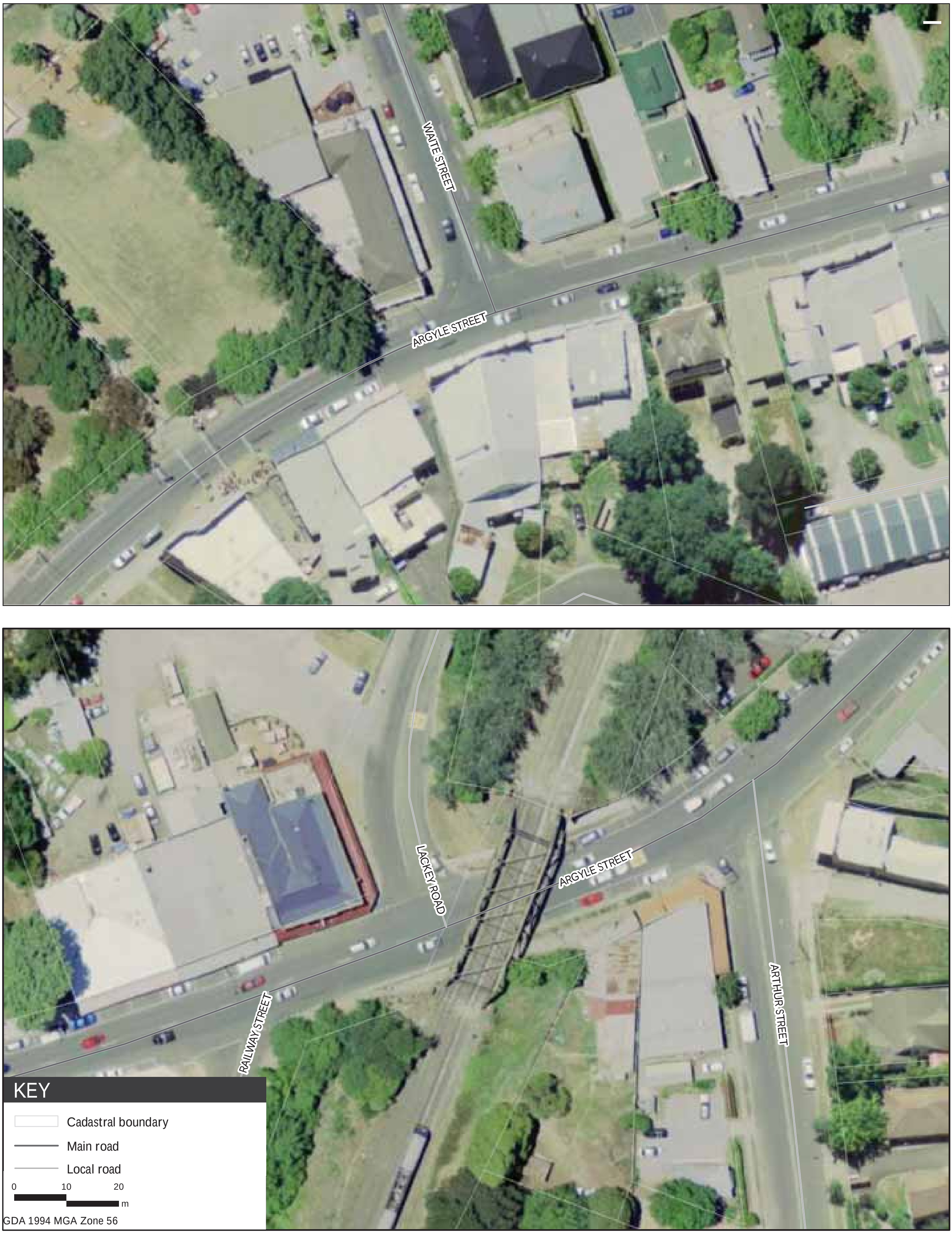
Berrima Road and Taylor Avenue Y intersection (top) and
Berrima Road and Douglas Road T intersection (bottom)
Hume Coal Project
Traffic Impact Assessment
Figure 2.8



Argyle Street and Waite Street intersection in Moss Vale (top) and Argyle Street and Lackey Road intersection in Moss Vale (bottom)

Hume Coal Project

Traffic Impact Assessment

Figure 2.9

Table 2.4 Design of existing Intersections

Major road	Minor road	Intersection type	Comment
Hume Highway	Medway Road (east side intersection)	Additional left turn merging lane for the Hume Highway exit traffic southbound	Will be used by some project traffic when travelling from the north from regional destinations
Hume Highway	Medway Road (west side intersection)	Additional left and right turning lanes for eastbound and westbound traffic on Medway Road	Will be used by some project traffic when travelling to the north to regional destinations
Hume Highway	Mereworth Road (east side intersection)	There are bypass lanes for the major traffic movements at the intersection and additional short turning lanes for the right turning traffic movements	Will be used by the majority of project traffic travelling to or from most regional and local destinations
Hume Highway	Mereworth Road (west side intersection)	No additional turning lanes. A change to the intersection priority is required as the existing intersection priority is confusing for most traffic	Will be used by virtually all the project traffic when travelling to or from regional or local destinations
Hume Highway	Golden Vale Road and private access road	This is a four-way intersection that has a wide median and deceleration lanes for left and right turning traffic from the Hume Highway	Will be used by some project traffic when travelling to or from the south to regional destinations or local destinations in the Sutton Forest area
Old Hume Highway	Medway Road and Taylor Avenue (roundabout intersection)	No additional turning lanes	Will be used by the majority of project traffic travelling to or from the north or east to and from both regional and local destinations
Berrima Road	Taylor Avenue	No additional turning lanes	Will be used by some project traffic travelling to or from the east from either regional or local destinations
Berrima Road	Douglas Road	Additional left and right turning lanes for south-east and north-westbound traffic on Berrima Road	Will be used by some project traffic travelling to or from the east from either regional or local destinations
Argyle Street	Waite Street	Additional left and right turning lanes for the north-east and south-westbound traffic on Argyle Street and a two-lane exit for the traffic using Waite Street	Will be used by some project traffic travelling to or from the east from regional destinations
Argyle Street	Lackey Road	Additional left and right turning lanes for the north-east and south-westbound traffic on Argyle Street and a two-lane exit for the traffic using Lackey Road	Will be used by some project traffic travelling to or from the east from regional destinations

2.6.2 Operating conditions

The existing intersection traffic operations for the project area intersections were assessed using SIDRA 5.1 intersection capacity analysis. The results are given in Appendix B and are interpreted according to the parameters that define different levels of service in Table 2.5.

The SIDRA analysis results, for the base year (2015) traffic, without any of the additional project traffic, are provided in Table 2.6 and 2.7.

Table 2.5 RTA/RMS Intersection level of service standards

Level of service	Average delay* (seconds per vehicle)	Traffic signals, roundabout	Priority intersection ('stop' and 'give way')
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity At signals, incidents would cause excessive delays Roundabouts require other control mode	At capacity; requires other control mode
F	Greater than 71	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing; requires other control mode

Source: *RTA (2002).*

Note: ** The average vehicle delay is calculated by the SIDRA intersection program for a roundabout or a priority controlled intersection as the vehicle movement with the highest average delay (usually the right turn movement from the minor road) regardless of how many or how few vehicles are actually using that movement at the intersection. The calculated delay for turning traffic movements also includes the geometric delay where the vehicle slows down and then accelerates after travelling through the intersection, as well as the average time spent queuing at the intersection.*

Table 2.6 Existing SIDRA intersection operations for intersections near the project area

Intersection	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of Service	Degree of saturation	Maximum queue length (m)
Hume Highway Medway Road (east side intersection)	Morning peak hour (7.45–8.45 am typically)	198	11.6	A	0.060	0
	Afternoon peak hour (3.15–4.15 pm typically)	204	11.9	A	0.065	0
Hume Highway Medway Road (west side intersection)	Morning peak hour (7.45–8.45 am typically)	100	12.5	A	0.066	2
	Afternoon peak hour (3.30–4.30 pm typically)	146	11.5	A	0.089	2
Hume Highway Mereworth Road (east side intersection)	Morning peak hour (8.00–9.00 am typically)	76	14.6	B	0.033	0
	Afternoon peak hour (3.00–4.00 pm typically)	78	11.3	A	0.022	0
Hume Highway Mereworth Road (west side intersection)**	Morning peak hour (8.00–9.00 am typically)	62	11.8	A	0.068	2
	Afternoon peak hour (4.00–5.00 pm typically)	46	12.4	A	0.054	2

Table 2.6 Existing SIDRA intersection operations for intersections near the project area

Intersection	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of Service	Degree of saturation	Maximum queue length (m)
Hume Highway southbound Golden Vale Road and private access road east side intersection	Morning peak hour (8.00–9.00 am typically)	693	18.8	B	0.170	3
	Afternoon peak hour (3.30–4.30 pm typically)	635	17.6	B	0.162	2
Hume Highway northbound Golden Vale Road and private access road west side intersection	Morning peak hour (8.00–9.00 am typically)	523	17.7	B	0.146	3
	Afternoon peak hour (3.30–4.30 pm typically)	735	21.0	B	0.191	3
Old Hume Highway Medway Road and Taylor Avenue	Morning peak hour (8.00–9.00 am typically)	358	17.1	B	0.097	4
	Afternoon peak hour (3.30–4.30 pm typically)	335	17.2	B	0.095	4

Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.

** The capacity analysis for this intersection assumes the intersection traffic priority will be changed to Mereworth Road as the existing intersection traffic priority is confusing for most traffic.

Table 2.7 Existing SIDRA intersection operations for Berrima Road and Moss Vale intersections

Intersection	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of Service	Degree of saturation	Maximum queue length (m)
Berrima Road and Taylor Avenue	Morning peak hour (8.00–9.00 am typically)	329	10.8	A	0.203	7
	Afternoon peak hour (3.15–4.15 pm typically)	427	11.9	A	0.198	6
Berrima Road and Douglas Road	Morning peak hour (8.00–9.00 am typically)	360	17.0	B	0.096	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	472	15.1	B	0.134	4
Argyle Street and Waite Street	Morning peak hour (8.00–9.00 am typically)	1,461	51.1	D	0.451	19
	Afternoon peak hour (3.15–4.15 pm typically)	1,562	38.8	C	0.478	27
Argyle Street and Lackey Road	Morning peak hour (8.00–9.00 am typically)	1,729	70.6	F	0.451	39
	Afternoon peak hour (3.15–4.15 pm typically)	1,864	102.5	F	0.541	55

Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.

2.7 Intersection levels of service

In Table 2.6 all of the intersections within or close to the project area are operating at very low degrees of saturation (less than 0.2). This corresponds to below 20% of the maximum traffic capacity of the intersection and generally provides a high intersection level of service (either A or B).

In Table 2.7, the intersections along the Berrima Road and Argyle Street routes towards and through Moss Vale become progressively more congested towards the centre of Moss Vale. The two intersections assessed in Moss Vale (at Argyle Street/Waite Street and Argyle Street/Lackey Road) are now operating with significantly congested traffic conditions during both the morning and afternoon traffic peak hours.

2.7.1 Summary of project area intersections

In Table 2.6, the two Hume Highway and Medway Road intersections have low peak hourly traffic volumes of 100–200 vehicles and are both operating at Level of Service A under all of the traffic scenarios considered. There are low degrees of saturation, 6–9% of capacity during the peak hours, and the maximum intersection traffic queues are 2 m or less typically.

The two Hume Highway and Mereworth Road intersections have very low peak hourly traffic volumes of 50–80 vehicles and are also generally operating at Level of Service A, except at the east side intersection during the morning peak hour, which has Level of Service B. There are generally very low peak hour degrees of saturation, 2–7% of capacity, with maximum intersection traffic queues 2 m or less.

The two Hume Highway and Golden Vale Road (northbound and southbound carriageway) local access intersections carry significant through traffic volumes on the Hume Highway (500–700 vehicles per hour in the peak direction) and are generally operating at Level of Service B. These two intersections have low peak hourly degrees of saturation, 15–19% of the maximum capacity for the road and maximum traffic queues of between 2–3 m.

At the Old Hume Highway, Medway Road and Taylor Avenue intersection, which has a large roundabout about 30 m in diameter, there are moderately busy peak hourly traffic volumes of 340–360 vehicles and the intersection is operating at Level of Service B under all of the traffic scenarios considered. The intersection is operating at around 10% of its maximum capacity during both the morning and afternoon peak traffic hours and the maximum traffic queues are about 4 m long.

2.7.2 Summary of Berrima Road and Moss Vale intersections

In Table 2.7, at the Berrima Road and Taylor Avenue intersection (which has an angled approach for Taylor Avenue similar to a Y-intersection), there are moderately busy peak hourly traffic volumes of 330–430 vehicles. The intersection is operating at Level of Service A under all of the traffic scenarios considered. It is operating at about 20% of its maximum capacity during the peak hours, with maximum traffic queues about 6–7 m long.

At the Berrima Road and Douglas Road intersection, there are peak hourly traffic volumes of 360–470 vehicles. The intersection is operating at Level of Service B under all of the traffic scenarios considered and at between 10% and 13% maximum capacity during the peak hours. The maximum intersection traffic queues are about 3–4 m long.

At the Argyle Street and Waite Street intersection (which is within the Moss Vale urban area), there are high peak hourly traffic volumes of 1,460–1,560 vehicles. The intersection is operating at levels of service either C or D for the peak hourly traffic volumes. It is operating at between 45% and 48% of its maximum traffic capacity during these peak hours, with maximum traffic queues between 19 m and 27 m long.

At the Argyle Street and Lackey Road intersection (which is also within the Moss Vale urban area), there are even higher peak hourly intersection traffic volumes of 1,730–1,860 vehicles, with the intersection operating at Level of Service F during both the current peak hours. The intersection is operating at between 45% to 54% maximum capacity during the peak hours, with maximum traffic queues between 39 m and 55 m long.

2.8 Traffic safety

The existing traffic safety conditions in and around the project area have been quantified by reviewing the accident records for Wingecarribee LGA and Berrima. The most recent available five-year accident history (for 2009 to 2013 inclusive) is illustrated in Figures 2.10 and 2.11 and summarised in Table 2.8.

Table 2.8 Recent five-year accident history for all roads in the Wingecarribee LGA

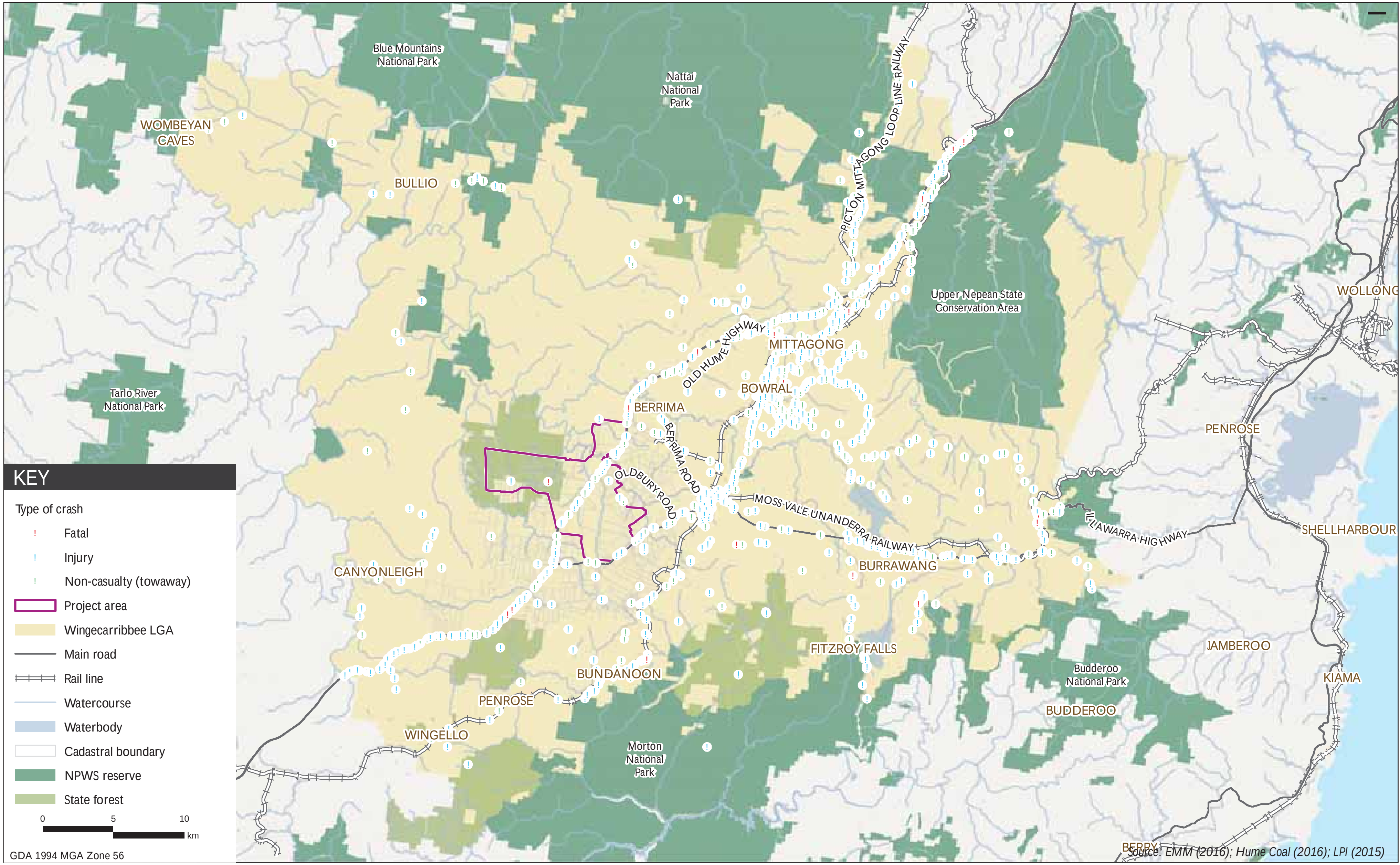
Road	2009	2010	2011	2012	2013	Average for all years
Hume Highway	50	75	80	79	72	71
Illawarra Highway	28	22	31	34	49	33
Other Roads	240	213	216	206	184	212
All Accidents	318	310	327	319	305	316

The data in Table 2.8 shows that the most accidents, about 33% of all those recorded, occurred on the two major roads in the LGA – the Hume Highway and the Illawarra Highway. Over the five years the total number of accidents in the LGA each year has not generally increased, but the number and proportion of the accidents that have occurred on the two state highways has steadily increased (from around 25% of all accidents in 2009 to almost 40% of all accidents in 2013).

The proportion and the total number of the accidents in the LGA that have occurred on the other roads (apart from the Hume Highway and Illawarra Highway) have both decreased significantly from about 240 accidents per year in 2009 to 184 accidents per year in 2013, which is a reduction of 23%. A further summary of the accident records by accident severity on each group of roads is provided in Table 2.9.

Table 2.9 Recent five-year accident history for accident severity in the Wingecarribee LGA

Road	Total accidents	Non-injury (%)	Personal injury (%)	Fatal (%)	Total persons Injured	Total fatalities
Hume Highway	356	225 (63%)	125 (35%)	6 (1.7%)	193	7
Illawarra Highway	164	79 (48%)	82 (50%)	3 (1.8%)	115	3
Other roads	1,059	573 (54%)	474 (45%)	12 (1.1%)	588	12
All accidents	1,579	877 (56%)	681 (43%)	21 (1.3%)	896	22



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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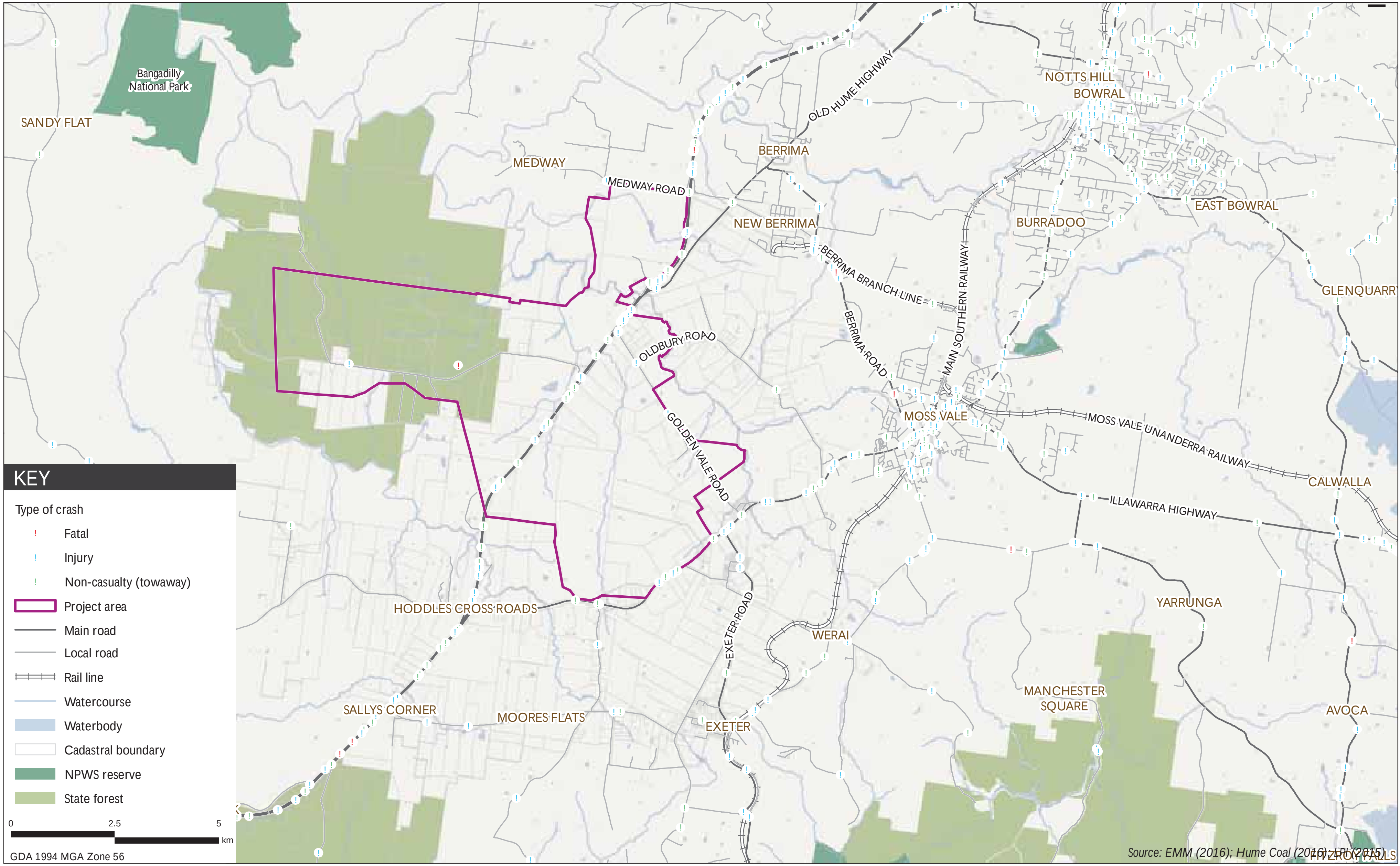
Five year (2009-2013) locality accident history map for Wingecarribee LGA

Hume Coal Project

Traffic Impact Assessment

Figure 2.10



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Five year (2009-2013) locality Accident History Map for the Berrima and Moss Vale areas

Hume Coal Project

Traffic Impact Assessment

Figure 2.11

On the two state highways, the proportion of fatal accidents is between 1.7% and 1.8%, while it is 1.1% for the other roads, giving an overall average LGA fatal accident proportion of 1.3%. This proportion is higher than the NSW state average, which was 0.8% in 2013, but is lower than in most rural areas of NSW where proportions of around 2% fatal accidents are normal.

2.9 Public transport, pedestrian and cyclist access

School buses are the main form of public transport in and around the project area. Most school buses within the study area travel to and from Mittagong, Moss Vale, Bowral and Berrima.

Commuter and CountryLink train services operate from Sydney to and from the railway stations at Mittagong, Bowral, Burradoo, Moss Vale and Exeter. Public bus services also operate within and between most of these townships but they do not extend into the main project surface access areas on the western side of the Hume Highway.

3 Details of the proposed development

3.1 Project access including accommodation village

During both the project construction and later operations stages, the main project access will be via Mereworth Road, west of the Hume Highway, where the existing road will be extended and reconstructed to an appropriate standard to service the project traffic.

Mereworth Road will also provide access to the accommodation village for the project construction stage workforce, which will accommodate up to 400 workers and be commissioned before the main stages of project construction. The construction stage will extend over about 28 months. This is currently planned to occur between November 2019 and February 2022.

Before the project accommodation village is operating, prior to March 2020, the early stage construction workforce for the project will be up to 173 persons. The project accommodation village will also accommodate additional construction personnel (up to 38 persons) working on the Berrima Rail Project. The peak project construction workforce for the project will be 414 persons. The combined peak total construction workforce for both workforces which is assessed in this report will be about 440 people in December 2020. This peak construction activity level will occur during the period when the accommodation village is operating and about 90% of the combined project construction workforce will be resident there.

The build-up of the combined project construction workforce numbers over the full 28-month construction period and the subsequent tailing off in the later months of construction, is shown in Figure 3.1.

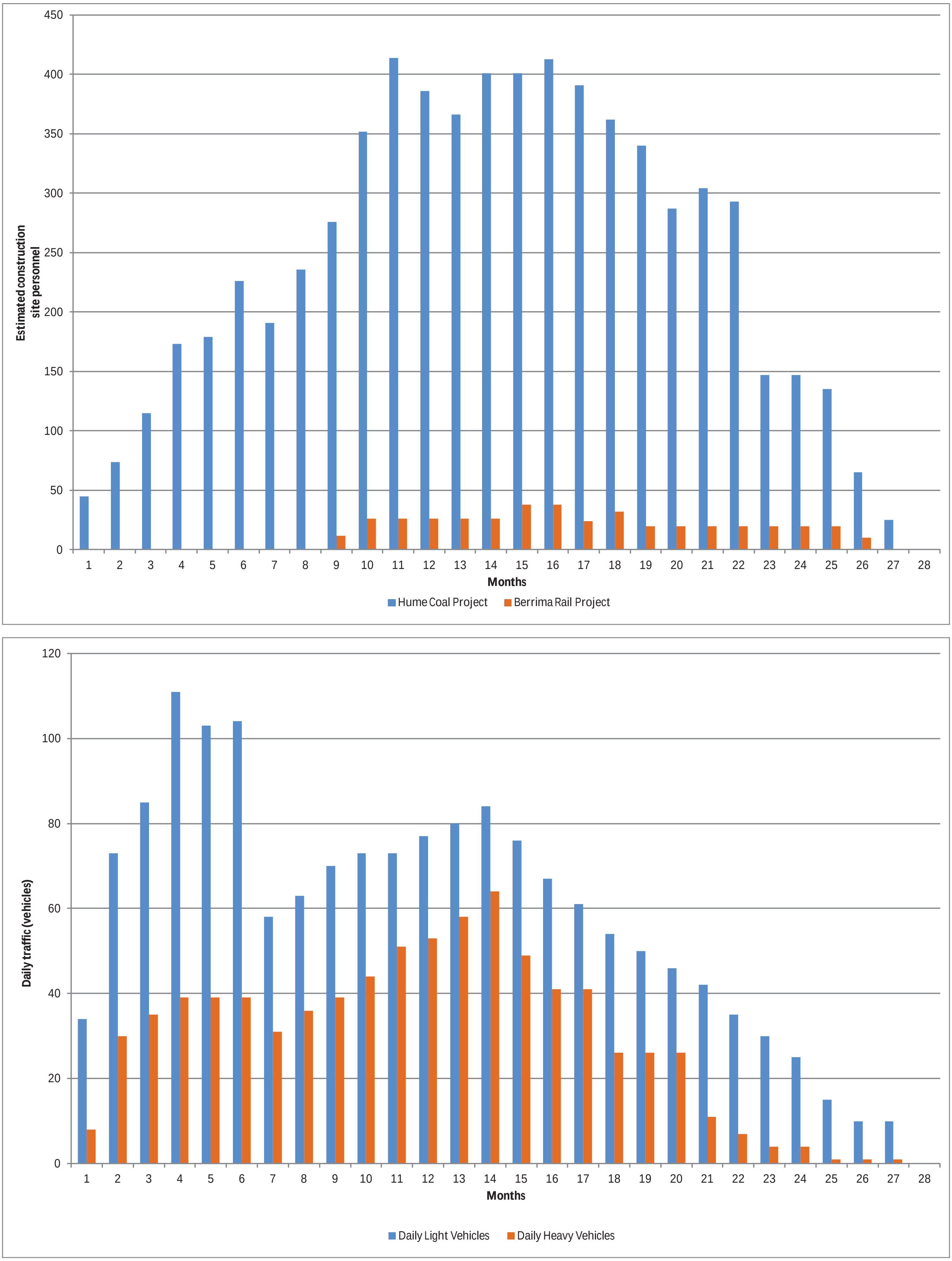
The subsequent project operations will have a 19-year operating life, and a maximum project operations workforce of about 300 full time equivalent employees.

3.2 Project workforce and hours of operation

A summary breakdown of the project workforce numbers who are travelling to and from the project area each day (excluding the accommodation village residents) is provided in Table 3.1, including the hours of operation of each shift, during the project early construction, peak construction and operations stage.

The maximum numbers of employees and employee vehicles travelling each day assumes car parking is provided at project accommodation village and surface infrastructure area for all the locally based workforce and site visitors who will be travelling by car.

Approximately 200 car parking spaces will be provided for the project accommodation village during the construction period and 176 car parking spaces will be provided at the main surface infrastructure area car parking area during project operations.



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Monthly summary of construction workforce numbers (top), and monthly summary of construction traffic generation (bottom)
Hume Coal Project
Traffic Impact Assessment
Figure 3.1

Table 3.1 Project workforce and hours of operation for light vehicle traffic

Project stage	Number of employees travelling each day	Number of light vehicles	Arrival time	Departure time
Early Stage Construction (without accommodation village)				
Day shift workforce	140	66	6–7 am	4–7 pm
Office admin staff	10	10	8–9 am	5–6 pm
Drift Construction day shift	12	12	5–6 am	6–7 pm
Drift Construction night shift	11	11	5–6 pm	6–7 am
Light vehicle supply deliveries		11	6 am–3 pm	7 am–4 pm
Head office visitors		1	8–9 am	4–5 pm
Total for early stage construction	**173**	**111**		
Peak Stage Construction (with accommodation village)				
Day shift workforce not based at the village	20	15	6–7 am	4–7 pm
Office admin staff	20	20	8–9 am	5–6 pm
Light vehicle supply deliveries		48	6 am–3 pm	7 am–4 pm
Head office visitors		1	8–9 am	4–5 pm
Total for peak stage construction	**40**	**84**		
Project operations (no accommodation village)				
Day shift workforce	53	42	6–7 am	4–5 pm
Afternoon shift workforce	52	42	2–3 pm	0–1 am
Night shift workforce	52	42	10–11 pm	8–9 am
CHPP Crew day shift	7	7	6–7 am	7–8 pm
CHPP Crew night shift	7	7	6–7 pm	7–8 am
Daytime Operations management	22	22	5–8 am	4–7 pm
Daytime CHPP management	5	5	6–7 am	4–7 pm
Daytime deliveries		5	8 am–5 pm	9 am–6 pm
Daytime visitors		2	9 am–2 pm	12 noon–5 pm
Consultants and contractors		2	8 am–1 pm	10 am–4 pm
Supplier visitors		2	10 am–3 pm	11 am–4 pm
Head office visitors		1	9–10 am	4–5 pm
Total during project operations	**198**	**179**		

3.3 Construction stage traffic generation

3.3.1 Worksite light vehicle and car traffic

From the summaries in Table 3.1, the maximum daily light vehicle traffic movements on weekdays that would be generated by the project construction workforce, accommodation village and light vehicle site visitor or delivery traffic movements would be:

- 111 daily external vehicle visits (222 daily vehicle movements) during the early stage construction work in February 2020, before the workforce accommodation village is operating; and

- 84 daily vehicle visits (168 daily vehicle movements) during the peak stage of construction work in December 2020, when about 90% of the project workforce would be resident at the accommodation village.

The proposed build-up and later decline of the project construction traffic (daily vehicle visits) by both light vehicle and heavy vehicles over the full 28-month construction period is also shown in Figure 3.1.

The main project workforce, construction materials and equipment delivery traffic movements, during all the project construction and operations stages, will all generally be travelling to and from the main project infrastructure area at the western end of Mereworth Road, which is shown in Figure 1.2. Where the project construction requires workforce and delivery access to other areas, this access will be managed according to RMS traffic control at worksite procedures.

Excluding the workforce traffic movements based around the accommodation village, the geographical distribution of the project workforce traffic movements on weekdays during the peak stage of the project construction would be about 86% locally based within the Wingecarribee LGA,. However, there would be a lower proportion (50%) of locally-based traffic movements during the early stages of construction before the accommodation village is operating, as a significant proportion (50% generally) of the early stage project construction workforce would not be locally based.

The project workforce (light vehicle) traffic proportions are summarised in Table 3.2 for the range of predicted origins and destinations within and external to the Wingecarribee LGA. The car traffic movements for the arriving and departing residents from the accommodation village would normally occur on a Sunday and would not contribute to the assessed weekday traffic movements.

Table 3.2 Project workforce traffic distribution for light vehicles

Destination	Early stage construction light vehicles	Peak stage construction light vehicles
Moss Vale	15%	25%
Mittagong	15%	25%
Bowral	11%	20%
New Berrima	2%	4%
Berrima	1%	2%
Sutton Forest	1%	2%
Exeter	1%	2%
Rural areas of Wingecarribee LGA	4%	6%
Outside LGA (Wollondilly)	21%	6%
Outside LGA (Goulburn Mulwaree)	21%	6%
Outside LGA (Kiama)	4%	1%
Outside LGA (Shoalhaven)	4%	1%
Total	**100%**	**100%**

3.3.2 Heavy vehicles

During the project construction phase heavy vehicle traffic movements will be generated by deliveries of construction materials (including gravel road base material), construction equipment and waste removal.

The estimated numbers of daily heavy vehicle deliveries and truck movements for the respective early stage and peak stage construction periods are summarised in Table 3.3.

Table 3.3 Project construction stage daily heavy vehicle traffic

Type of heavy vehicle movement	Daily number of deliveries	Approximate time period
Early Stage Construction (without accommodation village)		
Deliveries of materials	24	6 am– 6 pm
Deliveries of equipment and machinery	12	5 am–3 pm
Waste removal	3	5 am–2 pm
Total heavy vehicles	**39**	
Peak Stage Construction (with accommodation village)		
Deliveries of materials	40	6 am–6 pm
Deliveries of equipment and machinery	18	5 am–3 pm
Waste removal	6	5 am–2 pm
Total heavy vehicles	**64**	

Notes: Compiled by EMM from information provided by Palaris.

From the summaries in Table 3.3, the maximum daily heavy vehicle traffic movements on weekdays that would be generated by the project construction materials and other deliveries would be:

- 39 daily heavy vehicle visits (78 daily heavy vehicle movements) during the early stage construction work, before the workforce accommodation village is operating; and
- 64 daily vehicle visits (132 daily heavy vehicle movements) during the peak stage of construction work.

About 80% of the daily heavy vehicle delivery movements would normally occur during the morning and early afternoon (between 8 am–2 pm) on weekdays and the remaining 20% would occur at other times of the day, including some evening and night-time deliveries, such as for oversize vehicle movements that may not be allowed to travel during daylight hours.

The geographical distribution of the project heavy vehicle traffic movements would be about 20–40% contained within the Wingecarribee LGA, with the following proportions travelling via identified routes as shown in Table 3.4.

Table 3.4 Project construction heavy vehicle traffic routes

Direction and route	Proportion using route
From Sydney and the surrounding region via the Hume Highway to/from the north	40%
From Goulburn, Marulan and other areas via the Hume Highway to/from the south	20%
From the local Moss Vale area, via Berrima Road and Douglas Road	20%
From the east of Moss Vale via Berrima Road, the Illawarra Highway and other routes	20%
Total	**100%**

Notes: Compiled by EMM from information provided by Palaris.

3.4 Operations stage traffic generation

3.4.1 Light vehicle and car traffic

From the project workforce and car traffic summary in Table 3.1, the maximum daily light vehicle traffic movements that would be generated on weekdays with a maximum project operations workforce of up to 300 people would be:

- 179 daily external vehicle visits (358 daily vehicle movements).

The total project operations workforce would include 64 people working on weekend shifts, who would not travel to/or from work on normal weekdays.

The project operations workforce and other car travel movements on a normal weekday would be distributed over a wide range of daytime travel periods, including early morning, mid-afternoon and evening shift change times, which would not normally coincide with the peak hourly traffic periods for the roads surrounding the project area and through Moss Vale. These are generally between 8 am and 9 am in the morning and 4 pm and 5 pm in the afternoon at most of the major road intersections in the Moss Vale and Berrima areas.

The geographical distribution of the project workforce traffic movements on weekdays would be about 86% and contained within the Wingecarribee LGA. These proportions would be the same as were summarised in Table 3.2 for the project peak construction stage, for the same range of typical destinations within and external to the Wingecarribee LGA.

3.4.2 Heavy vehicles

The maximum daily heavy vehicle traffic movements on weekdays that project operations would generate after the completion of all construction work would be:

- 5 daily heavy vehicle visits (10 daily heavy vehicle movements) for store and bulk goods deliveries;
- 4 daily heavy vehicle visits (8 daily heavy vehicle movements) for maintenance deliveries of equipment and materials; and
- 1 daily heavy vehicle visit (2 daily heavy vehicle movements) for waste removal.

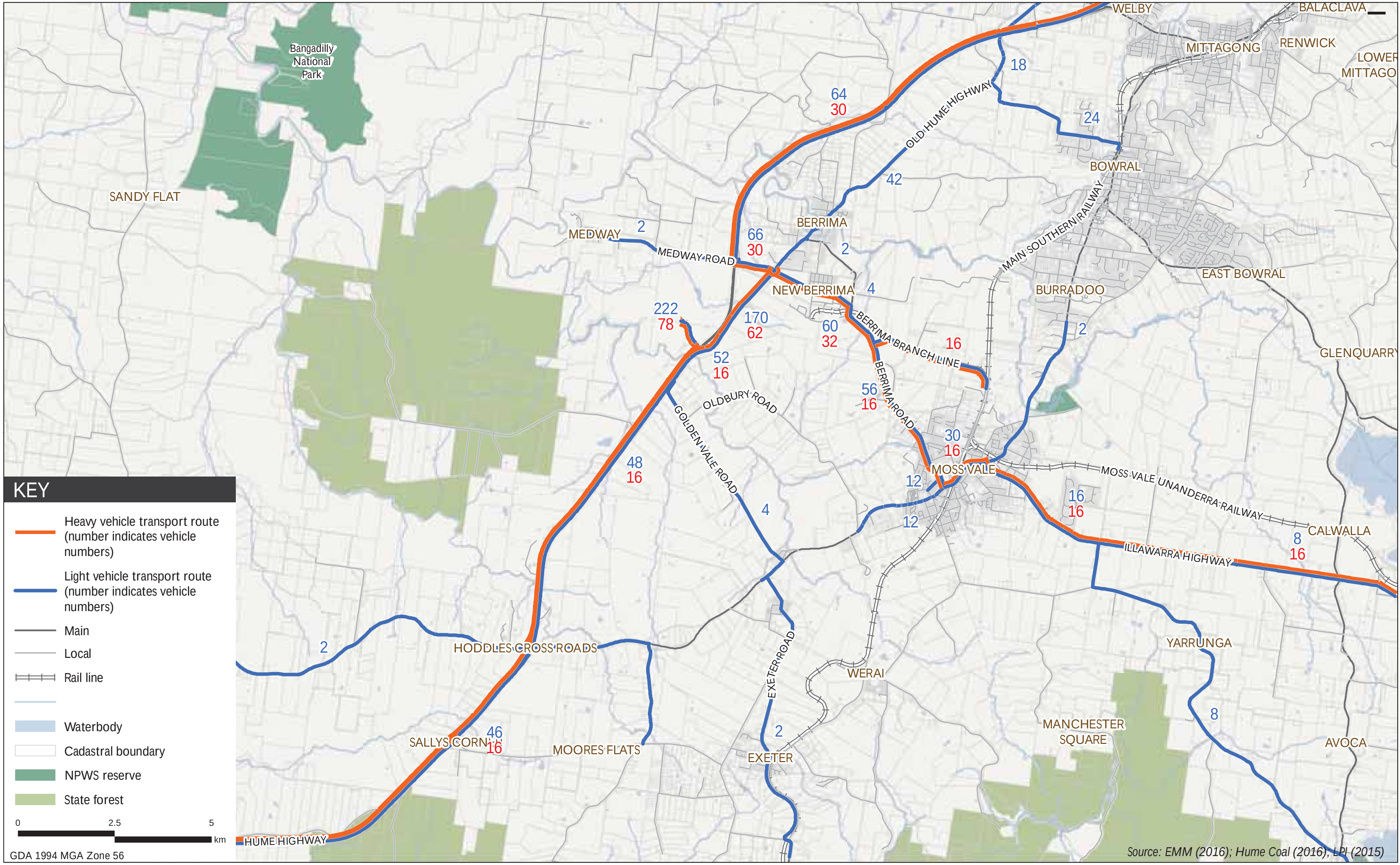
The heavy vehicle delivery movements at project operations stage would mostly occur (80%) during the morning and early afternoon (between 8 am and 2 pm) on weekdays and the remaining 20% would occur at other times of the day, including some evening and night-time deliveries. The geographical distribution of the project's heavy vehicle traffic movements would be similar to the distribution during the project construction stages, with the same proportions using the identified routes as shown in Table 3.4.

3.5 Car parking supply

Proposed car parking areas will be designed to meet the project requirements, which will generally surpass the requirements of the local council for the number of car parking spaces required for an industrial facility. A car park will be constructed for the village, which will have 200 spaces. A car park will be constructed at the surface infrastructure area for operations employees, with the capacity to accommodate 176 cars. This car park will be available early in the construction phase so that it can be used where overflow from the accommodation village car park occurs. These are shown on the site plan in Figure 1.2.

3.6 Distribution of generated traffic

Graphical plots of the geographic distribution of the project-generated car and heavy vehicle traffic movements for the early construction, peak construction and operations stages are provided in Figures 3.2, 3.3 and 3.4.

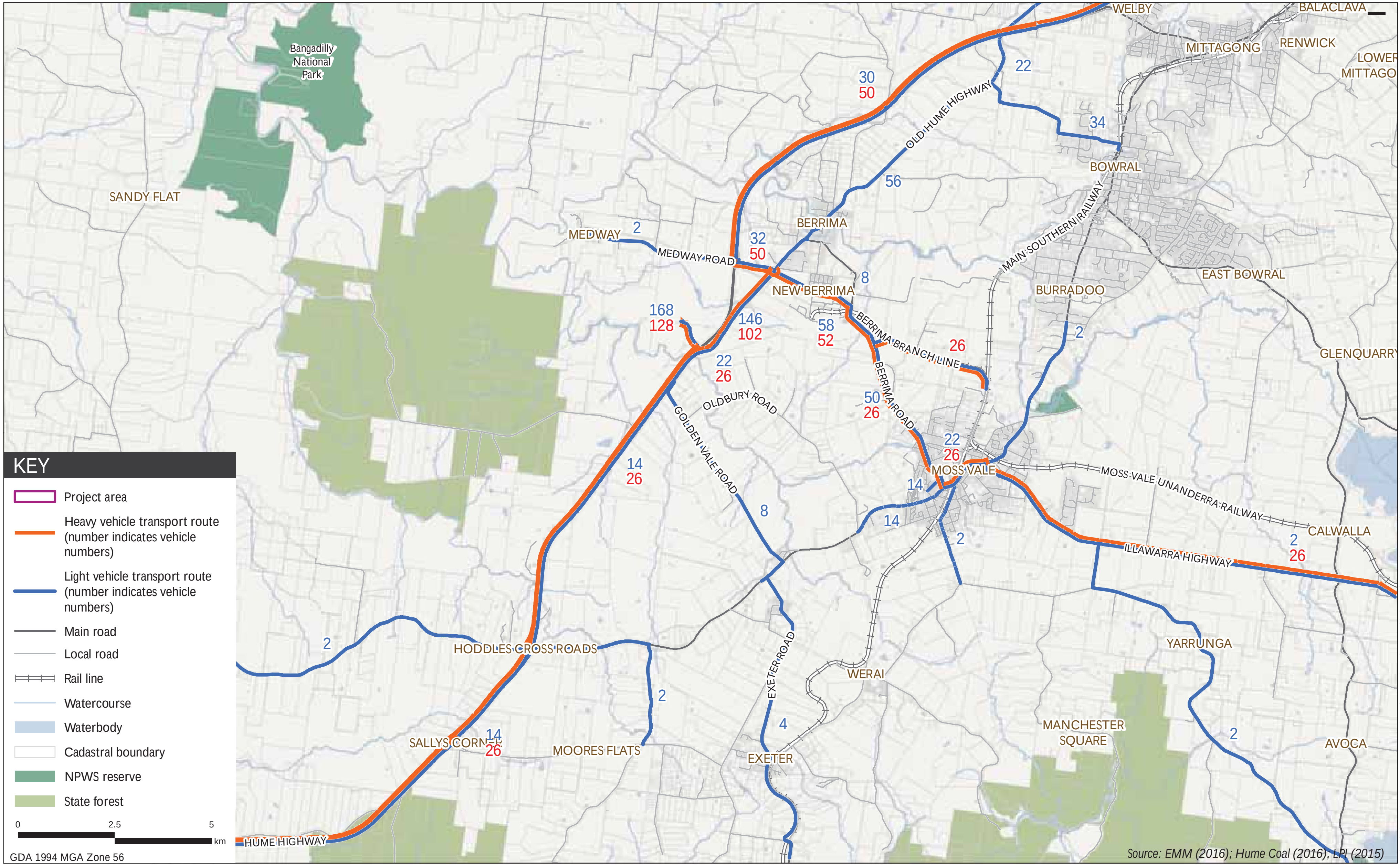


Daily traffic movements - early project construction

Hume Coal Project

Traffic Impact Assessment

Figure 3.2

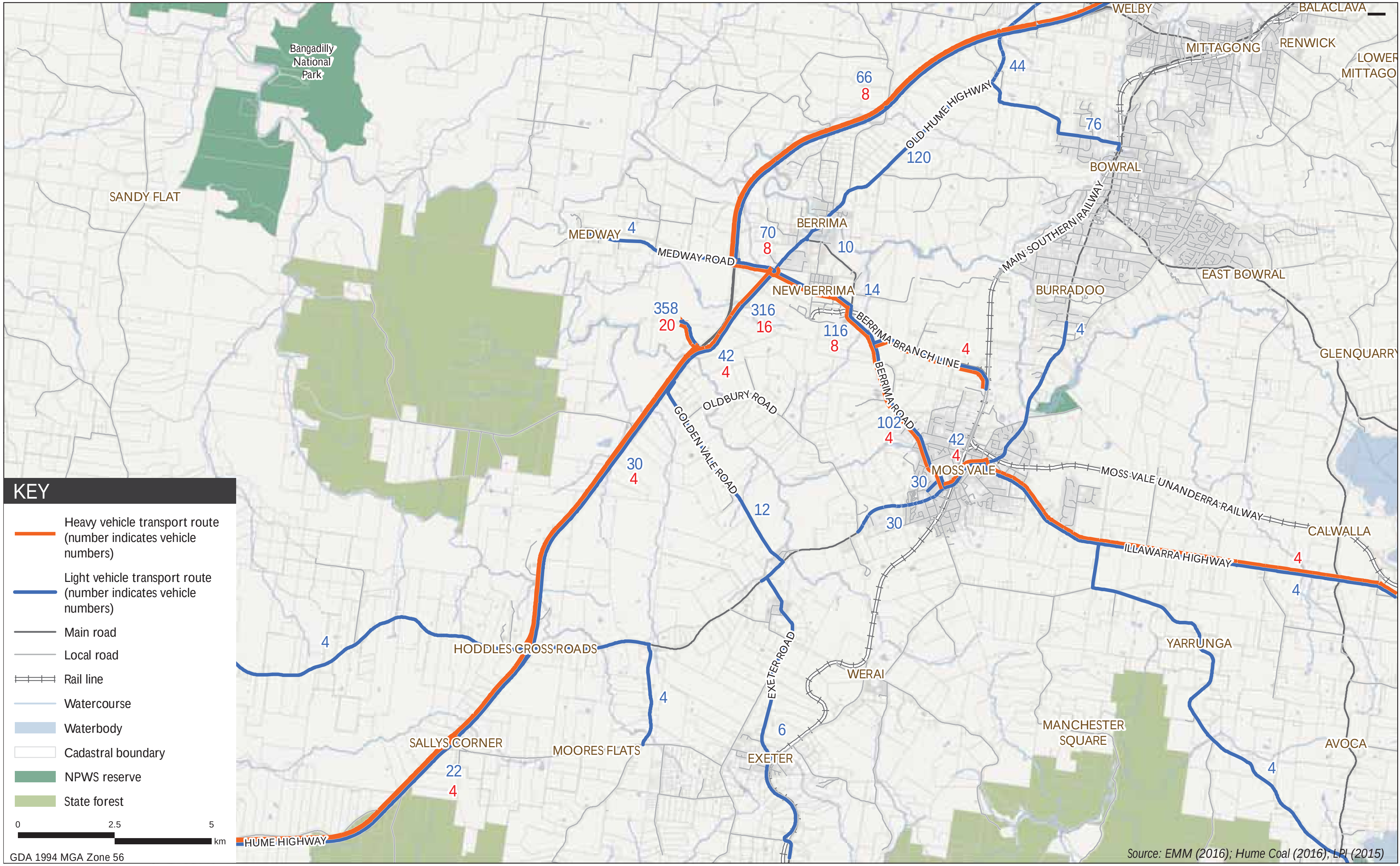


Daily traffic movements - peak project construction

Hume Coal Project

Traffic Impact Assessment

Figure 3.3



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Daily traffic movements - project operation

Hume Coal Project

Traffic Impact Assessment

Figure 3.4

4 Construction impact of the proposed development

Traffic impacts on the road network and at intersections have been determined with reference to the levels of service and intersection design standards for rural roads, as defined by the Guide to Traffic Generating Developments (RTA 2002) and the Guide to Road Design (Austroads 2010).

The assessment was nominally for the base year 2020 when the existing road network traffic volumes will have increased by around 10% (on the Hume Highway) and 5% on other routes, compared to the surveyed (year 2015) base road network traffic volumes, based on annual traffic growth of 2% for the Hume Highway and 1% for other routes.

The calculated future base year (2020) road network traffic volumes are listed in Table 4.1.

Table 4.1 Summary of calculated year 2020 base road network traffic volumes

Road	2015 morning peak hourly traffic	2015 afternoon peak hourly traffic	2015 daily traffic volume	2020 daily traffic volume
Hume Highway at Penrose			22,600*	24,900
Hume Highway south of Golden Vale Road	1,036	1,191	18,300	20,100
Hume Highway south of Mereworth Road	1,071	1,211	18,700	20,600
Hume Highway north of Medway Road	1,165	1,301	20,200	22,200
Hume Highway at Mittagong Bypass			20,900*	23,000
Old Hume Highway south of Medway Road	99	86	1,100	1,150
Old Hume Highway north of Medway Road	151	130	1,600	1,700
Medway Road west of Old Hume Highway	185	193	2,100	2,200
Medway Road west of Hume Highway	31	39	400	420
Golden Vale Road east of Hume Highway	74	74	800	840
Mereworth Road west of Hume Highway	2	2	20	22
Taylor Avenue east of Old Hume Highway	241	227	2,600	2,750
Taylor Avenue west of Berrima Road	201	251	2,500	2,650
Berrima Road south of Taylor Avenue	311	403	4,000	4,200
Berrima Road north of Douglas Road	334	440	4,300	4,500
Berrima Road south of Douglas Road	297	377	3,700	3,900
Douglas Road east of Berrima Road	53	79	700	740
Waite Street north of Argyle Street	610	657	7,000	7,350
Illawarra Highway at Sutton Forest			3,900*	4,100
Argyle Street west of Waite Street	866	915	9,900	10,400
Argyle Street east of Waite Street	1,300	1,396	15,000	15,800
Argyle Street east of Lackey Road	1,589	1,720	18,400	19,300
Illawarra Highway east of Robertson			3,600*	3,800

*Notes: * Year 2015 Volumes were extrapolated from the Year 2012 Daily Traffic Volumes as surveyed by RMS (Table 2.1).*

4.1 Road network

Tables 4.2 and 4.3 show the predicted impact of the daily construction traffic movements generated by the project and distributed onto the surrounding road network (as shown in Figures 3.3 and 3.4) in proportional terms for the project early stage and peak stage construction traffic movements.

Table 4.2 Summary of predicted year 2020 traffic increases for early stage construction

Road	2020 daily traffic volume	2020 daily project traffic	Proportional project traffic increase (%)
Hume Highway at Penrose	24,900	62	0.2
Hume Highway south of Golden Vale Road	20,100	64	0.3
Hume Highway south of Mereworth Road	20,600	68	0.3
Hume Highway north of Medway Road	22,200	94	0.4
Hume Highway at Mittagong Bypass	23,000	76	0.3
Old Hume Highway south of Medway Road	1,150	232	20.2
Old Hume Highway north of Medway Road	1,700	44	2.6
Medway Road west of Old Hume Highway	2,200	96	4.2
Medway Road west of Hume Highway	420	2	0.4
Golden Vale Road east of Hume Highway	840	4	0.5
Mereworth Road west of Hume Highway	22	300	1,364*
Taylor Avenue east of Old Hume Highway	2,750	92	3.3
Taylor Avenue west of Berrima Road	2,650	88	3.3
Berrima Road south of Taylor Avenue	4,200	88	2.1
Berrima Road north of Douglas Road	4,500	88	2.0
Berrima Road south of Douglas Road	3,900	72	1.8
Douglas Road east of Berrima Road	740	16	2.1
Waite Street north of Argyle Street	7,350	60	0.8
Illawarra Highway at Sutton Forest	4,100	4	0.1
Argyle Street west of Waite Street	10,400	14	0.1
Argyle Street east of Waite Street	15,800	46	0.3
Argyle Street east of Lackey Road	19,300	46	0.2
Illawarra Highway east of Robertson	3,800	24	0.6

Note: ** Only two rural properties have access via Mereworth Road currently so the proportional project traffic increase is very high for this route.*

Table 4.3 Summary of predicted year 2020 traffic increases for peak project construction

Road	2020 daily traffic volume	2020 daily project traffic	Proportional project traffic increase (%)
Hume Highway at Penrose	24,900	36	0.1
Hume Highway south of Golden Vale Road	20,100	40	0.2
Hume Highway south of Mereworth Road	20,600	48	0.2
Hume Highway north of Medway Road	22,200	80	0.4
Hume Highway at Mittagong Bypass	23,000	60	0.3
Old Hume Highway south of Medway Road	1,150	248	21.6
Old Hume Highway north of Medway Road	1,700	56	3.3
Medway Road west of Old Hume Highway	2,200	82	3.7
Medway Road west of Hume Highway	420	2	0.5
Golden Vale Road east of Hume Highway	840	8	1.0
Mereworth Road west of Hume Highway	22	296	1,345*
Taylor Avenue east of Old Hume Highway	2,750	110	4.0
Taylor Avenue west of Berrima Road	2,650	102	3.8
Berrima Road south of Taylor Avenue	4,200	102	2.4
Berrima Road north of Douglas Road	4,500	102	2.3
Berrima Road south of Douglas Road	3,900	76	1.9
Douglas Road east of Berrima Road	740	26	3.5
Waite Street north of Argyle Street	7,350	62	0.8
Illawarra Highway at Sutton Forest	4,100	4	0.1
Argyle Street west of Waite Street	10,400	16	0.2
Argyle Street east of Waite Street	15,800	46	0.3
Argyle Street east of Lackey Road	19,300	46	0.2
Illawarra Highway east of Robertson	3,800	28	0.7

Note: ** Only two rural properties have access via Mereworth Road currently so the proportional project traffic increase is very high for this route.*

In Tables 4.2 and 4.3, with the exception of Mereworth Road, which will effectively be reconstructed as the main future project access road, the highest proportional increases in project construction traffic (about 20–22%) will occur on the section of the Old Hume Highway route, between the project access (Mereworth Road) and Medway Road.

Due to its former use as the main Hume Highway, this section of the Old Hume Highway was previously built to a relatively high standard for prevailing traffic usage. Consequently the existing road carriageway can comfortably accommodate the future daily traffic increase related to project construction (230–250 extra daily vehicle movements) during either early stage or peak stage construction, with minimal change to the existing traffic flow conditions and level of service.

This section of the Old Hume Highway also has a relatively high proportion of existing heavy vehicle traffic, due to heavy vehicle movements from the Berrima Cement works and other local industries, such that the additional daily heavy vehicle traffic related to the project during the construction stage would be relatively minor compared to the existing heavy vehicle traffic usage.

On the other routes listed in Tables 4.2 and 4.3, the proportional daily traffic increases generated by the project will be 4% or less, which would not generally be noticeable on any specific route.

On the main street sections of the Illawarra Highway (Argyle Street) route through the Moss Vale town centre, the existing traffic volumes are already sufficiently heavy (up to 18,400 daily vehicle movements in 2015, increasing to about 19,800 daily vehicle movements in 2020) such that daily traffic increases from the project construction would be about 0.2–0.3%. This would produce only minimal disruption to the existing traffic flow conditions or the town centre traffic amenity along Argyle Street.

Nevertheless, the high existing daily traffic usage for the Argyle Route is a concern to the Wingecarribee Shire Council, which has been developing (with RMS) a preliminary traffic bypass proposal, with an additional railway line crossing at the northern edge of Moss Vale.

4.2 Intersections

The hourly traffic volumes that the project would generate during early stage and peak stage construction activity have been determined from the daily traffic volumes and are summarised in Tables 4.4 and 4.5.

During the early stage project construction, the peak period for the construction workforce traffic arrivals will be generally 6.00–7.00 am on weekday mornings. This is well before the morning peak traffic period for the surrounding roads, which is generally between 8.00 am and 9.00 am. During the peak stage of the project construction, the morning peak construction volumes will coincide more closely with the surrounding roads; but the project construction peak hourly volumes will be lower by then as the workforce accommodation village will be in use.

On weekday afternoons, the volumes of the project construction traffic that will coincide with the current afternoon peak traffic period for the surrounding roads, which is generally between 4.00 pm and 5.00 pm, will be more variable, although generally significantly lower than the morning construction traffic peak volumes.

Table 4.4 Hourly traffic generation summary for the project early construction stage

Hourly interval commencing	Light vehicles arriving	Heavy vehicles arriving	Light vehicles departing	Heavy vehicles departing	Total hourly traffic movements
0 am					
1 am					
2 am					
3 am					
4 am					
5 am	12	2			14
6 am	67	4	11	2	84
7 am	2	5	1	4	12
8 am	**13**	**5**	**1**	**5**	**24**
9 am	2	5	2	5	14
10 am	1	3	2	5	11
11 am	1	3	2	3	9
12 midday		3	1	3	7
1 pm	1	4		3	8
2 pm	1	2	1	4	8
3 pm		1	1	2	4
4 pm		**1**	**34**	**1**	**36**
5 pm	11	1	32	1	45

Table 4.4 Hourly traffic generation summary for the project early construction stage

Hourly interval commencing	Light vehicles arriving	Heavy vehicles arriving	Light vehicles departing	Heavy vehicles departing	Total hourly traffic movements
6 pm			23	1	24
7 pm					
8 pm					
9 pm					
10 pm					
11 pm					
Total	111	39	111	39	300

Table 4.5 Hourly traffic generation summary for the project peak construction

Hourly interval commencing	Light vehicles arriving	Heavy vehicles arriving	Light vehicles departing	Heavy vehicles departing	Total hourly traffic movements
0 am					
1 am					
2 am					
3 am					
4 am					
5 am		2			2
6 am	18	8		2	28
7 am	6	10	3	8	27
8 am	**27**	**8**	**6**	**10**	**51**
9 am	6	9	6	8	29
10 am	6	7	6	9	28
11 am	6	7	6	7	26
12 midday		4	6	7	17
1 pm	6	4		4	14
2 pm	6	2	6	4	18
3 pm	3	2	6	2	13
4 pm		**1**	**9**	**2**	**12**
5 pm			25	1	26
6 pm			5		5
7 pm					
8 pm					
9 pm					
10 pm					
11 pm					
Total	84	64	84	64	296

At the two Medway Road and Hume Highway interchange intersections, the respective volumes of the project construction traffic for 2015 and projected future base year 2020 traffic volumes are compared in Table 4.6 using SIDRA intersection results in Appendix B to Appendix D.

Table 4.6 Comparison of SIDRA intersection operations for Medway Road interchange

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (east side intersection)	Morning peak hour (7.45 to 8.45 am typically)	198	11.6	A	0.060	0
	Afternoon peak hour (3.15 to 4.15 pm typically)	204	11.9	A	0.065	0
Year 2015 baseline traffic (west side intersection)	Morning peak hour (7.45 to 8.45 am typically)	100	12.5	A	0.066	2
	Afternoon peak hour (3.30 to 4.30 pm typically)	146	11.5	A	0.089	2
Year 2020 baseline traffic (east side intersection)	Morning peak hour (7.45 to 8.45 am typically)	208	11.7	A	0.063	0
	Afternoon peak hour (3.15 to 4.15 pm typically)	214	12.0	A	0.068	0
Year 2020 baseline traffic (west side intersection)	Morning peak hour (7.45 to 8.45 am typically)	105	12.5	A	0.070	2
	Afternoon peak hour (3.30 to 4.30 pm typically)	154	11.5	A	0.093	2
Project early construction (east side intersection)	Morning peak hour (7.45 to 8.45 am typically)	218	11.7	A	0.068	0
	Afternoon peak hour (3.15 to 4.15 pm typically)	227	12.1	A	0.074	0
Project early construction (west side intersection)	Morning peak hour (7.45 to 8.45 am typically)	108	12.6	A	0.074	2
	Afternoon peak hour (3.30 to 4.30 pm typically)	166	11.5	A	0.103	3
Project peak construction (east side intersection)	Morning peak hour (7.45 to 8.45 am typically)	222	11.8	A	0.069	0
	Afternoon peak hour (3.15 to 4.15 pm typically)	218	12.0	A	0.070	0
Project peak construction (west side intersection)	Morning peak hour (7.45 to 8.45 am typically)	111	12.8	A	0.078	2
	Afternoon peak hour (3.30 to 4.30 pm typically)	157	11.6	A	0.097	3

Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 4.6, the future intersection traffic impacts from either project construction stage will be minimal in comparison to either 2015 or 2020 baseline traffic conditions, with the intersection level of service remaining at A for all traffic scenarios considered.

In the baseline traffic assessment results for 2020, the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 12.5 seconds and 0.093 respectively. These results would increase to 12.8 seconds and 0.097 respectively for either of the two project construction traffic scenarios analysed.

At the two Mereworth Road and Hume Highway interchange intersections, the respective volumes of the project construction traffic with the current year 2015 and projected future base year 2020 traffic volumes are compared in Table 4.7 using the SIDRA intersection results from Appendix B to Appendix D.

The SIDRA intersection analysis assumes the current intersection priority is reconfigured, as has been discussed with representatives of RMS and Wingecarribee Shire Council, to realign the future traffic priority to Mereworth Road in recognition of the increased future traffic volumes using that route. The changed traffic priority will have minimal future impact on the Hume Highway off-ramp traffic, as it already has to slow to a virtual stop to make either a sharp right or a sharp left turn at the intersection.

Table 4.7 Comparison of SIDRA intersection operations for Mereworth Road interchange

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	76	14.6	B	0.033	0
	Afternoon peak hour (3.00 to 4.00 pm typically)	78	11.3	A	0.022	0
Year 2015 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	62	11.8	A	0.068	2
	Afternoon peak hour (4.00 to 5.00 pm typically)	46	12.4	A	0.054	2
Year 2020 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	80	14.7	B	0.035	0
	Afternoon peak hour (3.00 to 4.00 pm typically)	82	11.4	A	0.023	0
Year 2020 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	64	11.8	A	0.071	2
	Afternoon peak hour (4.00 to 5.00 pm typically)	48	12.4	A	0.056	2
Project early construction (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	101	16.2	B	0.039	0
	Afternoon peak hour (3.00 to 4.00 pm typically)	120	14.0	A	0.037	0
Project early construction (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	89	12.2	A	0.074	2
	Afternoon peak hour (4.00 to 5.00 pm typically)	86	12.8	A	0.060	2
Project peak construction (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	128	16.1	B	0.046	0
	Afternoon peak hour (3.00 to 4.00 pm typically)	95	14.0	A	0.028	0
Project peak construction (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	118	13.2	A	0.078	2
	Afternoon peak hour (4.00 to 5.00 pm typically)	61	12.5	A	0.058	2

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 4.7, the future intersection traffic impacts from either project construction stage will be minimal compared to baseline traffic conditions in either 2015 or 2020, with the intersection level of service remaining at either A or B for all traffic scenarios considered.

In the baseline traffic assessment results for 2020, the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 14.7 seconds and 0.071 respectively. These results would increase to 16.1 seconds and 0.078 respectively for the two project construction traffic access scenarios considered.

At the two Golden Vale Road and Hume Highway interchange intersections, the respective volumes of the project construction traffic with the current year 2015 and projected future base year 2020 traffic volumes are compared in Table 4.8 using the SIDRA intersection results from Appendix B to Appendix D.

Table 4.8 Comparison of SIDRA intersection operations for Golden Vale Road intersections

Intersection and year of operation	**Peak hour**	**Traffic demand flow (vehicles)***	**Average vehicle delay (seconds)**	**Level of service**	**Degree of saturation**	**Maximum queue length (m)**
Year 2015 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	693	18.8	B	0.170	3
	Afternoon peak hour (3.30 to 4.30 pm typically)	635	17.6	B	0.162	2
Year 2015 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	523	17.7	B	0.146	3
	Afternoon peak hour (3.30 to 4.30 pm typically)	735	21.0	B	0.191	3
Year 2020 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	757	20.3	B	0.188	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	694	19.1	B	0.178	2
Year 2020 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	573	19.3	B	0.161	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	806	23.4	B	0.210	4
Project early construction (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	758	20.4	B	0.188	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	703	19.3	B	0.181	2
Project early construction (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	577	19.4	B	0.162	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	806	23.4	B	0.210	4
Project peak construction (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	760	20.5	B	0.189	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	695	19.1	B	0.179	2
Project peak construction (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	578	19.5	B	0.163	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	806	23.4	B	0.210	4

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 4.8, the future intersection traffic changes during either project construction stage will be minimal compared to either 2015 or 2020 baseline traffic conditions, with the intersection levels of service remaining at B for all traffic scenarios considered.

In the baseline traffic assessment results for 2020, the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 20.3 seconds (morning) and 23.4 seconds (afternoon) respectively and 0.188 (morning) and 0.210 (afternoon) respectively.

The future project construction (afternoon) maximum intersection delay and degree of saturation would not change from the future 2020 baseline traffic conditions.

The future project construction (morning) maximum intersection delay and degree of saturation would increase very marginally to 20.5 seconds and 0.189 respectively for the largest impact of the two project construction traffic scenarios analysed.

At the Old Hume Highway, Medway Road and Taylor Avenue roundabout intersections, the respective volumes of the project construction traffic with the current year 2015 and projected future base year 2020 traffic volumes are compared in Table 4.9 using SIDRA intersection results in Appendix B to Appendix D.

Table 4.9 Comparison of SIDRA intersection operations for Old Hume Highway roundabout

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic	Morning peak hour (8.00 to 9.00 am typically)	358	17.1	B	0.097	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	335	17.2	B	0.095	4
Year 2020 baseline traffic	Morning peak hour (8.00 to 9.00 am typically)	375	17.0	B	0.102	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	351	17.3	B	0.101	4
Project early construction	Morning peak hour (8.00 to 9.00 am typically)	395	17.5	B	0.109	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	379	16.7	B	0.101	4
Project peak construction	Morning peak hour (8.00 to 9.00 am typically)	420	17.7	B	0.097	5
	Afternoon peak hour (3.30 to 4.30 pm typically)	362	17.2	B	0.101	4

Notes: **The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

In the baseline traffic assessment results for 2020, the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 17.0 seconds (morning) and 17.3 seconds (afternoon) respectively and 0.102 (morning) and 0.101 (afternoon) respectively.

The future project construction (afternoon) maximum intersection delay and degree of saturation would not generally increase from the future baseline year 2020 traffic conditions.

The future project construction (morning) maximum intersection delay and degree of saturation would increase very marginally to 17.7 seconds and 0.109 respectively for the largest impact of the two project construction traffic scenarios analysed.

At the two Berrima Road intersections, with Taylor Avenue and Douglas Road, the respective volumes of the project construction traffic with the current year 2015 and projected future base year 2020 traffic volumes are compared in Table 4.10 using the SIDRA intersection results from Appendix B to Appendix D.

Table 4.10 Comparison of SIDRA intersection operations for two Berrima Road intersections

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (Taylor Avenue intersection)	Morning peak hour (8.00 to 9.00 am typically)	329	10.8	A	0.203	7
	Afternoon peak hour (3.15 to 4.15 pm typically)	427	11.9	A	0.198	6
Year 2015 baseline traffic (Douglas Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	360	17.0	B	0.096	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	472	15.1	B	0.134	4
Year 2020 baseline traffic (Taylor Avenue intersection)	Morning peak hour (8.00 to 9.00 am typically)	347	10.9	A	0.218	7
	Afternoon peak hour (3.15 to 4.15 pm typically)	448	12.2	A	0.214	7
Year 2020 baseline traffic (Douglas Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	379	17.1	B	0.101	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	493	15.4	B	0.142	4
Project early construction (Taylor Avenue intersection)	Morning peak hour (8.00 to 9.00 am typically)	355	11.1	A	0.226	8
	Afternoon peak hour (3.15 to 4.15 pm typically)	455	12.1	A	0.223	7
Project early construction (Douglas Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	386	18.0	B	0.102	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	499	15.5	B	0.143	4
Project peak construction (Taylor Avenue intersection)	Morning peak hour (8.00 to 9.00 am typically)	365	11.3	A	0.236	8
	Afternoon peak hour (3.15 to 4.15 pm typically)	453	12.2	A	0.222	7
Project peak construction (Douglas Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	397	19.0	B	0.104	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	497	15.4	B	0.143	4

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

At the Berrima Road and Taylor Avenue intersection, the 2020 baseline traffic assessment results show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 10.9 seconds (morning) and 12.2 seconds (afternoon) respectively and 0.218 (morning) and 0.214 (afternoon) respectively.

The future project construction (afternoon) maximum intersection delays would not generally increase from the future baseline traffic conditions in 2020.

The future project construction (morning) maximum intersection delay and degree of saturation would increase very marginally to 11.3 seconds and 0.236 respectively for the largest impact of the two project construction traffic scenarios analysed.

At the Berrima Road and Douglas Road intersection the baseline traffic assessment results for 2020 show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 17.1 seconds (morning) and 15.4 seconds (afternoon) respectively and 0.101 (morning) and 0.142 (afternoon) respectively.

The future project construction (afternoon) maximum intersection delay and degree of saturation would not generally increase from the future baseline year 2020 traffic conditions.

The future project construction (morning) maximum intersection delay and degree of saturation would increase marginally to 19.0 seconds and 0.104 respectively for the largest impact of the two project construction traffic scenarios analysed.

At the two Argyle Street intersections in Moss Vale, with Waite Street and Lackey Road, the respective volumes of the project construction traffic with the current year 2015 and projected future base year 2020 traffic volumes are compared in Table 4.11 using the SIDRA intersection results from Appendix B to Appendix D.

Table 4.11 Comparison of SIDRA intersection operations for two Argyle Street intersections

Intersection and year of operation	**Peak hour**	**Traffic demand flow (vehicles)***	**Average vehicle delay (seconds)**	**Level of service**	**Degree of saturation**	**Maximum queue length (m)**
Year 2015 baseline traffic (Waite Street intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,461	51.1	D	0.451	19
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,562	38.8	C	0.478	27
Year 2015 baseline traffic (Lackey Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,729	70.6	F	0.451	39
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,864	102.5	F	0.541	55
Year 2020 baseline traffic (Waite Street intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,535	59.0	E	0.495	21
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,639	44.6	D	0.519	30
Year 2020 baseline traffic (Lackey Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,816	82.5	F	0.499	43
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,957	129.3	F	0.580	59

Table 4.11 Comparison of SIDRA intersection operations for two Argyle Street intersections

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Project early construction (Waite Street intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,539	59.4	E	0.500	21
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,643	45.5	D	0.522	30
Project early construction (Lackey Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,819	83.1	F	0.500	43
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,959	130.1	F	0.581	59
Project peak construction (Waite Street intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,545	57.8	E	0.502	21
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,642	45.1	D	0.522	30
Project peak construction (Lackey Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,823	83.8	F	0.502	43
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,959	130.1	F	0.581	59

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

At the Argyle Street and Waite Street intersection, the baseline traffic assessment results for 2020 show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 59.0 seconds (morning) and 44.6 seconds (afternoon) respectively and 0.495 (morning) and 0.519 (afternoon) respectively. These intersection traffic conditions correspond to Level of Service E (morning) and Level of Service D (afternoon) for the respective peak hour traffic conditions.

The future project construction (afternoon) maximum intersection delays would not generally result in any significant change to the future baseline traffic conditions for 2020 at the intersection, with no change to the future intersection peak hour levels of service.

The future project construction (morning) maximum intersection delay and degree of saturation would increase very marginally to 59.4 seconds and 0.502 respectively for the largest impact of the two project construction traffic scenarios analysed.

The future project construction (afternoon) maximum intersection delay and degree of saturation would increase very marginally to 45.5 seconds and 0.522 respectively for the largest impact of the two project construction traffic scenarios analysed.

At the Argyle Street and Lackey Road intersection, the baseline traffic assessment results for 2020 show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 82.5 seconds (morning) and 129.3 seconds (afternoon) respectively and 0.499 (morning) and 0.580 (afternoon) respectively. These intersection traffic conditions correspond to Level of Service F for both the morning and afternoon peak hour traffic conditions.

The future project construction (afternoon) maximum intersection delays would not generally result in any significant change to the baseline traffic conditions for 2020 at the intersection, with no change to the future intersection peak hour levels of service.

The future project construction (morning) maximum intersection delay and degree of saturation would increase very marginally to 83.8 seconds and 0.502 respectively for the largest impact of the two project construction traffic scenarios analysed.

The future project construction (afternoon) maximum intersection delay and degree of saturation would increase very marginally to 130.1 seconds and 0.581 respectively for the largest impact of the two project construction traffic scenarios analysed.

Although this assessment shows the future peak hourly intersection traffic conditions at the two Argyle Street intersections will be congested (in particular at the Lackey Road intersection), there will be no significant worsening of the intersection traffic operations with the future project construction traffic.

4.3 Traffic safety

The detailed accident review for the LGA and the Moss Vale local area (see Section 2.8 of this assessment) has shown a generally good and improving road safety record for most roads in the LGA, particularly the local road network managed by the Wingecarribee Shire Council, which excludes the two major state highways, the Hume Highway and the Illawarra Highway.

The proposed project (construction stage) daily traffic movements would not have any adverse road safety implications for the LGA road network, in particularly as the project will mainly use a locally-based workforce, with generally 85% of employed persons resident within the Wingecarribee LGA, largely in Moss Vale, Mittagong and Bowral, except for during the early construction stage.

The use of a primarily locally based workforce, or workforce resident at the project accommodation village, during the majority of the project construction period, will minimise the longer distance workforce commuter traffic movements, which could otherwise contribute to an increased road safety risk for the workforce associated with the project.

4.4 Road condition

The potential traffic impact to the road pavement condition, on the access routes which are proposed to be used by project generated truck traffic during the construction phase, will depend on the existing route condition and the combination of the existing and the proposed project daily truck movements.

On the Hume Highway and Illawarra Highway routes, which carry large volumes of interstate and long distance truck traffic currently, the additional project generated daily truck traffic movements are expected to have minimal impacts to the road pavement condition. On the other major road routes in the Moss Vale and Berrima areas which are under the care and control of the local Council, such as Old Hume Highway and Berrima Road, these roads are also used by substantial volumes of heavy truck traffic from local heavy industries, such that significant additional road pavement condition impacts from the project truck traffic are also unlikely to occur.

4.5 Access by public transport and other travel modes

The immediate locality of the mine project area on the western side of the Hume Highway, which is accessed via Mereworth Road, is generally remote from the existing locality (local and regional) bus- and rail-based public transport services.

Consequently the project construction workforce or people visiting the project area are unlikely to use public transport services in the future, and such access or the need to provide services have not been specifically analysed in this traffic impacts assessment.

During the peak stages of project construction, when most of the project workforce will be resident on weekdays at the project accommodation village and will generally transfer their shifts at weekends, a proportion of the shift transfer movements could use charter coach to travel. For example, on weekends, if there were large numbers of the future construction workforce who did not live in either Wingecarribee LGA or the Sydney metropolitan area, those workers could travel to and from Sydney Airport by coach.

5 Operations impact of the proposed development

Traffic impacts on the road network and at intersections have been determined with reference to the levels of service and intersection design standards for rural roads, as defined by the Guide to Traffic Generating Developments (RTA 2002) and the Guide to Road Design (Austroads 2010).

The assessment is nominally for the base year 2020 when the existing road network traffic volumes will have increased by about 10% on the Hume Highway and 5% on other routes, compared to the surveyed (year 2015) base road network traffic volumes.

5.1 Road network

The predicted impact of the daily operations traffic movements generated by the project (shown in Figure 3.6) is shown in proportional terms in Table 5.1 based on the year 2020 baseline road network traffic volumes.

Table 5.1 Summary of predicted year 2020 traffic increases for project operations

Road	2020 daily traffic volume	2020 daily project traffic	Proportional project traffic increase (%)
Hume Highway at Penrose	24,900	26	0.1
Hume Highway south of Golden Vale Road	20,100	34	0.2
Hume Highway south of Mereworth Road	20,600	46	0.2
Hume Highway north of Medway Road	22,200	74	0.3
Hume Highway at Mittagong Bypass	23,000	30	0.1
Old Hume Highway south of Medway Road	1,150	332	28.9
Old Hume Highway north of Medway Road	1,700	130	7.6
Medway Road west of Old Hume Highway	2,200	78	3.5
Medway Road west of Hume Highway	420	4	1.0
Golden Vale Road east of Hume Highway	840	12	1.4
Mereworth Road west of Hume Highway	22	378	1,718*
Taylor Avenue east of Old Hume Highway	2,750	124	4.5
Taylor Avenue west of Berrima Road	2,650	110	4.2
Berrima Road south of Taylor Avenue	4,200	110	2.6
Berrima Road north of Douglas Road	4,500	110	2.4
Berrima Road south of Douglas Road	3,900	106	2.7
Douglas Road east of Berrima Road	740	4	0.5
Waite Street north of Argyle Street	7,350	76	1.0
Illawarra Highway at Sutton Forest	4,100	6	0.1
Argyle Street west of Waite Street	10,400	30	0.3
Argyle Street east of Waite Street	15,800	46	0.3
Argyle Street east of Lackey Road	19,300	46	0.2
Illawarra Highway east of Robertson	3,800	8	0.2

Note: ** Only two rural properties have access via Mereworth Road currently so the proportional project traffic increase is very high for this route.*

In Table 5.1, with the exception of Mereworth Road, which will effectively be rebuilt as the main future project access road, the highest proportion of increases in project operations traffic (28.9% and 7.6%) will occur on the section of the Old Hume Highway route to the north and the south of the Medway Road and Taylor Avenue (roundabout) intersection.

These sections of the Old Hume Highway were previously built to a relatively high design standard due to their former use as the main Hume Highway route. The existing road carriageway can comfortably accommodate the future project operations-related daily traffic increase (130–330 extra daily vehicle movements) with minimal change to the existing traffic flow conditions and level of service. This includes the potential environmental amenity impacts where the Old Hume Highway route passes through Berrima.

On the other routes listed in Table 5.1, the proportional daily traffic increases generated by the project will be generally 4% or less, which would not normally be noticeable on these routes.

On the main Illawarra Highway route (Argyle Street) through the town centre of Moss Vale, the existing traffic volumes are already generally heavy, up to 18,400 daily vehicle movements in 2015 and predicted to increase to approximately 19,800 daily vehicle movements by 2020.

Similarly to during project construction the proportional project operations daily traffic increases of 0.2% to 0.3% on this route would produce only minimal traffic impacts to existing traffic flow conditions or the town centre traffic amenity along Argyle Street.

The high existing daily traffic usage for the Argyle Route is a concern to the Wingecarribee Shire Council who have been developing (in conjunction with RMS) a preliminary traffic bypass proposal, with an additional railway line crossing, at the northern edge of Moss Vale township.

5.2 Intersections

The hourly traffic volumes for the operations workforce and other site operations traffic are summarised in Table 5.2. It shows the morning peak period for the operations workforce shift traffic, which comprises mainly workforce arrivals, will be between 6.00 am and 7.00 am on weekday mornings. This is well before the morning peak traffic period for the surrounding roads, as summarised in Table 2.2. Normally, however, there will be some traffic from night-shift departures from the mine between 8.00 am and 9.00 am.

During the main afternoon peak period for the operations workforce shift traffic, traffic departures will mainly be from 4.00–5.00 pm on weekdays. They will generally coincide with the afternoon peak traffic periods at most intersections on the surrounding road network that, as summarised in Table 2.2, are generally between 3.30 pm and 4.30 pm.

Table 5.2 Hourly traffic generation summary for project operations

Hourly interval commencing	Light vehicles arriving	Heavy vehicles arriving	Light vehicles departing	Heavy vehicles departing	Total hourly traffic movements
0 am			42		42
1 am					
2 am		1			1
3 am					
4 am				1	1
5 am	7				7
6 am	62	1			63
7 am	7		7	1	15
8 am	**2**	**2**	**42**		**46**
9 am	2		1	1	4
10 am	2	1	1	1	5
11 am			2	1	3
12 midday	2	1	1		4
1 pm	1		1	1	3
2 pm	44	2			46
3 pm			3	1	4
4 pm	**1**	**1**	**53**	**1**	**56**
5 pm			10	1	11
6 pm	7		9		16
7 pm			7		7
8 pm		1			1
9 pm					0
10 pm	42			1	43
11 pm					0
Total	179	10	179	10	378

At the two Medway Road and Hume Highway interchange intersections, the respective volumes of the project operations traffic for 2015 and the projected future base year 2020 are compared in Table 5.3 using the SIDRA intersection results from Appendices B, C and E.

Table 5.3 Comparison of SIDRA intersection operations for Medway Road interchange

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (east side intersection)	Morning peak hour (7.45 to 8.45 am typically)	198	11.6	A	0.060	0
	Afternoon peak hour (3.15 to 4.15 pm typically)	204	11.9	A	0.065	0
Year 2015 baseline traffic (west side intersection)	Morning peak hour (7.45 to 8.45 am typically)	100	12.5	A	0.066	2
	Afternoon peak hour (3.30 to 4.30 pm typically)	146	11.5	A	0.089	2

Table 5.3 Comparison of SIDRA intersection operations for Medway Road interchange

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2020 baseline traffic (east side intersection)	Morning peak hour (7.45 to 8.45 am typically)	208	11.7	A	0.063	0
	Afternoon peak hour (3.15 to 4.15 pm typically)	214	12.0	A	0.068	0
Year 2020 baseline traffic (west side intersection)	Morning peak hour (7.45 to 8.45 am typically)	105	12.5	A	0.070	2
	Afternoon peak hour (3.30 to 4.30 pm typically)	154	11.5	A	0.093	2
Project operations traffic (east side intersection)	Morning peak hour (7.45 to 8.45 am typically)	218	11.7	A	0.064	0
	Afternoon peak hour (3.15 to 4.15 pm typically)	226	12.1	A	0.074	0
Project operations traffic (west side intersection)	Morning peak hour (7.45 to 8.45 am typically)	114	12.4	A	0.077	2
	Afternoon peak hour (3.30 to 4.30 pm typically)	165	11.5	A	0.103	3

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 5.3, the future intersection traffic impacts from project operations will be minimal, in comparison to either the 2015 or 2020 baseline traffic conditions, with the future intersection levels of service remaining at A for all traffic scenarios considered.

In the 2020 baseline traffic assessment results, the maximum intersection traffic delay and maximum degree of saturation for any morning or afternoon peak hour traffic movement will be 12.5 seconds and 0.093 respectively. The maximum intersection delays will not increase with the project operations traffic, although the maximum intersection degree of saturation would increase marginally to 0.103.

At the two Mereworth Road and Hume Highway interchange intersections, the respective volumes of the project operations traffic are compared with the 2015 and projected future base year 2020 traffic volumes in Table 5.4, using the SIDRA intersection results from Appendices B, C and E.

Similarly to during project construction, the SIDRA intersection analysis assumes the current intersection priority is reconfigured to realign the future traffic priority to Mereworth Road, in recognition of the increased future traffic volumes using that route. The changed traffic priority will have minimal future impact on the Hume Highway off-ramp traffic, as it already has to slow to a virtual stop to make either a sharp right or a sharp left turn at the intersection.

Table 5.4 Comparison of SIDRA intersection operations for Mereworth Road interchange

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	76	14.6	B	0.033	0
	Afternoon peak hour (3.00 to 4.00 pm typically)	78	11.3	A	0.022	0
Year 2015 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	62	11.8	A	0.068	2
	Afternoon peak hour (4.00 to 5.00 pm typically)	46	12.4	A	0.054	2
Year 2020 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	80	14.7	B	0.035	0
	Afternoon peak hour (3.00 to 4.00 pm typically)	82	11.4	A	0.023	0
Year 2020 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	64	11.8	A	0.071	2
	Afternoon peak hour (4.00 to 5.00 pm typically)	48	12.4	A	0.056	2
Project operations traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	128	13.4	A	0.056	0
	Afternoon peak hour (3.00 to 4.00 pm typically)	141	13.0	A	0.037	0
Project operations traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	113	12.3	A	0.076	2
	Afternoon peak hour (4.00 to 5.00 pm typically)	107	13.1	A	0.062	2

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 5.4, the future intersection traffic impacts from project operations traffic will be minimal in comparison to either 2015 or 2020 baseline traffic conditions, with the future intersection levels of service remaining at either A or B for all traffic scenarios considered.

In the 2020 baseline traffic assessment results, the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 14.7 seconds and 0.071 respectively.

The maximum intersection traffic delays would not increase with the project operations traffic, and the maximum degree of saturation would increase marginally to 0.078 as a result of the project operations traffic.

In Table 5.5, the respective volumes of the project operations traffic in 2015 and projected future base year 2020 traffic volumes are compared at the two Golden Vale Road and Hume Highway interchange intersections, using the SIDRA intersection results from Appendices B, C and E.

Table 5.5 Comparison of SIDRA intersection operations for Golden Vale Road intersections

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	693	18.8	B	0.170	3
	Afternoon peak hour (3.30 to 4.30 pm typically)	635	17.6	B	0.162	2
Year 2015 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	523	17.7	B	0.146	3
	Afternoon peak hour (3.30 to 4.30 pm typically)	735	21.0	B	0.191	3
Year 2020 baseline traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	757	20.3	B	0.188	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	694	19.1	B	0.178	2
Year 2020 baseline traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	573	19.3	B	0.161	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	806	23.4	B	0.210	4
Project operations traffic (east side intersection)	Morning peak hour (8.00 to 9.00 am typically)	762	20.4	B	0.188	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	700	19.2	B	0.179	2
Project operations traffic (west side intersection)	Morning peak hour (8.00 to 9.00 am typically)	573	19.3	B	0.161	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	806	23.4	B	0.210	4

Notes: **The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 5.5, the future intersection traffic changes during project operations will be minimal in comparison to either 2015 or 2020 baseline traffic conditions, with the future intersection levels of service remaining at B for all traffic scenarios considered.

In the 2020 baseline traffic assessment results, the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 20.3 seconds (morning) and 23.4 seconds (afternoon) respectively and 0.188 (morning) and 0.210 (afternoon) respectively.

The future project operations (morning) maximum intersection delay would increase very marginally to 20.4 seconds although the maximum degree of saturation would not change from the future 2020 baseline traffic conditions.

The future project operations (afternoon) maximum intersection delay and degree of saturation would not change from the future 2020 baseline traffic conditions.

At the Old Hume Highway, Medway Road and Taylor Avenue roundabout intersections, the respective volumes of the project operations traffic are compared with 2015 and projected future base year 2020 traffic volumes in Table 5.6 using the SIDRA intersection results in Appendices B, C and E.

Table 5.6 Comparison of SIDRA intersection operations for Old Hume Highway roundabout

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic	Morning peak hour (8.00 to 9.00 am typically)	358	17.1	B	0.097	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	335	17.2	B	0.095	4
Year 2020 baseline traffic	Morning peak hour (8.00 to 9.00 am typically)	375	17.0	B	0.102	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	351	17.3	B	0.101	4
Project operations traffic	Morning peak hour (8.00 to 9.00 am typically)	418	17.5	B	0.107	4
	Afternoon peak hour (3.30 to 4.30 pm typically)	403	16.8	B	0.101	4

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 5.6, the future intersection traffic impacts from project operations traffic will be minimal in comparison to either 2015 or 2020 baseline traffic conditions, with the intersection level of service remaining at B for all the traffic scenarios considered.

In the 2020 baseline traffic assessment results, the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 17.0 seconds (morning) and 17.3 seconds (afternoon) respectively and 0.102 (morning) and 0.101 (afternoon) respectively.

The future project operations (afternoon) maximum intersection traffic delay and degree of saturation would not generally increase from the future baseline year 2020 traffic.

The future project operations (morning) maximum intersection traffic delay and degree of saturation would increase marginally to 17.5 seconds and 0.107 respectively, which would represent a relatively minor impact for the morning peak hour project operations traffic.

At the two Berrima Road intersections, with Taylor Avenue and Douglas Road, the respective volumes of the project operations traffic in 2015 and projected future base year 2020 traffic volumes are compared in Table 5.7 using the SIDRA intersection results from Appendices B, C and E.

Table 5.7 Comparison of SIDRA intersection operations for two Berrima Road intersections

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (Taylor Avenue intersection)	Morning peak hour (8.00 to 9.00 am typically)	329	10.8	A	0.203	7
	Afternoon peak hour (3.15 to 4.15 pm typically)	427	11.9	A	0.198	6
Year 2015 baseline traffic (Douglas Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	360	17.0	B	0.096	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	472	15.1	B	0.134	4
Year 2020 baseline traffic (Taylor Avenue intersection)	Morning peak hour (8.00 to 9.00 am typically)	347	10.9	A	0.218	7
	Afternoon peak hour (3.15 to 4.15 pm typically)	448	12.2	A	0.214	7
Year 2020 baseline traffic (Douglas Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	379	17.1	B	0.101	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	493	15.4	B	0.142	4
Project operations traffic (Taylor Avenue intersection)	Morning peak hour (8.00 to 9.00 am typically)	362	10.9	A	0.235	8
	Afternoon peak hour (3.15 to 4.15 pm typically)	465	12.1	A	0.239	8
Project operations traffic (Douglas Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	394	17.5	B	0.107	3
	Afternoon peak hour (3.15 to 4.15 pm typically)	509	15.7	B	0.146	4

Notes: **The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

From the results in Table 5.7, the future intersection traffic impacts from project operations traffic will be minimal in comparison to either the 2015 or 2020 baseline traffic conditions, with the intersection levels of service remaining at either A or B for all the traffic scenarios considered.

At the Berrima Road and Taylor Avenue intersection, the 2020 baseline traffic assessment results show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 10.9 seconds (morning) and 12.2 seconds (afternoon) respectively and 0.218 (morning) and 0.214 (afternoon) respectively.

The future project operations (morning) maximum intersection delay would not increase, although the maximum degree of saturation would increase to 0.235 with the project operations traffic. The future project operations (afternoon) maximum intersection delay would also not increase, although the maximum degree of saturation would increase to 0.239 with the project operations traffic.

At the Berrima Road and Douglas Road intersection the 2020 baseline traffic assessment results show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 17.1 seconds (morning) and 15.4 seconds (afternoon) respectively and 0.101 (morning) and 0.142 (afternoon) respectively.

The future project operations (morning) maximum intersection delay would increase marginally to 17.5 seconds and the degree of saturation would increase to 0.107 with the project operations traffic. The future project operations (afternoon) maximum intersection delay would increase marginally to 15.7 seconds and the degree of saturation would increase to 0.146 with the project operations traffic.

At the two Argyle Street intersections in Moss Vale, with Waite Street and Lackey Road, the respective volumes of the project operations traffic are compared with the 2015 and projected future 2020 baseline traffic volumes in Table 5.8 using the SIDRA intersection results from Appendices B, C and E.

Table 5.8 Comparison of SIDRA intersection operations for two Argyle Street intersections

Intersection and year of operation	Peak hour	Traffic demand flow (vehicles)*	Average vehicle delay (seconds)	Level of service	Degree of saturation	Maximum queue length (m)
Year 2015 baseline traffic (Waite Street intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,461	51.1	D	0.451	19
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,562	38.8	C	0.478	27
Year 2015 baseline traffic (Lackey Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,729	70.6	F	0.451	39
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,864	102.5	F	0.541	55
Year 2020 baseline traffic (Waite Street intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,535	59.0	E	0.495	21
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,639	44.6	D	0.519	30
Year 2020 baseline traffic (Lackey Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,816	82.5	F	0.499	43
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,957	129.3	F	0.580	59
Project operations traffic (Waite Street intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,546	53.3	D	0.503	21
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,651	46.9	D	0.528	30
Project operations traffic (Lackey Road intersection)	Morning peak hour (8.00 to 9.00 am typically)	1,823	83.8	F	0.503	43
	Afternoon peak hour (3.15 to 4.15 pm typically)	1,963	131.8	F	0.582	59

*Notes: *The SIDRA intersection analysis program automatically adds 5% to all surveyed traffic volumes as a contingency measure.*

At the Argyle Street and Waite Street intersection, the 2020 baseline traffic assessment results show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 59.0 seconds (morning) and 44.6 seconds (afternoon) respectively, and 0.495 (morning) and 0.519 (afternoon) respectively. These intersection traffic conditions correspond to Level of Service E (morning) and Level of Service D (afternoon) for the respective peak hour traffic conditions.

The future project operations (morning) peak hour intersection traffic delays would not increase and the intersection degree of saturation would increase only marginally to 0.503 with the project operations traffic.

The future project operations (afternoon) peak hour intersection traffic delays would increase to 46.9 seconds, the intersection degree of saturation would increase marginally to 0.528 with the project operations traffic, with no change to the future intersection peak hour level of service.

At the Argyle Street and Lackey Road intersection, the year 2020 baseline traffic assessment results show the maximum intersection traffic delay and degree of saturation for any morning or afternoon peak hour traffic movement will be 82.5 seconds (morning) and 129.3 seconds (afternoon) respectively, and 0.499 (morning) and 0.580 (afternoon) respectively. These intersection traffic conditions correspond to Level of Service F for both the morning and afternoon peak hour traffic conditions.

The future project operations (morning) intersection traffic delay would increase very marginally to 83.8 seconds and the degree of saturation to 0.503 with the project operations traffic.

The future project operations (afternoon) intersection traffic delay would increase very marginally to 131.8 seconds and the degree of saturation to 0.582 with the project operations traffic.

Although this assessment shows that the future peak hourly intersection traffic conditions at the two Argyle Street intersections will be congested (in particular at the Lackey Road intersection), there will be no significant worsening of the future intersection traffic operations with the project operations traffic.

5.3 Traffic safety

The detailed accident review for the Wingecarribee LGA and the Moss Vale local area road networks, in Section 2.8 of this assessment, has shown a generally good and improving road safety record for most of the roads in the LGA, in particular for the local road network managed by Wingecarribee Shire Council, which excludes the two major state highways, the Hume Highway and the Illawarra Highway.

The proposed project (operations) daily traffic movements would not have any adverse safety implications for the LGA road network, in particular as the project will mainly use a locally-based workforce, with approximately 85% of employed persons resident within the Wingecarribee LGA, largely in Moss Vale, Mittagong and Bowral.

The use of a primarily locally based workforce throughout the project operations period will minimise the potential road safety risk associated with longer distance workforce commuter travel movements occurring on a daily basis with the project.

5.4 Road pavement condition

The potential traffic impact to the road pavement condition, on the access routes which are proposed to be used by project generated truck traffic during operations, will depend on the existing route condition and the combination of the existing and the proposed project daily truck movements.

On the Hume Highway and Illawarra Highway routes, which carry large volumes of interstate and long distance truck traffic currently, the additional project generated daily truck traffic movements would be expected to have minimal impacts to the road pavement condition. On the other major road routes in the Moss Vale and Berrima areas which are under the care and control of the local Council, such as Old Hume Highway and Berrima Road, these roads are also used by substantial volumes of heavy truck traffic from local heavy industries, such that significant additional road pavement condition impacts from the project truck traffic are also unlikely to occur.

5.5 Access by public transport and other travel modes

The immediate locality of the mine project area on the western side of the Hume Highway, which is accessed via Mereworth Road, is generally remote from the existing locality (local and regional) bus- and rail-based public transport services.

Consequently the project operations workforce or people visiting the project area are unlikely to use public transport services in the future, and such access has not been specifically analysed for the project operations workforce or other site visitors in this traffic impacts assessment.

6 Mitigation measures

6.1 Construction stage traffic management

No specific external road widening measures were identified for the project construction stage as being required for the primary project construction stage access. What is effectively a private road will, however, require some project-related widening and reconstruction for it to serve as the project's main future construction and operation stage access route.

The existing road cross-section of Mereworth Road, west of the Hume Highway interchange, will be widened and upgraded, with marked road centre and edge lines and gravel road shoulders. It will be to an appropriate standard for the anticipated peak hour and daily traffic volumes the project will generate, including heavy vehicle movements.

The related measures to manage project construction stage traffic will mainly be to construct the accommodation village, which will accommodate up to 90% of the project construction workforce during the major part of the project construction period (from February/March 2020 onwards).

The accommodation village will minimise the externally generated project traffic movements (for both car and truck traffic) such that there will effectively be no significant project construction stage traffic impacts within the local area roads surrounding the project, or on major locality traffic routes such as the Berrima Road between Old Hume Highway and Argyle Street at Moss Vale.

Where temporary construction stage access is required for any project worksite that is not within the Mereworth Road locality, an additional locality project construction stage traffic management plan (and traffic control plan) will be prepared to confirm the local access safety and traffic management requirements for the work. Project traffic control plans would be prepared and implemented in accordance with RMS traffic control at worksite requirements.

6.2 Operations stage traffic management

No additional road widening or traffic management measures will be required for the project operations stage access compared with the primary project construction stage access.

The workforce accommodation village will be decommissioned and removed from the site when the project construction is completed. The project will then operate with a more locally based workforce, whereby about 85% of the future project management and operations staff and workers would residents of the Wingecarribee LGA, such that longer distance project workforce commuter traffic movements would be effectively avoided.

6.3 Intersection improvements

One intersection will require upgrading to safely accommodate the project related traffic during construction and operation; the intersection of the Hume Highway north bound off-ramp with Mereworth Road.

Mereworth Road currently has very low traffic volumes west of the Hume Highway and the primary traffic movement is from the Hume Highway off ramp, turning right onto Mereworth Road. This suits the current intersection priority which has Give Way signs on the two Mereworth Road approaches. However, the additional Hume Coal project traffic volumes mean that a design change to this intersection will be required. Potential design changes considered were:

- Retaining the existing T intersection design but changing the intersection priority to the eastern and western approaches via Mereworth Road, which is the normal intersection priority for a T-intersection, and would be generally more familiar to most road users in the future.
- Constructing a new roundabout at the intersection with an outside diameter of 32 metres. This is the effective minimum future circulating area which would be required for a B Double truck to undertake all possible traffic movements at the intersection.

SIDRA analysis of these two options was conducted. In relation to traffic delays, the analysis found that changing the priority to east-west at the T-intersection would reduce the average traffic delays by approximately 40% in comparison to the existing intersection priority, while the roundabout option would increase the average traffic delays by approximately 10%. The east-west priority intersection would provide a Level of Service A under the am and pm peak hour traffic scenarios considered, while the roundabout would provide a Level of Service B under the same six traffic scenarios. In addition only minimal changes to the existing intersection roadway (line marking primarily) will be required to change the existing intersection priority.

Retention of the existing T-intersection with a change in intersection priority was therefore shown to be best solution. The changed traffic priority will have minimal future impact on the Hume Highway off-ramp traffic, as it already has to slow to a virtual stop to make either a sharp right or a sharp left turn at the intersection. The reconfiguration of the Mereworth Road/Hume Highway interchange has been discussed with representatives of RMS and Wingecarribee Shire Council, as outlined in Chapter 5.

Hume Coal will fund the necessary works associated with the required intersection upgrade.

6.4 Special vehicle movements

At times during both project construction and operations, oversize vehicle movements and dangerous goods transport will be required to transport specific construction and maintenance components for the project.

6.4.1 Oversize vehicles

Suppliers of equipment for the project will be chosen following a detailed engineering design and procurement process, which will occur after the development application is determined so that investment decisions can be made with certainty. Given this, the exact dimensions and quantities of construction materials, machinery and equipment, or where these items will be sourced from has not been confirmed. However, it is anticipated that oversize vehicles transporting items to the project area could be up to 8 m wide and 30 m long.

The permitted routes and time restrictions for oversize vehicles, which may include either night-time or daytime deliveries, will be determined in consultation with RMS and documented in the CEMP and OEMP before construction commences. RMS will decide on the oversize vehicle routes and travel times for the project on a case by case basis in accordance with its policy for oversize vehicle movements within urban areas and key transport routes, such as Picton Road, which connects from the Hume Highway near Wilton to the Wollongong urban area near Mount Keira.

6.4.2 Hazardous materials

Contractors for transportation of hazardous goods will be required to comply with the following guidelines:

- *Australian Code for the Transport of Dangerous Goods by Road and Rail Edition 7.4* (National Transport Commission 2016);
- *Australian Standard 1940:2004 The Storage and Handling of Flammable and Combustible Liquids*;
- *Australian Standard/New Zealand Standard 1596:2008 The Storage and Handling of LP Gas*;
- *Australian Standard 2187:1998 Explosives – Storage, Transport and Use: Storage*;
- *Workplace Relations Minister's Council 2009 Australian code for the transport of explosives by road and rail third edition 2008;* and
- *Code of practice for transport of radioactive material* (Australian Radiation Protection and Nuclear Safety Agency 2008).

Appendix P of the EIS considered if transportation of hazardous goods would qualify the project as a hazardous development under State Environmental Planning Policy 33 (Hazardous and Offensive Development) (SEPP 33). This involved comparison of the quantities and frequency of transportation of dangerous goods to the thresholds in Table 2 of *Applying SEPP 33* (DoP 2011). This comparison determined that transportation of hazardous goods to and from the project will not qualify it as a potentially hazardous development under SEPP 33.

Generally, the risk assessment in Appendix P of the EIS determined that transportation of dangerous goods would represent a medium risk, provided this is in accordance with the above guidelines. This is because the consequences of a crash or other incident involving these goods, regardless of the likelihood of an incident, could lead to major injury.

7 Conclusions

7.1 Method

This report addresses the road transport-related SEARs for the project construction and operations stages, including considering the *RTA Guide to Traffic Generating Developments* (RTA 2002). An accompanying Rail Infrastructure Transport Assessment assesses the project's rail infrastructure transport impacts, including the potential impacts to traffic safety and traffic delays at railway level crossings.

7.2 Findings

The project traffic impacts assessment for the project construction and operations stage traffic movements has investigated the existing (2015) and future baseline (2020) traffic volumes at a large number of locations and intersections on the road network in the locality of the project area and on the Berrima Road route between Berrima and Moss Vale.

A summary of the study findings and recommendations in terms of the capacity, condition, safety and efficiency of the local and state road networks is listed in Table 7.1

Table 7.1 Summary of the project traffic impacts assessment

Type of potential impact	Impacts to the local road network	Impacts to the state road network	Summary of Impact
Capacity	Minimal impacts are predicted to the local road network (Council controlled roads) for either mid block road capacity or the peak hour traffic capacity of intersections	Minimal impacts are predicted to the state road network (Hume Highway and Illawarra Highway) for either mid block road capacity or the peak hour traffic capacity of intersections	Low Impact
Condition	Minimal impacts are anticipated from the project truck traffic using roads which are maintained by the local Council.	Where access is proposed to the state road network during project construction, the access will be of short duration, of low traffic generation intensity and will be managed by standard RMS worksite traffic control plans prepared in accordance with RMS traffic control guidelines for worksites with access to major roads	Low Impact
Safety	The current traffic safety record (accident history) for the local road network is good and safety will not be significantly impacted by the additional project traffic	The current traffic safety record (accident history) for the state road network is relatively good and safety will not be significantly impacted by the additional project traffic	Low impact
Efficiency	The project will not generate any significant road traffic increases which will adversely affect the efficiency of the local road network (Council controlled roads)	The project will not generate any significant road traffic increases which will adversely affect the efficiency of the local road network (Council controlled roads)	Low impact

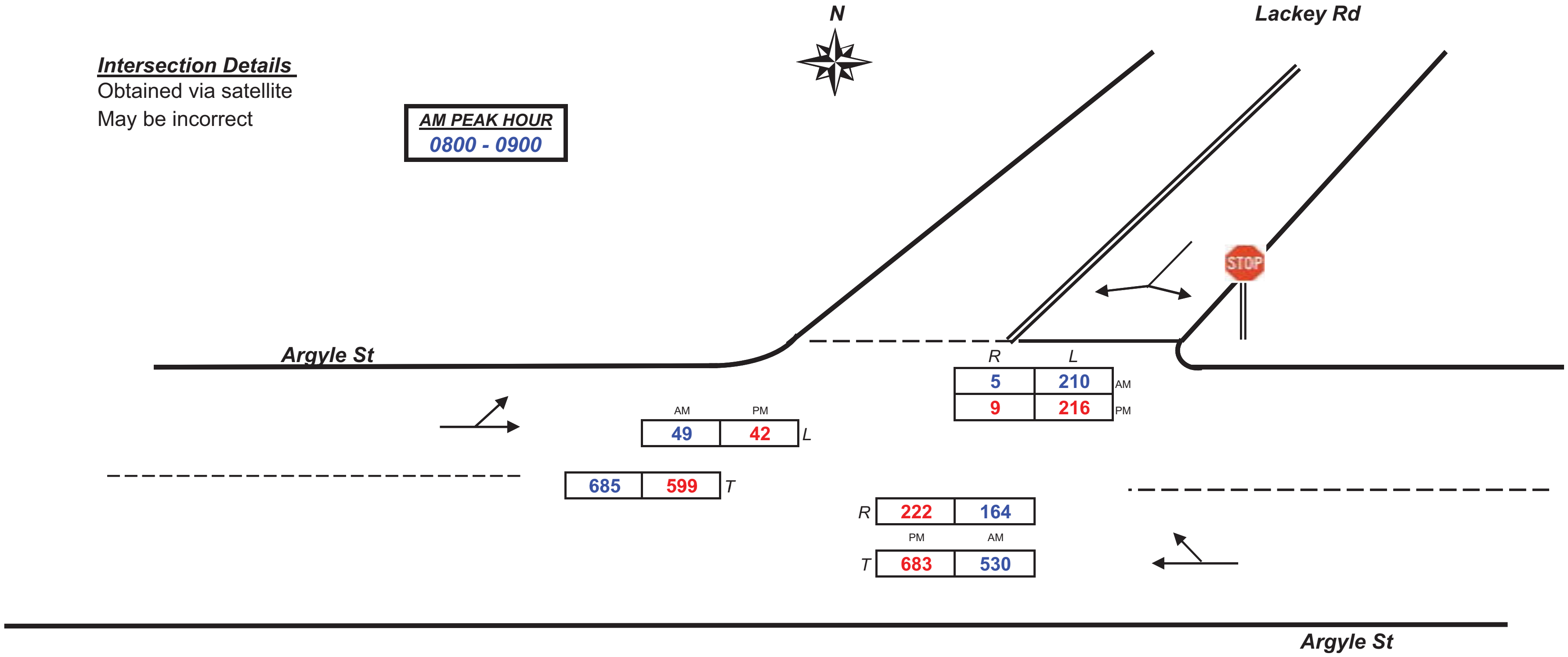
No significant adverse traffic impacts have been identified for the future traffic movements generated by the project for either the road network traffic capacity, intersection traffic operations; the road network condition; road safety and the efficiency of operation of the road network.

Appendix A

Intersection Traffic Surveys

Client : EMM
Job No/Name : 5939 BERRIMA Additional Surveys
Day/Date : Wednesday 17th February 2016

Intersection Details
Obtained via satellite
May be incorrect



Combined figures only

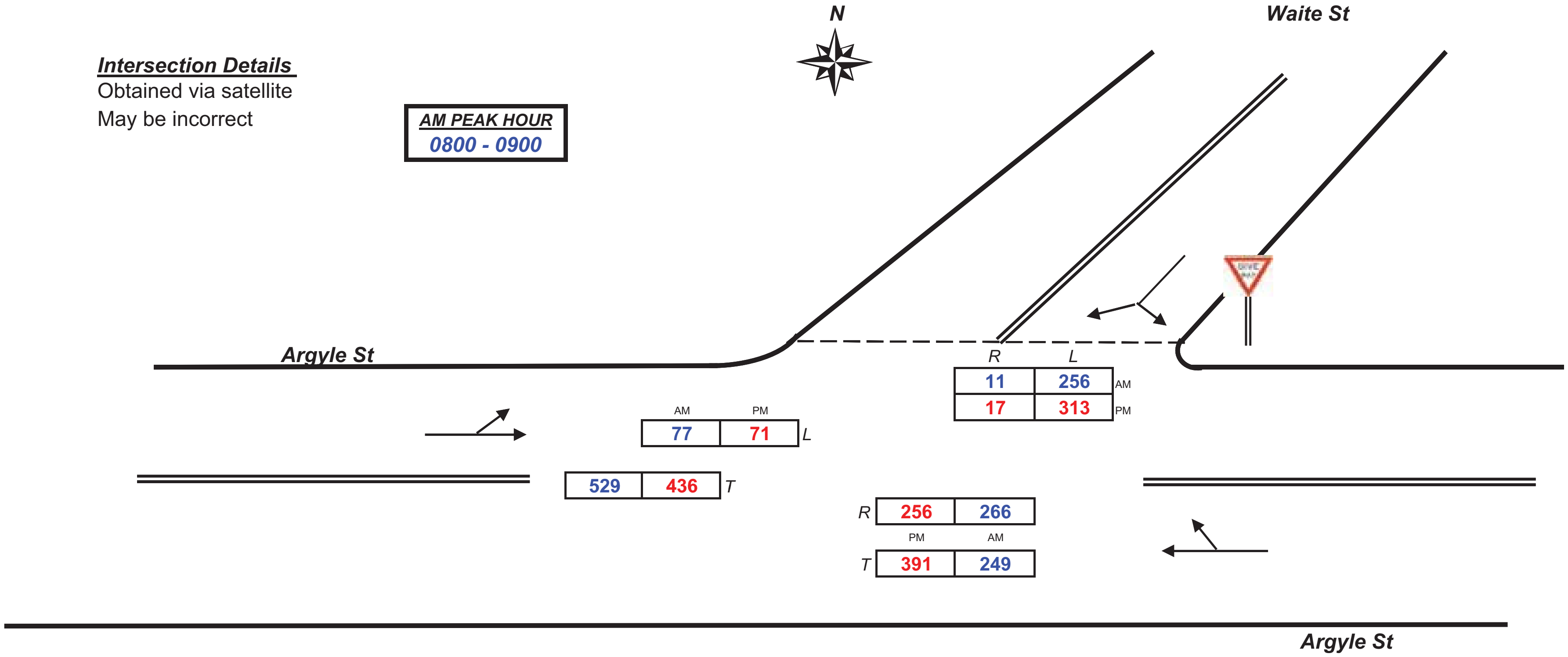
PM PEAK HOUR
1530 - 1630

Weather >>>

Client : EMM
Job No/Name : 5939 BERRIMA Additional Surveys
Day/Date : Wednesday 17th February 2016

Intersection Details
Obtained via satellite
May be incorrect

AM PEAK HOUR
0800 - 0900



Combined figures only

PM PEAK HOUR
1500 - 1600

Weather >>>

R.O.A.R. DATA
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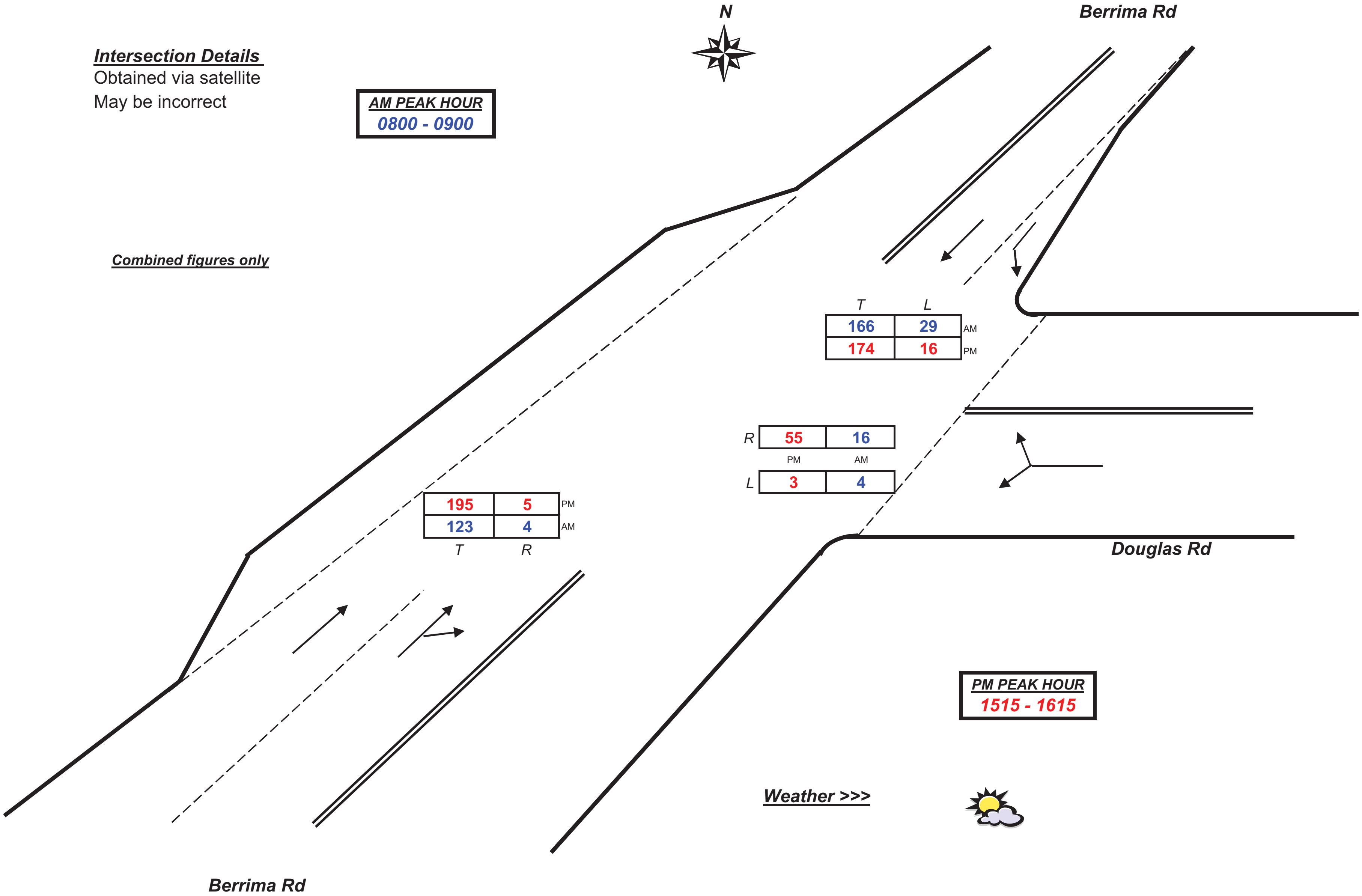
Ph.88196847, Fax 88196849, Mob.0418-239019

Client : EMM
Job No/Name : 5939 BERRIMA Additional Surveys
Day/Date : Thursday 18th February 2016

Intersection Details
Obtained via satellite
May be incorrect

AM PEAK HOUR
0800 - 0900

Combined figures only



PM PEAK HOUR
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Weather >>>

Client : EMM
Job No/Name : 5939 BERRIMA Additional Surveys
Day/Date : Thursday 18th February 2016

Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
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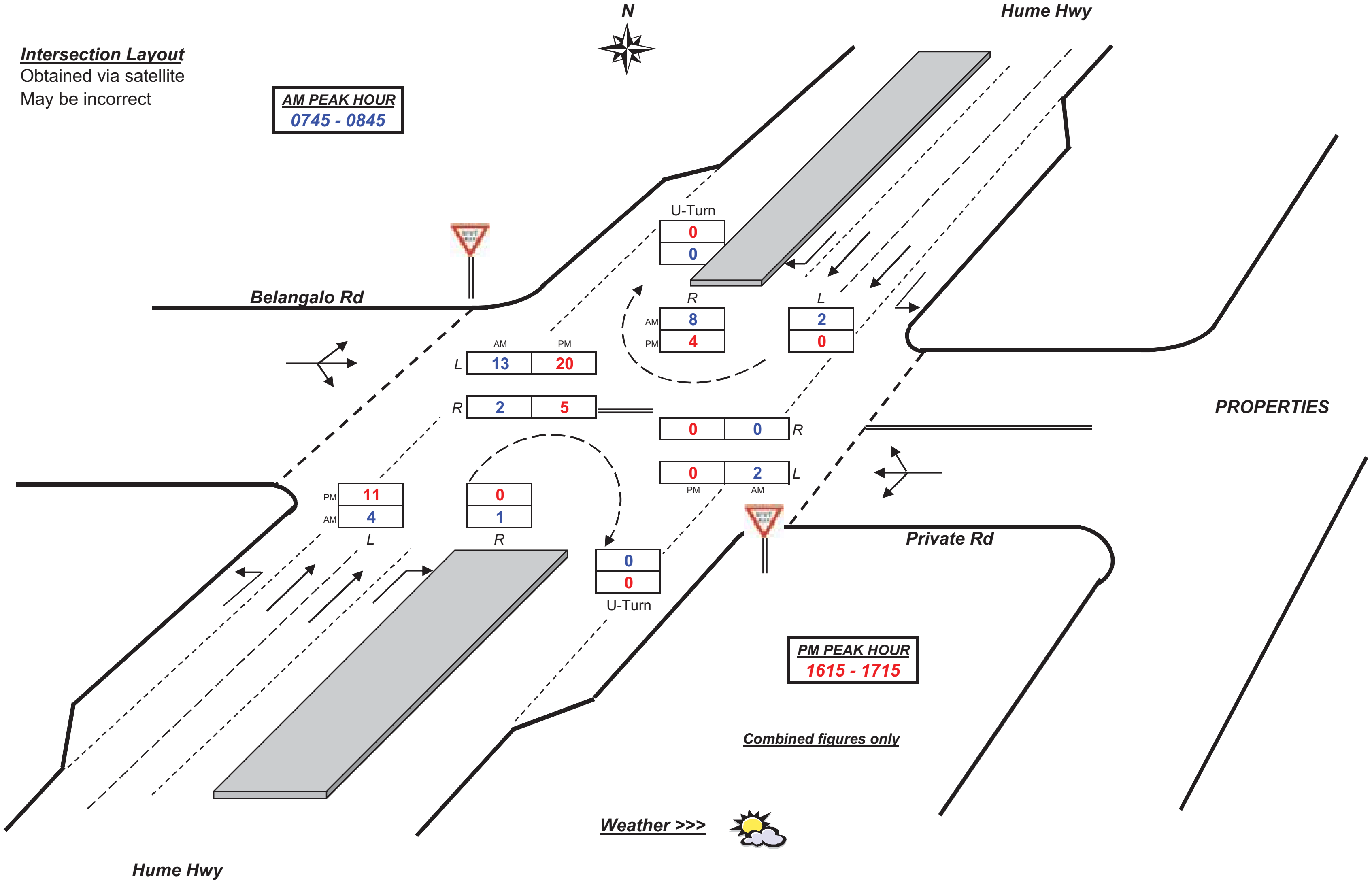

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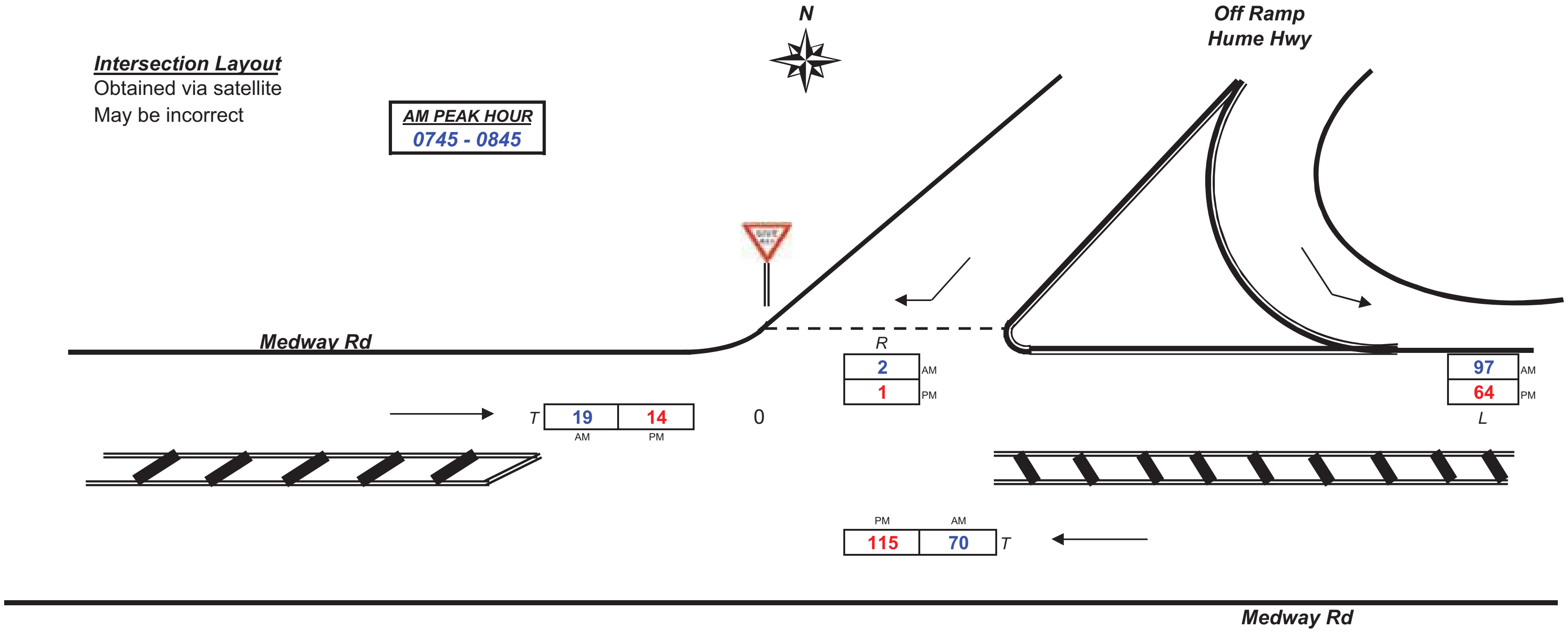
Combined figures only

Weather >>>

Client : EMGA
Job No/Name : 5659 BERRIMA Traffic Surveys
Day/Date : Thursday / 25th June 2015

Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0745 - 0845



PM PEAK HOUR
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Combined figures only

Weather >>>

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Day/Date : Thursday / 25th June 2015

Intersection Layout
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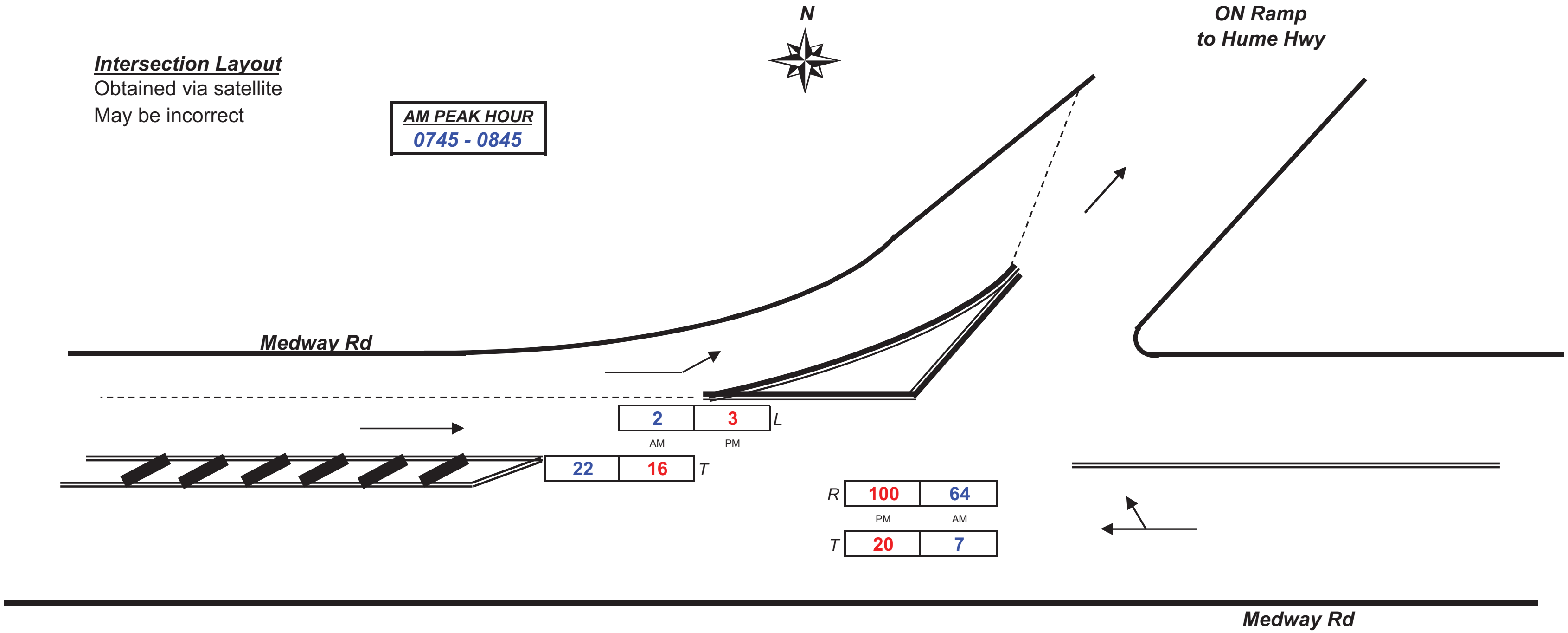
May be incorrect

AM PEAK HOUR
0745 - 0845



PM PEAK HOUR
1530 - 1630

Combined figures only

Weather >>>

Client : EMGA
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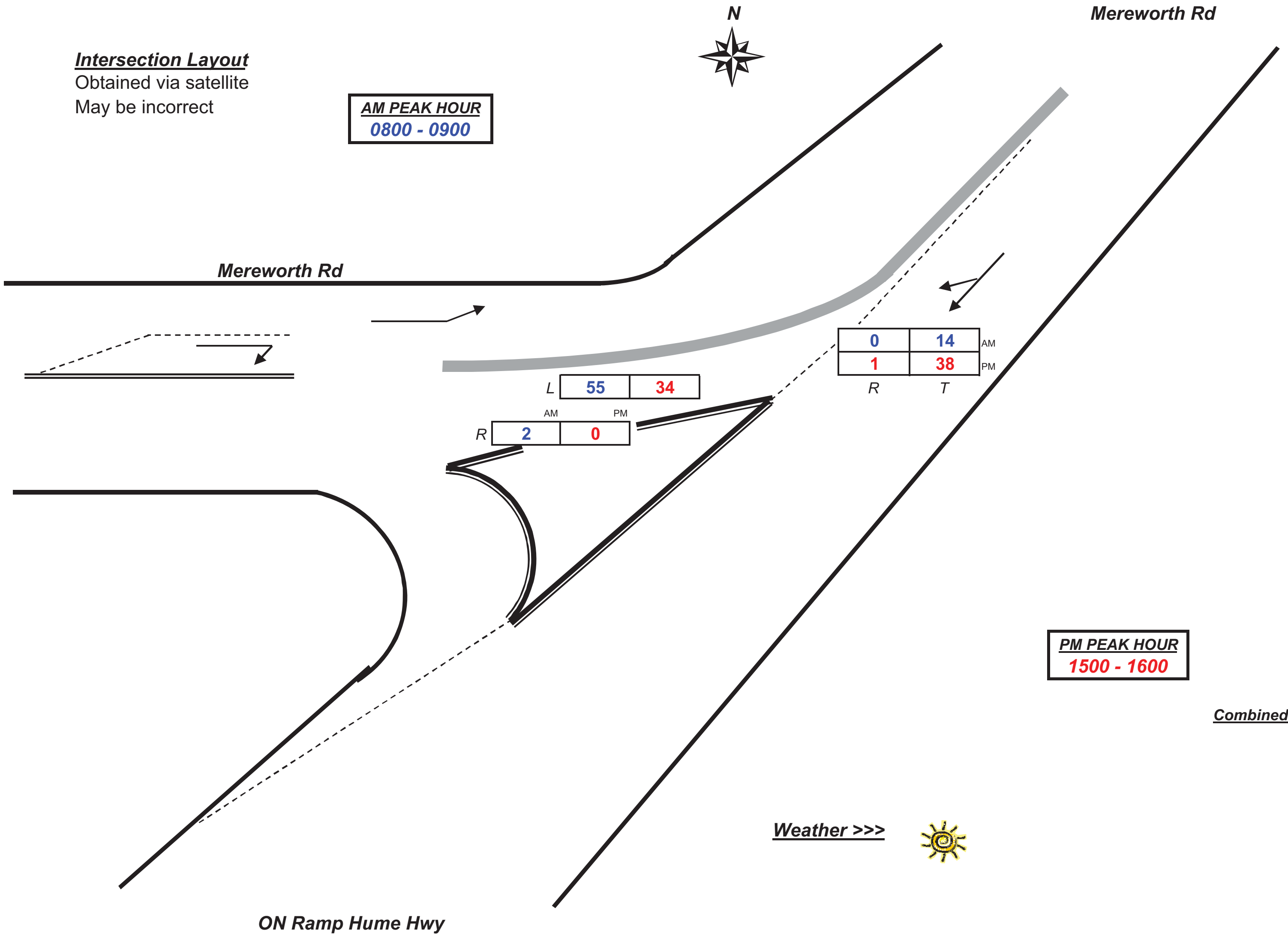
Day/Date : Wednesday / 24th June 2015

Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0800 - 0900



PM PEAK HOUR
1500 - 1600

Combined figures only

Weather >>> ☀

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Client : EMGA
Job No/Name : 5659 BERRIMA Traffic Surveys
Day/Date : Wednesday / 24th June 2015

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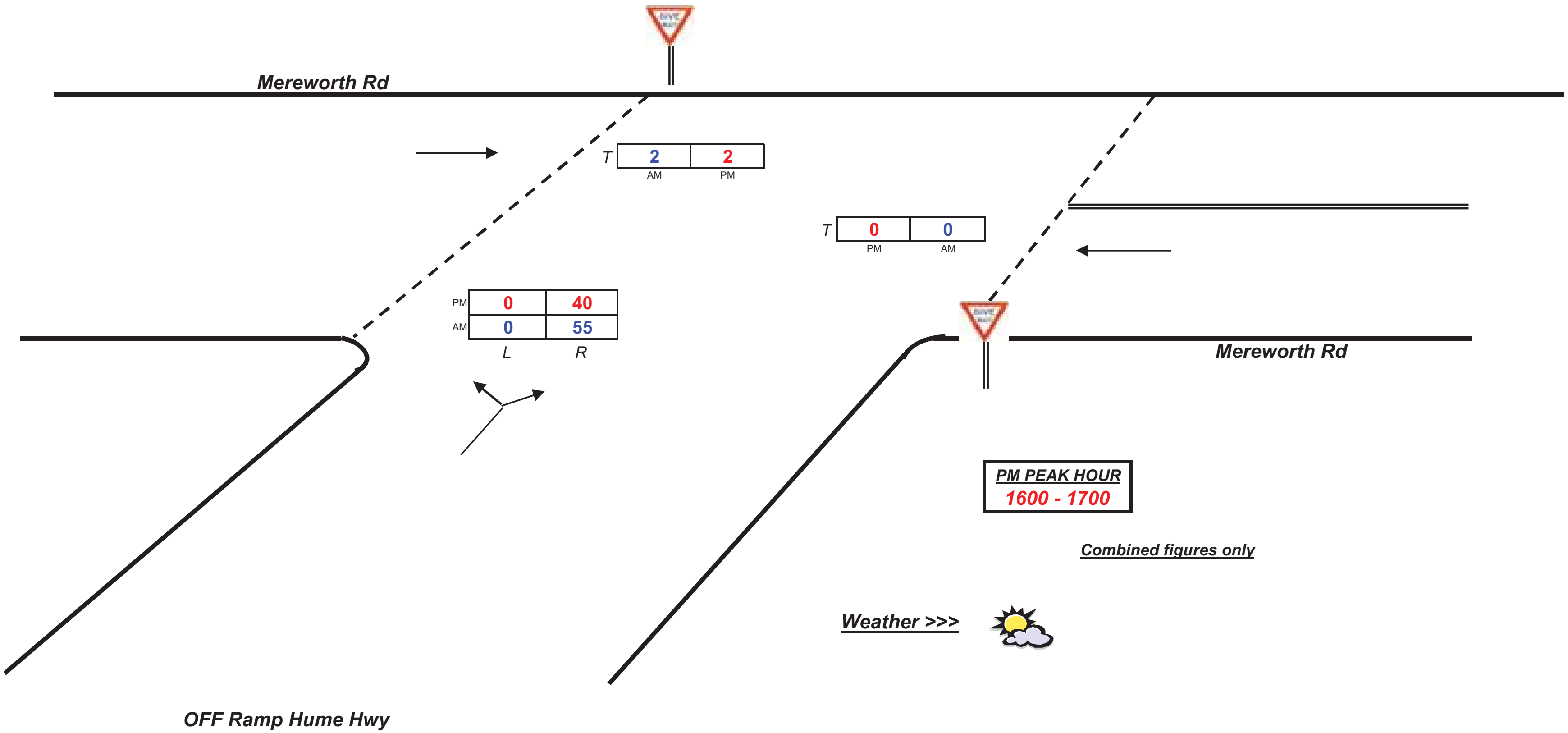
Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0800 - 0900



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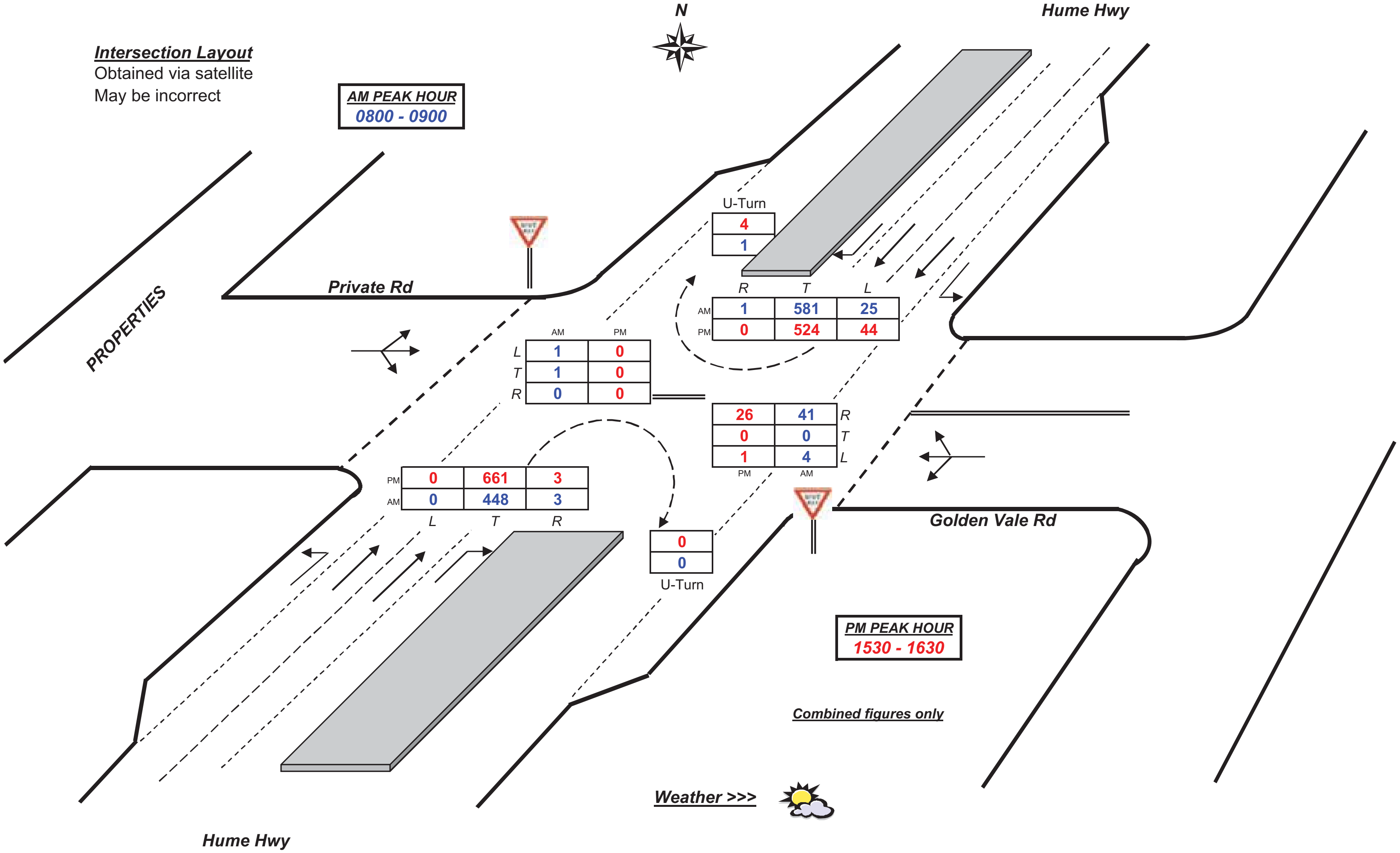
Client	: EMGA
Job No/Name	: 5659 BERRIMA Traffic Surveys
Day/Date	: Wednesday / 24th June 2015

Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0800 - 0900

PM PEAK HOUR
1530 - 1630

Combined figures only



Hume Hwy (north approach)

	R	T	L
AM	1	581	25
PM	0	524	44

U-Turn

4
1

Private Rd

	AM	PM
L	1	0
T	1	0
R	0	0

Golden Vale Rd

PM	AM	
26	41	R
0	0	T
1	4	L

Hume Hwy (south approach)

	L	T	R
PM	0	661	3
AM	0	448	3

U-Turn

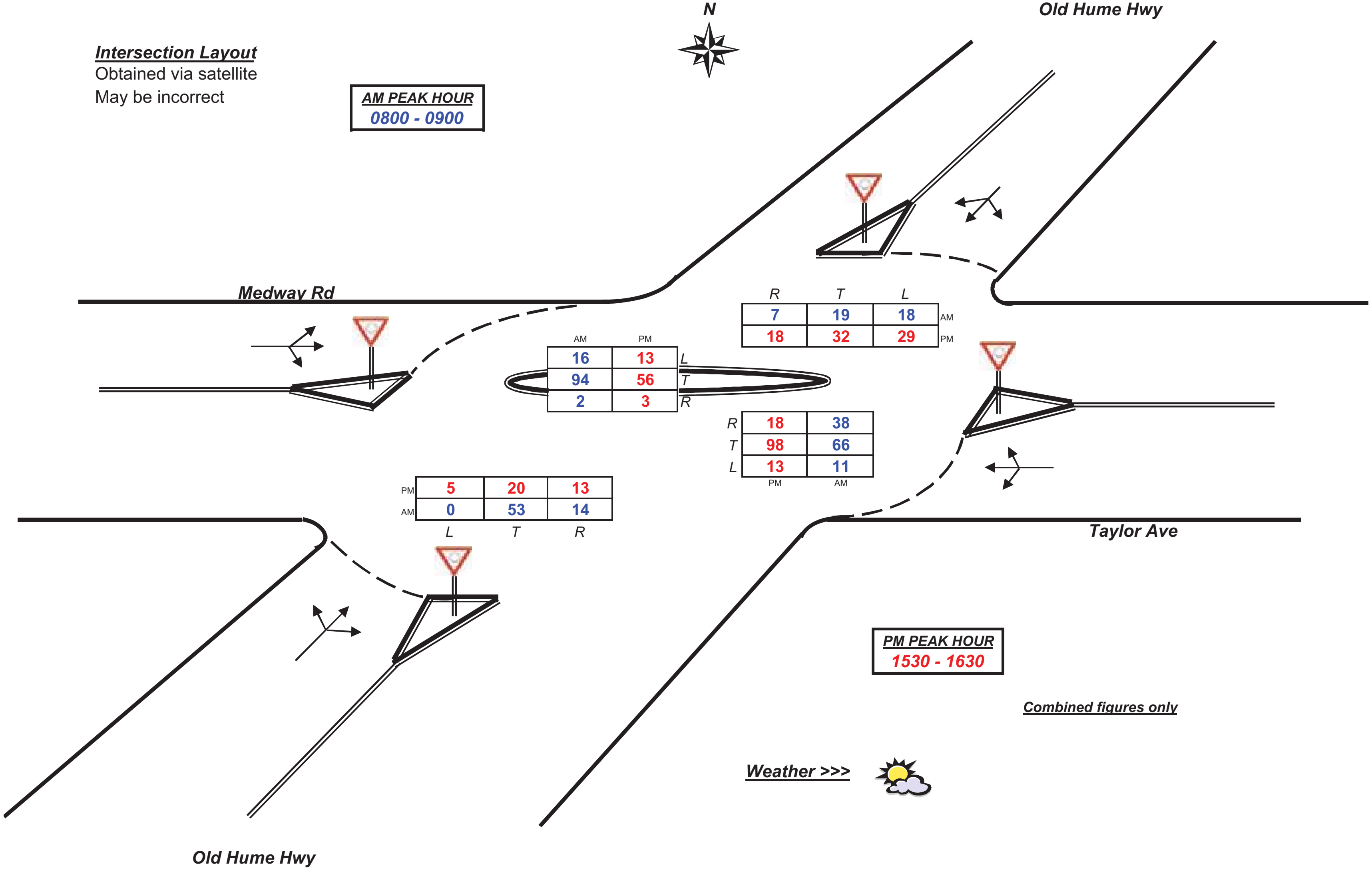
0
0

R.O.A.R. DATA
Reliable, Original & Authentic Results
Ph.88196847, Fax 88196849, Mob.0418-239019

Client : EMGA
Job No/Name : 5659 BERRIMA Traffic Surveys
Day/Date : Thursday / 25th June 2015

Intersection Layout
Obtained via satellite
May be incorrect

AM PEAK HOUR
0800 - 0900



Old Hume Hwy (north-east approach):

	R	T	L
AM	7	19	18
PM	18	32	29

Medway Rd:

	AM	PM
L	16	13
T	94	56
R	2	3

Taylor Ave:

	PM	AM
R	18	38
T	98	66
L	13	11

Old Hume Hwy (south-west approach):

	L	T	R
PM	5	20	13
AM	0	53	14

PM PEAK HOUR
1530 - 1630

Combined figures only

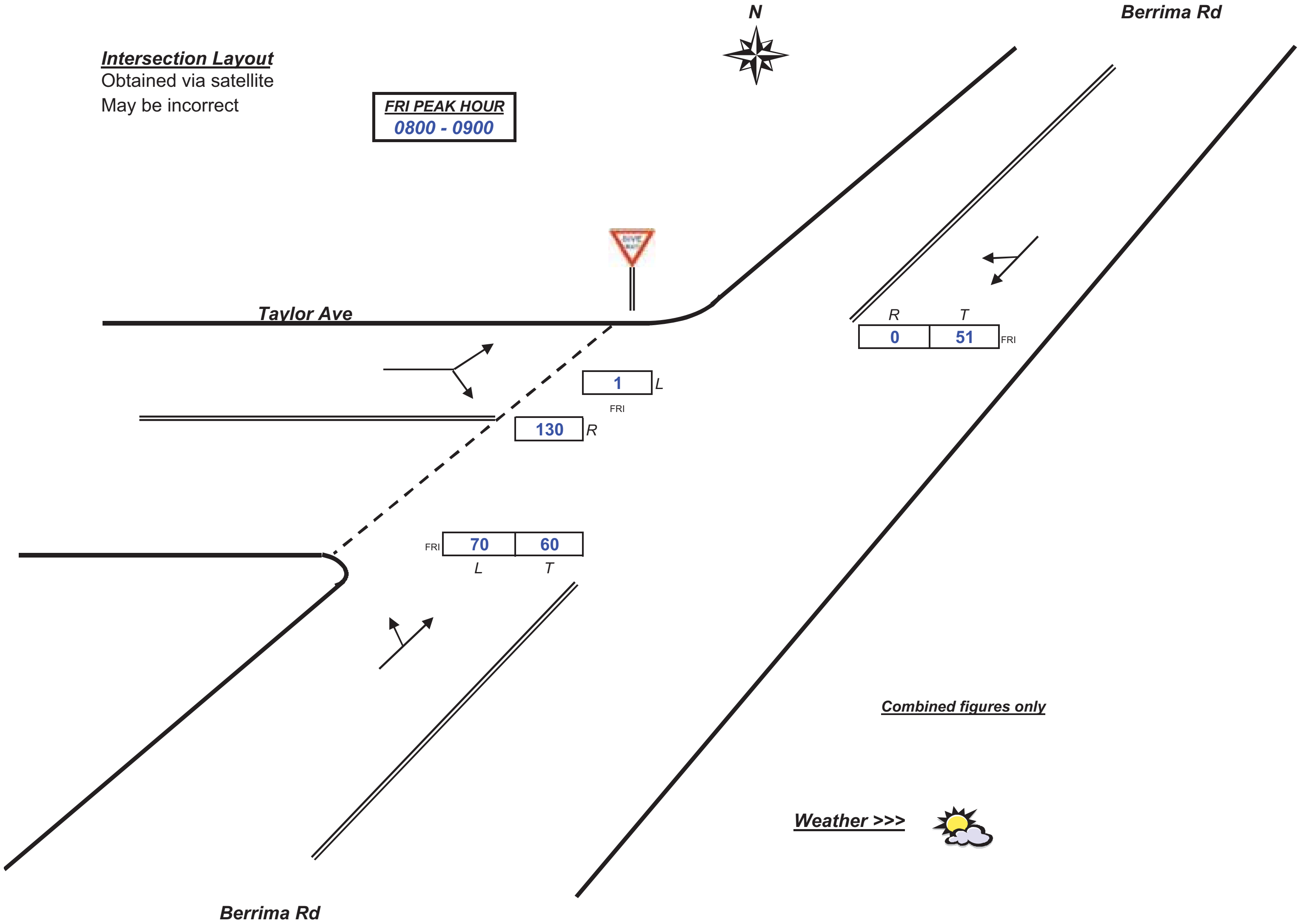
Weather >>>

R.O.A.R. DATA
Reliable, Original & Authentic Results
Ph.88196847, Fax 88196849, Mob.0418-239019

Client : EMGA
Job No/Name : 5659 BERRIMA Traffic Surveys
Day/Date : Friday / 26th June 2015

Intersection Layout
Obtained via satellite
May be incorrect

FRI PEAK HOUR
0800 - 0900



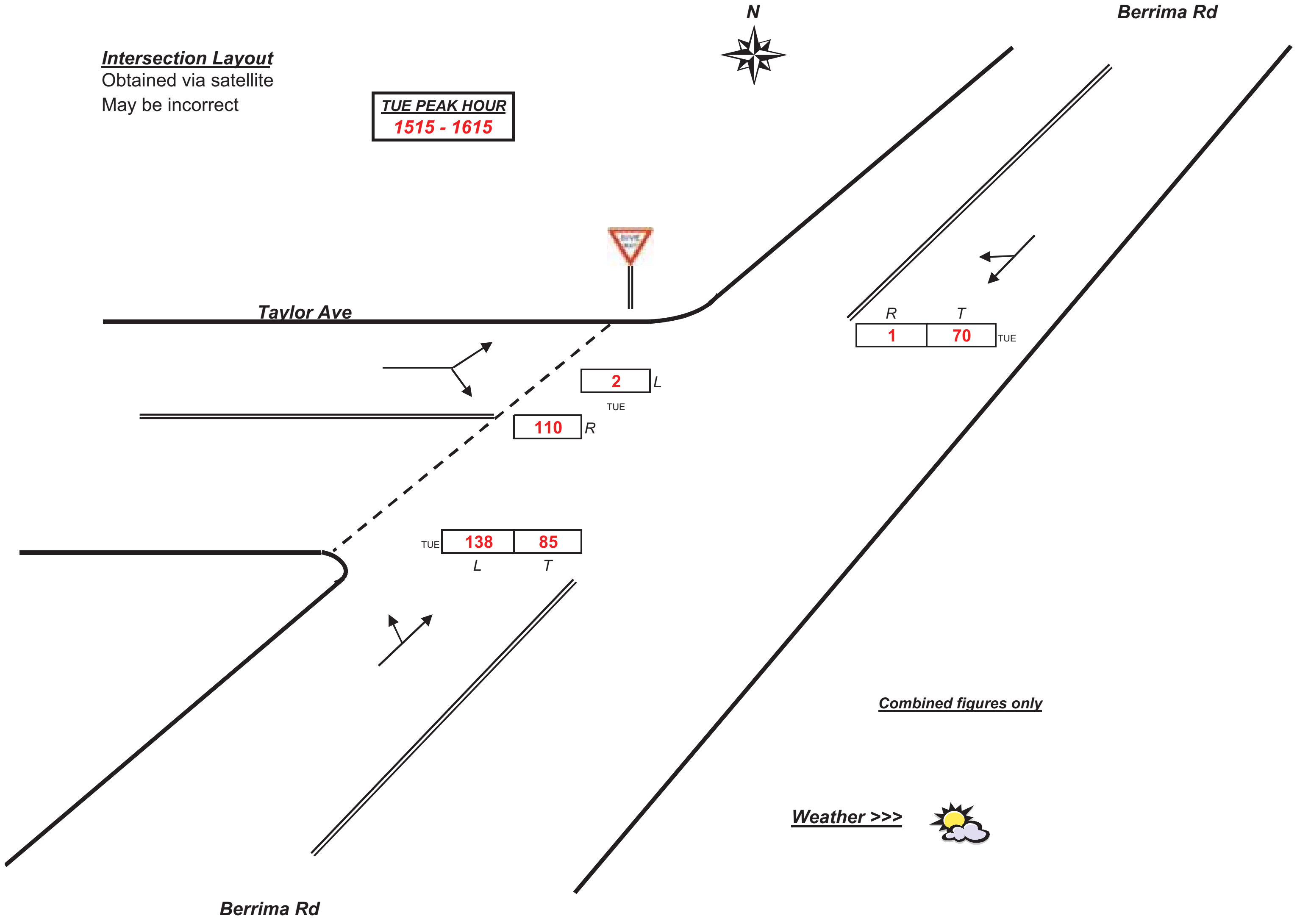
Combined figures only

Weather >>>

Client : EMGA
Job No/Name : 5659 BERRIMA Traffic Surveys
Day/Date : Tuesday / 23rd June 2015

Intersection Layout
Obtained via satellite
May be incorrect

TUE PEAK HOUR
1515 - 1615

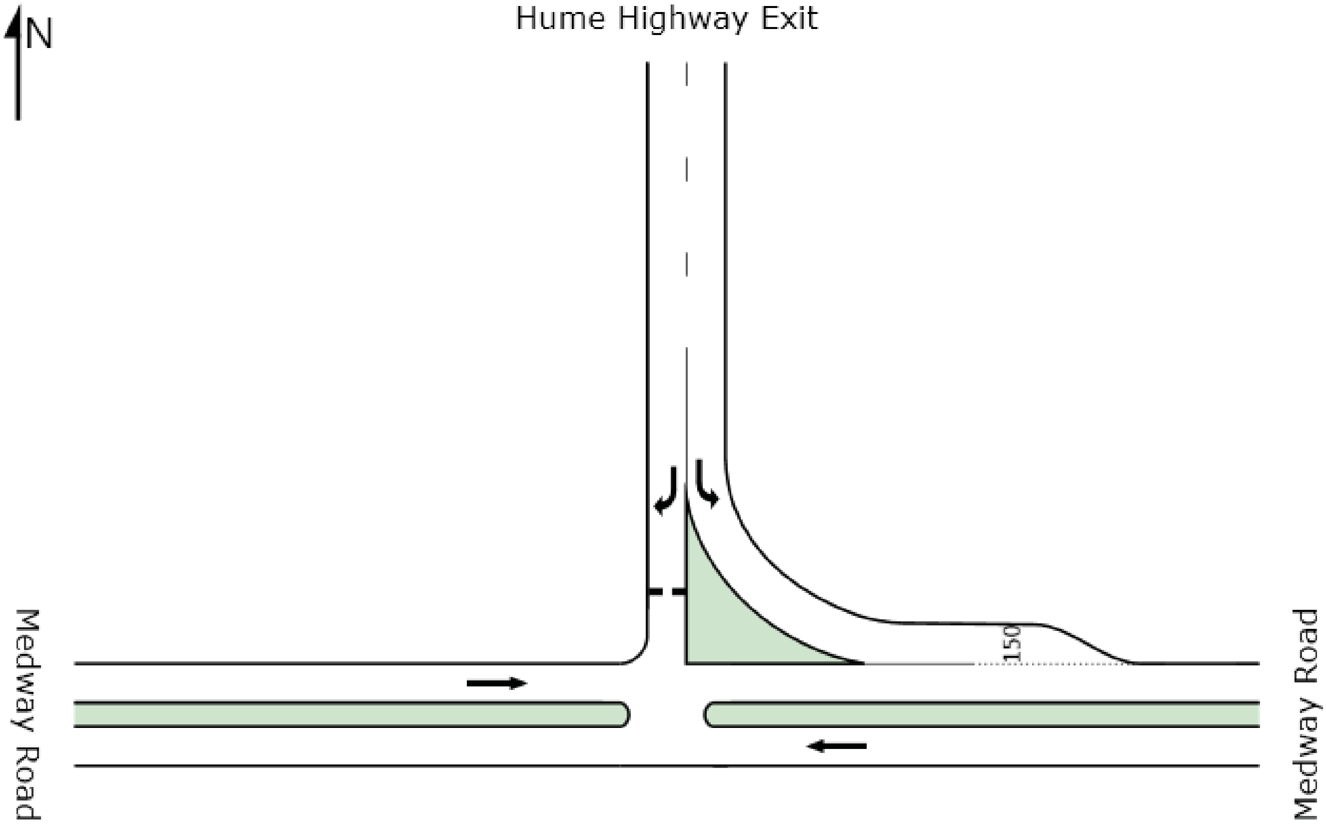


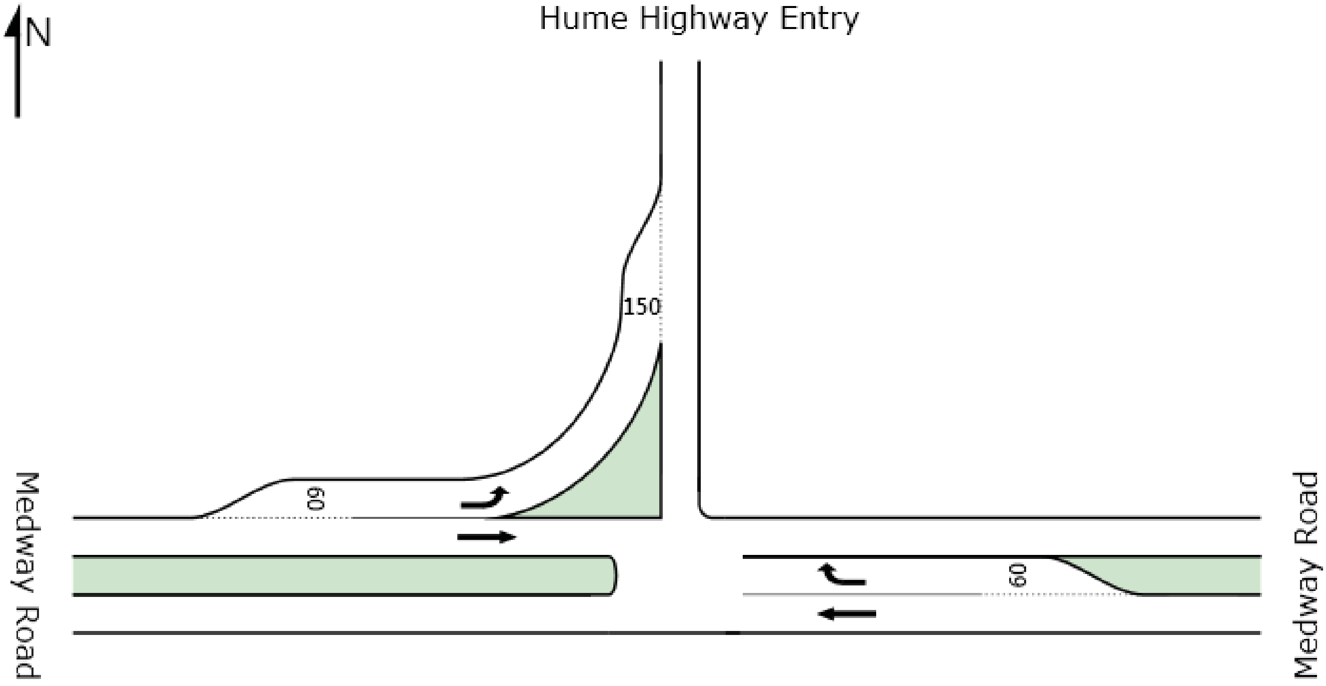
Combined figures only

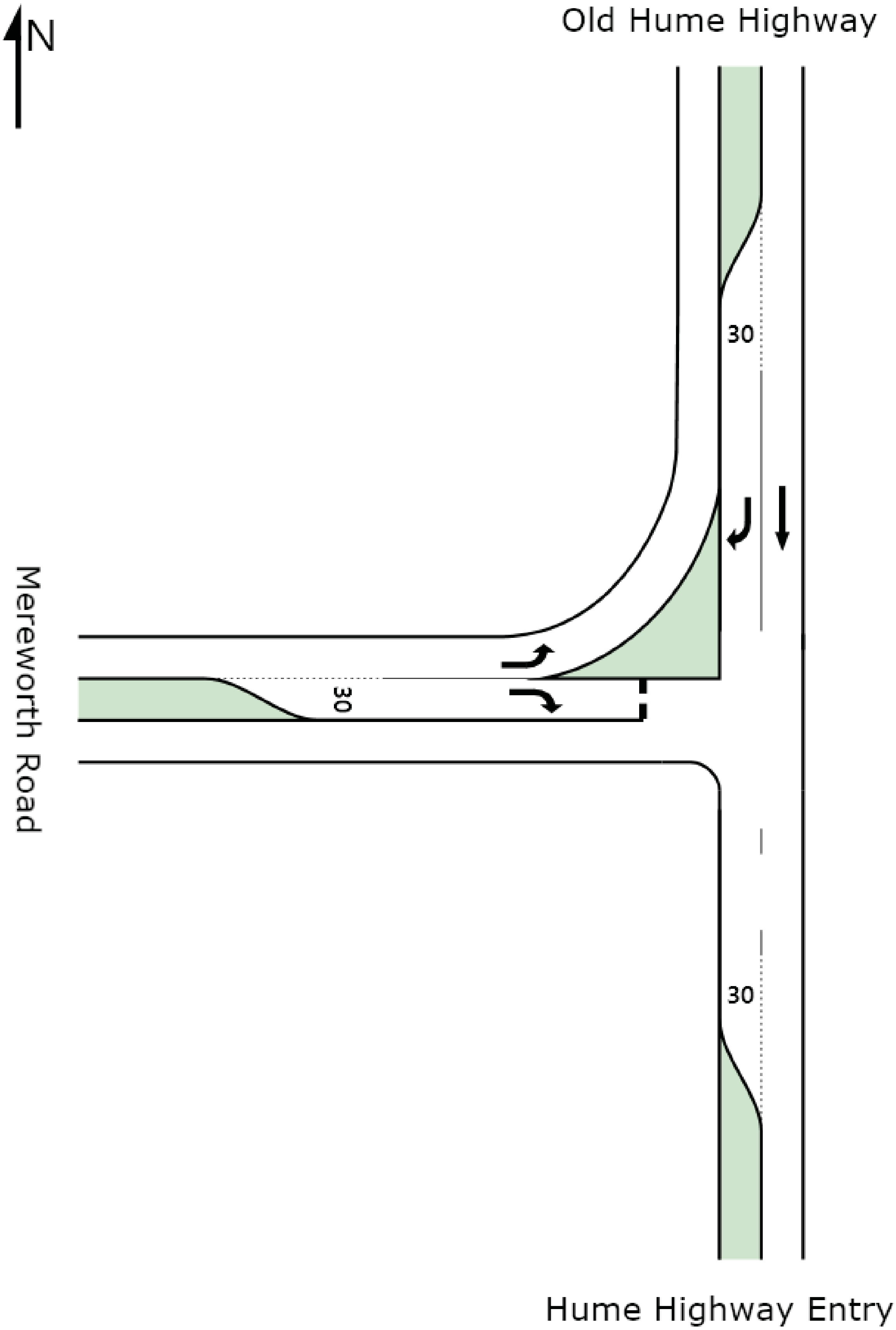
Weather >>>

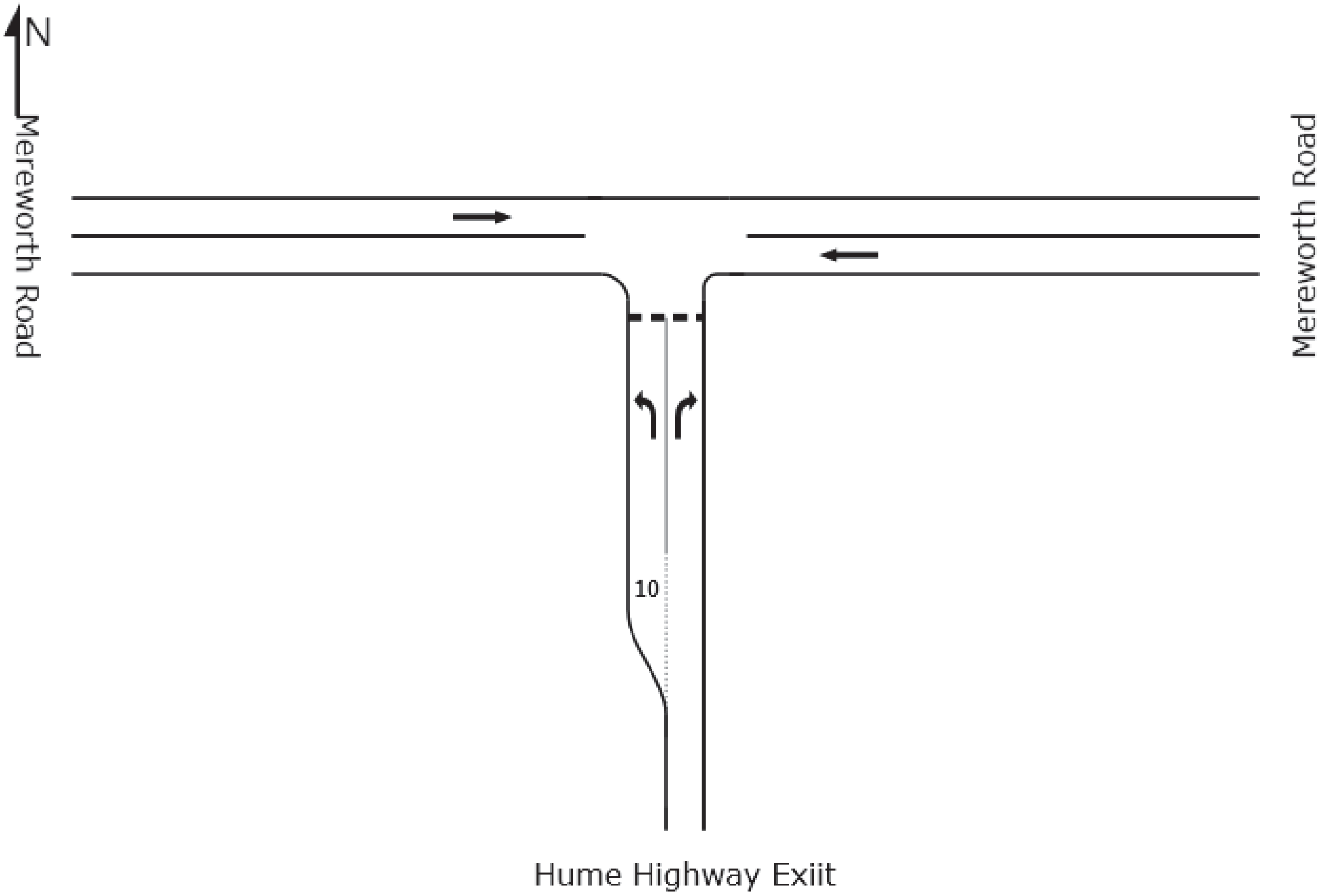
Appendix B

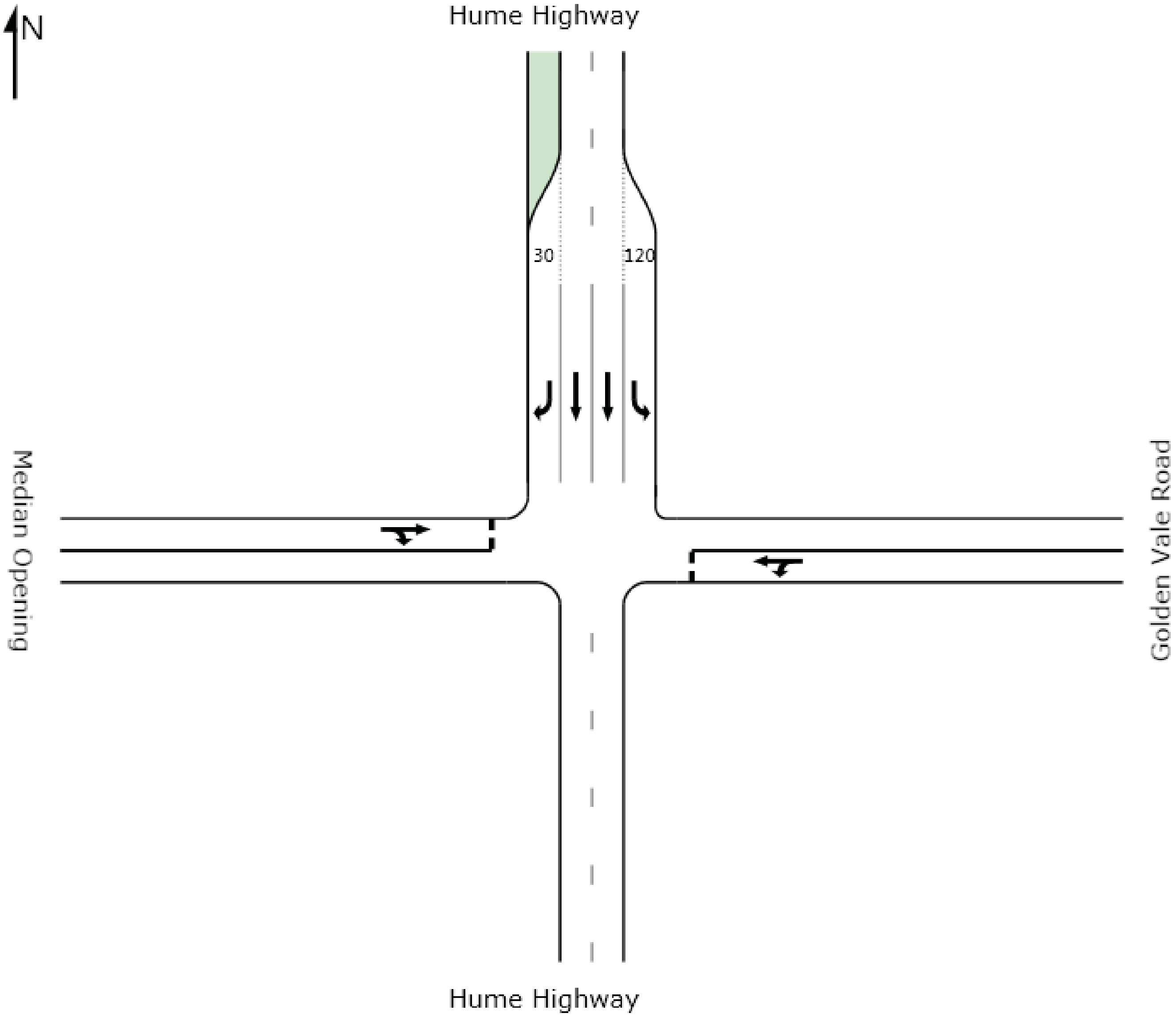
SIDRA Intersection Delay Results for existing traffic

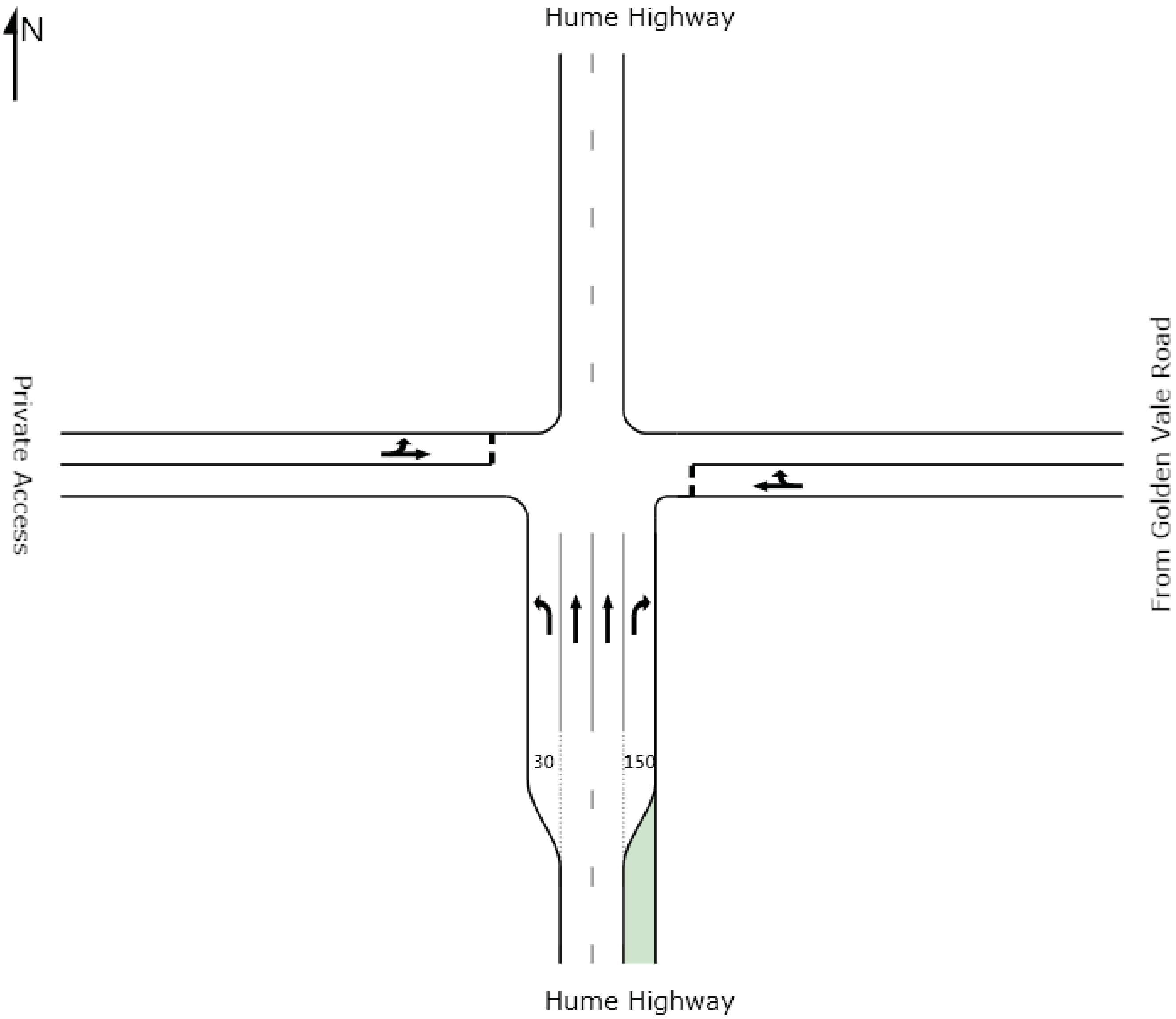

N
Hume Highway Exit
Medway Road
150
Medway Road

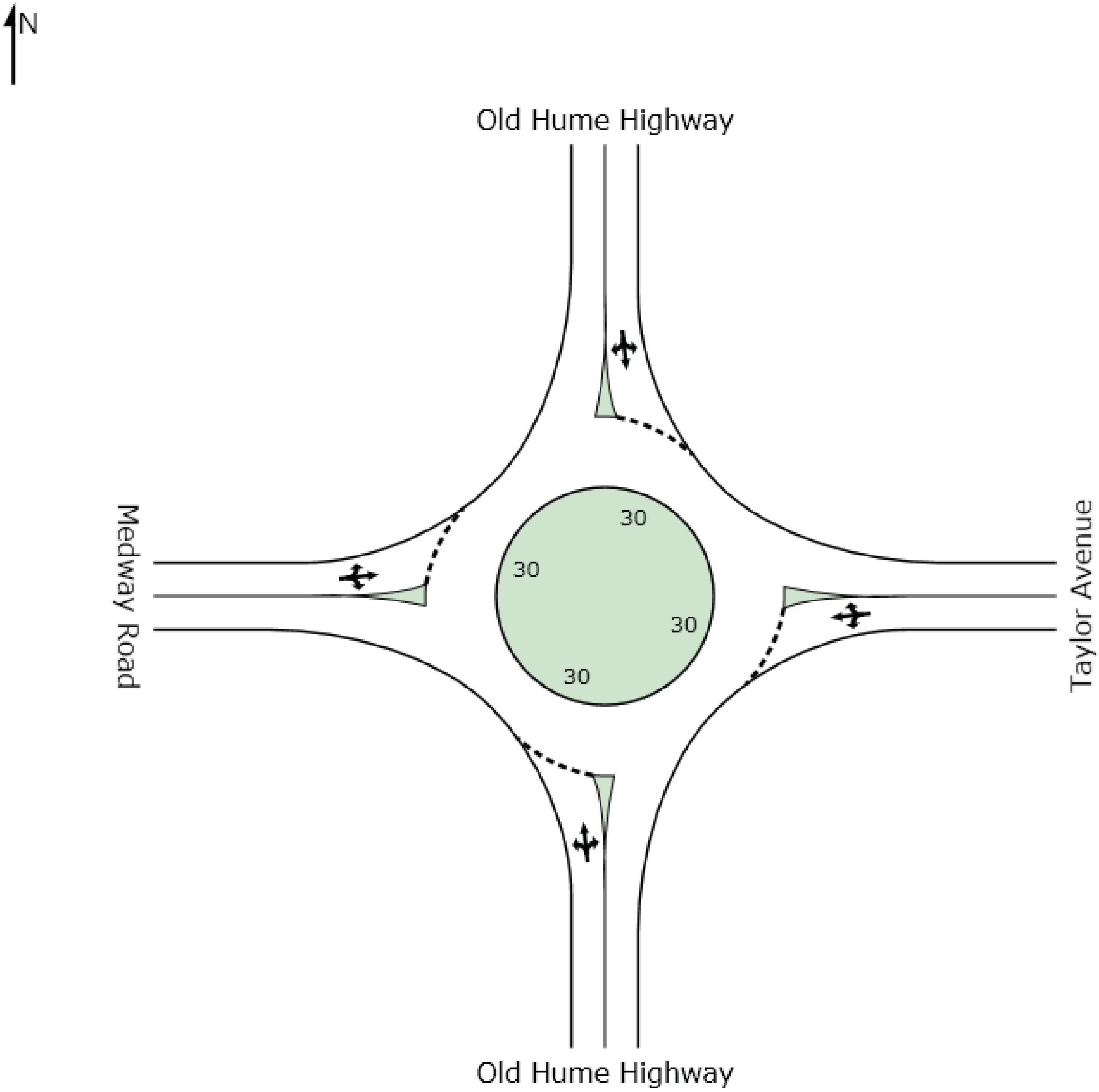

N
Hume Highway Entry
150
60
60
Medway Road
Medway Road

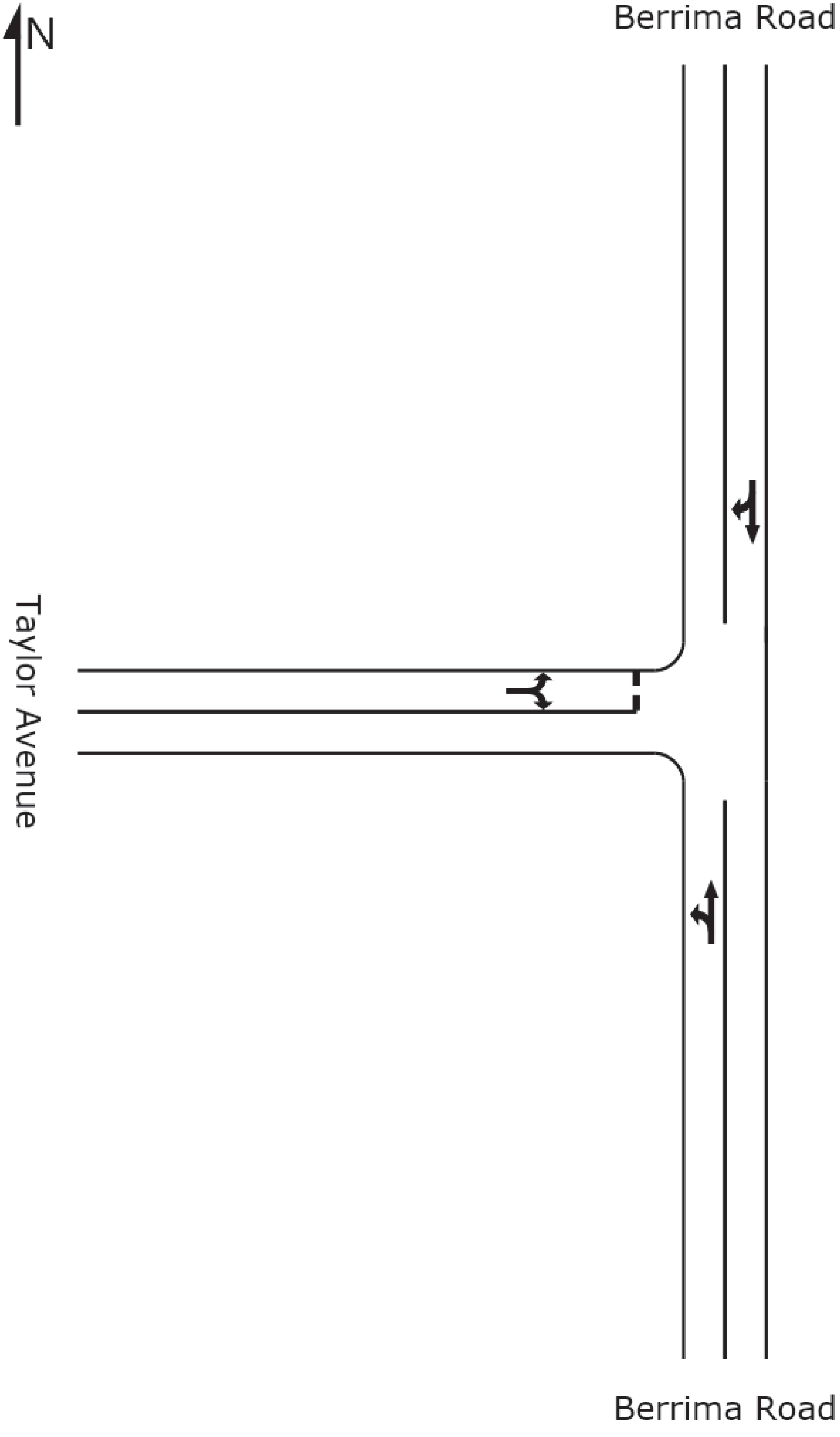

N
Old Hume Highway
30
Mereworth Road
30
30
Hume Highway Entry

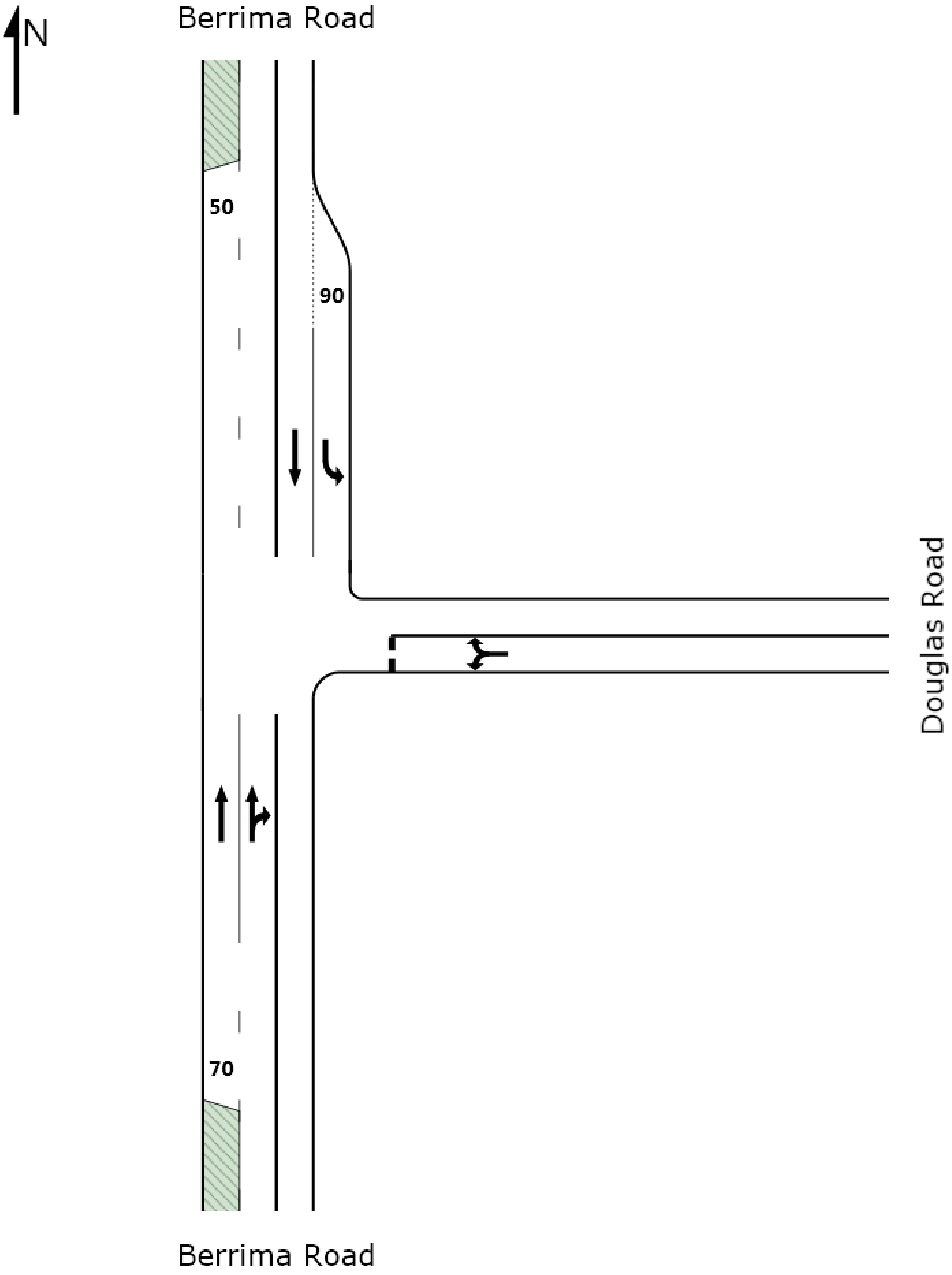

N
Mereworth Road
Mereworth Road
10
Hume Highway Exiit

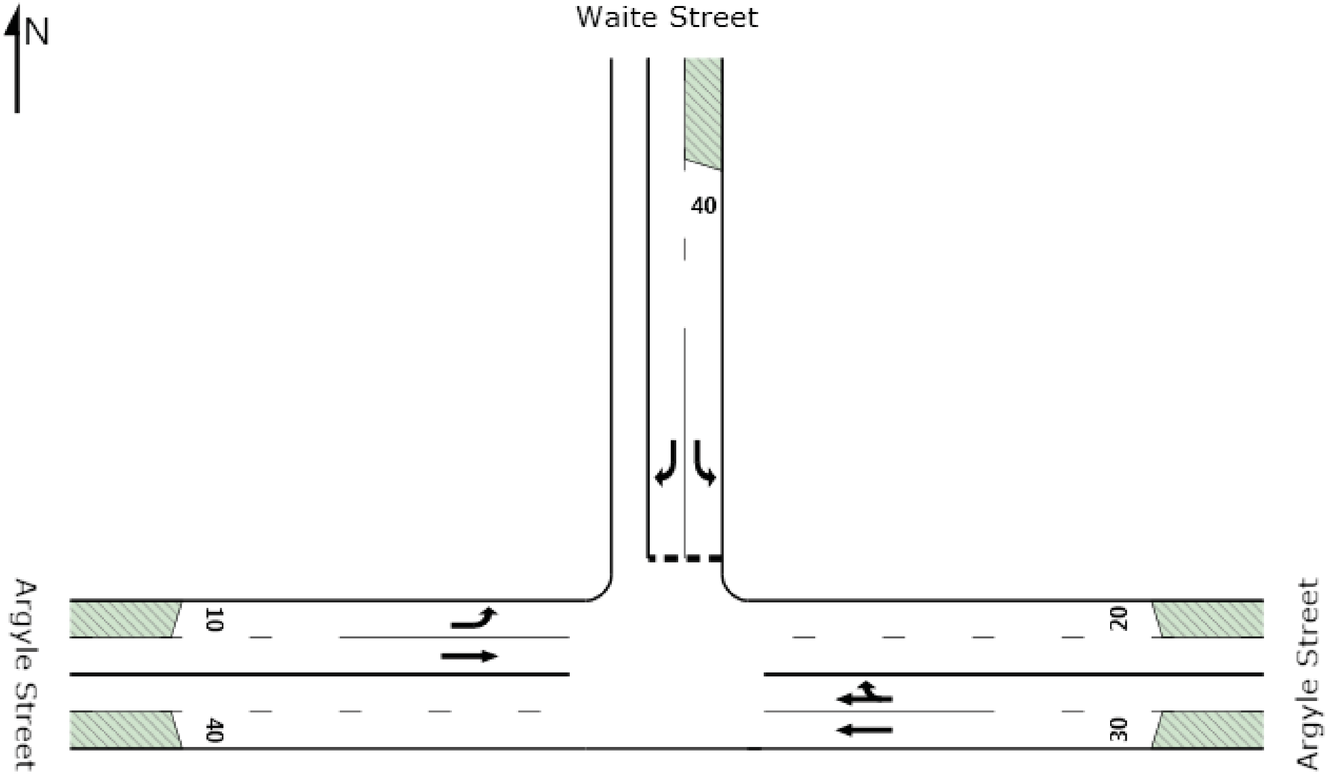

N
Hume Highway
30
120
Median Opening
Golden Vale Road
Hume Highway

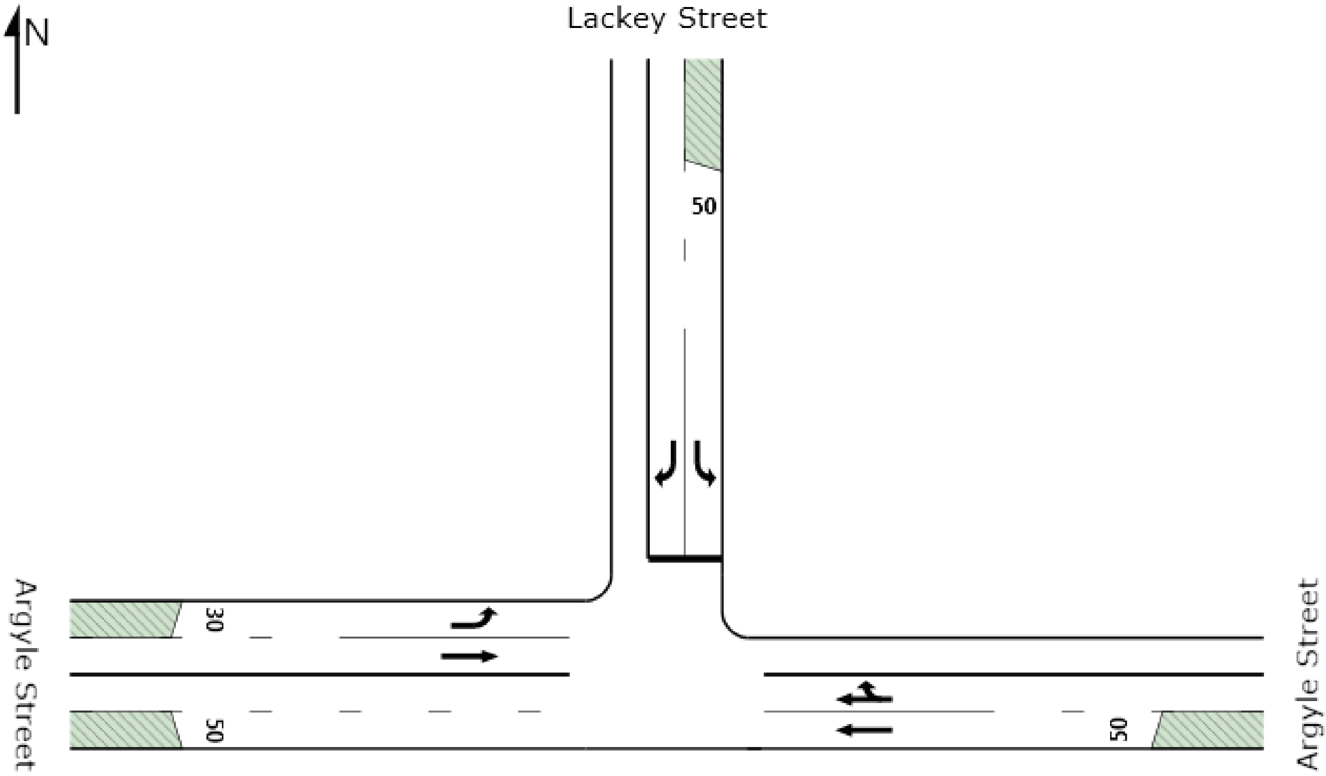

N
Hume Highway
Private Access
From Golden Vale Road
30
150
Hume Highway


N
Old Hume Highway
Medway Road
Taylor Avenue
30
30
30
30
Old Hume Highway


N
Berrima Road
Taylor Avenue
Berrima Road

N
Berrima Road
50
90
Douglas Road
70
Berrima Road


N
Waite Street
40
Argyle Street
10
40
20
30
Argyle Street


N
Lackey Street
50
Argyle Street
30
50
50
Argyle Street

MOVEMENT SUMMARY

Site: Medway Road Interchange
East Side AM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
							Vehicles veh	Distance m			
East: Medway Road											
5	T	74	18.6	0.042	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		74	18.6	0.042	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	102	13.4	0.060	11.7	X	X	X	X	0.69	58.9
9	R	2	0.0	0.003	11.6	LOS A	0.0	0.1	0.25	0.66	57.9
Approach		104	13.1	0.060	11.7	LOS A	0.0	0.1	0.01	0.69	58.8
West: Medway Road											
11	T	20	5.3	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		20	5.3	0.011	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		198	14.4	0.060	6.2	NA	0.0	0.1	0.00	0.36	67.3

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Processed: Thursday, 5 November 2015 2:35:27 PM
SIDRA INTERSECTION 5.1.13.2093
Project: P:\SIDRA RESULTS\Hume Coal Intersections\Project Baseline Study 2015.sip
8001331, EMG, SINGLE

MOVEMENT SUMMARY

Site: Medway Road Interchange
East Side PM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	121	7.0	0.065	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		121	7.0	0.065	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	67	14.1	0.040	11.7	X	X	X	X	0.69	58.9
9	R	1	0.0	0.001	11.9	LOS A	0.0	0.0	0.30	0.65	57.5
Approach		68	13.8	0.040	11.7	LOS A	0.0	0.0	0.00	0.69	58.8
West: Medway Road											
11	T	15	14.3	0.008	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		15	14.3	0.008	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		204	9.8	0.065	3.9	NA	0.0	0.0	0.00	0.23	71.5

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Medway Road Interchange
West Side AM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	7	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	67	20.3	0.066	12.5	LOS A	0.2	1.8	0.09	0.73	58.4
Approach		75	18.3	0.066	11.2	NA	0.2	1.8	0.08	0.65	60.0
West: Medway Road											
10	L	2	0.0	0.001	11.1	X	X	X	X	0.69	58.9
11	T	23	4.5	0.012	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		25	4.2	0.012	0.9	NA	0.0	0.0	0.00	0.06	77.7
All Vehicles		100	14.7	0.066	8.6	NA	0.2	1.8	0.06	0.50	63.7

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Medway Road Interchange
West Side PM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	21	5.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	105	7.0	0.089	11.5	LOS A	0.3	2.3	0.07	0.73	58.5
Approach		126	6.7	0.089	9.6	NA	0.3	2.3	0.06	0.61	61.3
West: Medway Road											
10	L	3	0.0	0.002	11.1	X	X	X	X	0.69	58.9
11	T	17	6.3	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		20	5.3	0.009	1.7	NA	0.0	0.0	0.00	0.11	75.8
All Vehicles		146	6.5	0.089	8.5	NA	0.3	2.3	0.05	0.54	62.9

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Mereworth Road Interchange
East Side AM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	15	21.4	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	1	0.0	0.001	10.8	LOS A	0.0	0.0	0.00	0.74	59.0
Approach		16	20.0	0.009	0.7	NA	0.0	0.0	0.00	0.05	78.2
West: Mereworth Road											
10	L	58	9.1	0.033	11.5	X	X	X	X	0.69	58.9
12	R	2	50.0	0.005	14.6	LOS B	0.0	0.1	0.11	0.72	58.3
Approach		60	10.5	0.033	11.6	LOS A	0.0	0.1	0.00	0.69	58.8
All Vehicles		76	12.5	0.033	9.3	NA	0.0	0.1	0.00	0.56	62.1

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Processed: Friday, 6 November 2015 10:36:22 AM
SIDRA INTERSECTION 5.1.13.2093
Project: P:\SIDRA RESULTS\Hume Coal Intersections\Project Baseline Study 2015.sip
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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Mereworth Road Interchange
East Side PM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	40	7.9	0.022	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	1	0.0	0.001	10.8	LOS A	0.0	0.0	0.00	0.74	59.0
Approach		41	7.7	0.022	0.3	NA	0.0	0.0	0.00	0.02	79.3
West: Mereworth Road											
10	L	36	8.8	0.020	11.5	X	X	X	X	0.69	58.9
12	R	1	0.0	0.002	11.3	LOS A	0.0	0.0	0.15	0.69	58.1
Approach		37	8.6	0.020	11.5	LOS A	0.0	0.0	0.00	0.69	58.8
All Vehicles		78	8.1	0.022	5.6	NA	0.0	0.0	0.00	0.34	68.2

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Mereworth Road Interchange
West Side AM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.00	0.73	58.9
3	R	58	10.9	0.068	11.8	LOS A	0.3	2.1	0.03	0.75	58.6
Approach		59	10.7	0.068	11.8	LOS A	0.3	2.1	0.03	0.75	58.6
East: Mereworth Road											
5	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		1	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	2	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		62	10.2	0.068	11.2	NA	0.3	2.1	0.03	0.71	59.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Mereworth Road Interchange
West Side PM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
							Vehicles veh	Distance m			
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.00	0.73	58.9
3	R	42	20.0	0.054	12.4	LOS A	0.2	1.7	0.04	0.76	58.6
Approach		43	19.5	0.054	12.4	LOS A	0.2	1.7	0.04	0.75	58.6
East: Mereworth Road											
5	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		1	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	2	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		46	18.2	0.054	11.6	NA	0.2	1.7	0.03	0.70	59.7

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	4	25.0	0.127	18.8	LOS B	0.5	3.4	0.67	0.91	47.7
5	T	43	0.0	0.127	15.4	LOS B	0.5	3.4	0.67	0.86	42.0
Approach		47	2.2	0.127	15.7	LOS B	0.5	3.4	0.67	0.87	42.6
North: Hume Highway											
7	L	26	12.0	0.015	13.2	LOS A	0.0	0.0	0.00	0.76	63.3
8	T	612	13.4	0.170	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	2	0.0	0.001	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		640	13.3	0.170	0.6	NA	0.0	0.0	0.00	0.03	98.1
West: Median Opening											
11	T	4	0.0	0.015	15.5	LOS B	0.1	0.4	0.66	0.75	41.8
12	R	1	0.0	0.015	17.7	LOS B	0.1	0.4	0.66	0.86	47.8
Approach		5	0.0	0.015	15.9	LOS B	0.1	0.4	0.66	0.78	43.2
All Vehicles		693	12.5	0.170	1.7	NA	0.5	3.4	0.05	0.10	90.9

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	1	0.0	0.075	17.0	LOS B	0.3	2.0	0.65	0.86	48.1
5	T	27	0.0	0.075	15.0	LOS B	0.3	2.0	0.65	0.85	42.4
Approach		28	0.0	0.075	15.1	LOS B	0.3	2.0	0.65	0.85	42.6
North: Hume Highway											
7	L	46	0.0	0.025	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
8	T	552	22.3	0.162	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	4	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		602	20.5	0.162	1.1	NA	0.0	0.0	0.00	0.06	96.4
West: Median Opening											
11	T	3	0.0	0.012	15.4	LOS B	0.0	0.3	0.66	0.74	41.9
12	R	1	0.0	0.012	17.6	LOS B	0.0	0.3	0.66	0.84	47.9
Approach		4	0.0	0.012	15.9	LOS B	0.0	0.3	0.66	0.76	43.5
All Vehicles		635	19.4	0.162	1.8	NA	0.3	2.0	0.03	0.10	91.7

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION 5.1.13.2093
Project: P:\SIDRA RESULTS\Hume Coal Intersections\Project Baseline Study 2015.sip
8001331, EMG, SINGLE

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	472	32.4	0.146	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		476	32.1	0.146	0.1	NA	0.0	0.0	0.00	0.01	99.6
East: From Golden Vale Road											
5	T	1	0.0	0.130	15.6	LOS B	0.5	3.3	0.65	0.83	41.2
6	R	44	0.0	0.130	17.7	LOS B	0.5	3.3	0.65	0.91	47.3
Approach		45	0.0	0.130	17.7	LOS B	0.5	3.3	0.65	0.90	47.2
West: Private Access											
10	L	1	0.0	0.004	13.8	LOS A	0.0	0.1	0.56	0.69	50.7
11	T	1	0.0	0.004	11.8	LOS A	0.0	0.1	0.56	0.65	45.1
Approach		2	0.0	0.004	12.8	LOS A	0.0	0.1	0.56	0.67	48.1
All Vehicles		523	29.2	0.146	1.7	NA	0.5	3.3	0.06	0.09	90.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION 5.1.13.2093
Project: P:\SIDRA RESULTS\Hume Coal Intersections\Project Baseline Study 2015.sip
8001331, EMG, SINGLE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	696	10.6	0.191	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		700	10.5	0.191	0.1	NA	0.0	0.0	0.00	0.00	99.7
East: From Golden Vale Road											
5	T	1	0.0	0.120	18.8	LOS B	0.4	2.9	0.72	0.87	38.8
6	R	32	0.0	0.120	21.0	LOS B	0.4	2.9	0.72	0.93	44.9
Approach		33	0.0	0.120	20.9	LOS B	0.4	2.9	0.72	0.92	44.7
West: Private Access											
10	L	1	0.0	0.005	15.6	LOS B	0.0	0.1	0.63	0.73	49.1
11	T	1	0.0	0.005	13.6	LOS A	0.0	0.1	0.63	0.70	43.4
Approach		2	0.0	0.005	14.6	LOS B	0.0	0.1	0.63	0.71	46.4
All Vehicles		735	10.0	0.191	1.0	NA	0.4	2.9	0.03	0.05	94.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION 5.1.13.2093
Project: P:\SIDRA RESULTS\Hume Coal Intersections\Project Baseline Study 2015.sip
8001331, EMG, SINGLE

MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout AM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	1	0.0	0.056	9.6	LOS A	0.3	2.0	0.28	0.58	59.6
2	T	56	0.0	0.056	8.5	LOS A	0.3	2.0	0.28	0.51	60.5
3	R	15	28.6	0.056	17.1	LOS B	0.3	2.0	0.28	0.82	54.3
Approach		72	5.9	0.056	10.3	LOS A	0.3	2.0	0.28	0.57	59.1
East: Taylor Avenue											
4	L	12	27.3	0.090	10.6	LOS A	0.5	3.7	0.13	0.57	60.6
5	T	69	21.2	0.090	9.1	LOS A	0.5	3.7	0.13	0.48	62.0
6	R	40	13.2	0.090	15.9	LOS B	0.5	3.7	0.13	0.82	54.3
Approach		121	19.1	0.090	11.5	LOS A	0.5	3.7	0.13	0.60	59.0
North: Old Hume Highway											
7	L	19	5.6	0.036	9.8	LOS A	0.2	1.3	0.27	0.57	59.4
8	T	20	5.3	0.036	8.7	LOS A	0.2	1.3	0.27	0.49	60.4
9	R	8	12.5	0.036	16.3	LOS B	0.2	1.3	0.27	0.78	54.1
Approach		47	6.7	0.036	10.5	LOS A	0.2	1.3	0.27	0.57	58.8
West: Medway Road											
10	L	17	6.3	0.097	9.9	LOS A	0.5	3.8	0.28	0.59	59.7
11	T	99	17.0	0.097	9.3	LOS A	0.5	3.8	0.28	0.52	60.7
12	R	2	0.0	0.097	15.7	LOS B	0.5	3.8	0.28	0.84	54.5
Approach		118	15.2	0.097	9.5	LOS A	0.5	3.8	0.28	0.54	60.4
All Vehicles		358	13.5	0.097	10.5	LOS A	0.5	3.8	0.23	0.57	59.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION 5.1.13.2093
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8001331, EMG, SINGLE

MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout PM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	5	0.0	0.033	9.6	LOS A	0.2	1.2	0.29	0.56	59.3
2	T	21	0.0	0.033	8.6	LOS A	0.2	1.2	0.29	0.49	60.2
3	R	14	30.8	0.033	17.2	LOS B	0.2	1.2	0.29	0.77	54.0
Approach		40	10.5	0.033	11.7	LOS A	0.2	1.2	0.29	0.60	57.8
East: Taylor Avenue											
4	L	14	23.1	0.095	10.5	LOS A	0.5	3.6	0.18	0.59	60.4
5	T	103	7.1	0.095	8.5	LOS A	0.5	3.6	0.18	0.50	61.6
6	R	19	0.0	0.095	15.4	LOS B	0.5	3.6	0.18	0.85	54.4
Approach		136	7.8	0.095	9.7	LOS A	0.5	3.6	0.18	0.56	60.3
North: Old Hume Highway											
7	L	31	3.4	0.060	9.5	LOS A	0.3	2.1	0.21	0.57	59.9
8	T	34	0.0	0.060	8.3	LOS A	0.3	2.1	0.21	0.49	61.1
9	R	19	5.6	0.060	15.8	LOS B	0.3	2.1	0.21	0.79	54.2
Approach		83	2.5	0.060	10.4	LOS A	0.3	2.1	0.21	0.59	58.9
West: Medway Road											
10	L	14	7.7	0.058	9.7	LOS A	0.3	2.2	0.18	0.59	60.4
11	T	59	16.1	0.058	8.9	LOS A	0.3	2.2	0.18	0.50	61.6
12	R	3	0.0	0.058	15.4	LOS B	0.3	2.2	0.18	0.86	54.5
Approach		76	13.9	0.058	9.3	LOS A	0.3	2.2	0.18	0.53	61.1
All Vehicles		335	8.2	0.095	10.0	LOS A	0.5	3.6	0.20	0.56	59.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

Processed: Thursday, 5 November 2015 4:00:14 PM
SIDRA INTERSECTION 5.1.13.2093
Project: P:\SIDRA RESULTS\Hume Coal Intersections\Project Baseline Study 2015.sip
8001331, EMG, SINGLE

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
AM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	74	17.1	0.077	8.8	LOS A	0.0	0.0	0.00	0.82	49.0
2	T	63	0.0	0.077	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		137	9.2	0.077	4.7	NA	0.0	0.0	0.00	0.44	53.5
North: Berrima Road											
8	T	54	2.0	0.029	0.5	LOS A	0.2	1.2	0.27	0.00	54.9
9	R	1	0.0	0.029	9.0	LOS A	0.2	1.2	0.27	0.99	49.0
Approach		55	1.9	0.029	0.7	NA	0.2	1.2	0.27	0.02	54.8
West: Taylor Avenue											
10	L	1	0.0	0.203	10.1	LOS A	0.9	6.7	0.38	0.59	46.8
12	R	137	10.0	0.203	10.8	LOS A	0.9	6.7	0.38	0.70	46.6
Approach		138	9.9	0.203	10.8	LOS A	0.9	6.7	0.38	0.70	46.6
All Vehicles		329	8.3	0.203	6.6	NA	0.9	6.7	0.20	0.48	50.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION 5.1.13.2093
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8001331, EMG, SINGLE

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
PM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	145	4.3	0.127	8.3	LOS A	0.0	0.0	0.00	0.78	49.0
2	T	89	0.0	0.127	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		235	2.7	0.127	5.2	NA	0.0	0.0	0.00	0.48	52.7
North: Berrima Road											
8	T	74	1.4	0.039	0.9	LOS A	0.3	1.8	0.37	0.00	53.4
9	R	1	0.0	0.039	9.4	LOS A	0.3	1.8	0.37	0.97	49.2
Approach		75	1.4	0.039	1.1	NA	0.3	1.8	0.37	0.01	53.3
West: Taylor Avenue											
10	L	2	0.0	0.198	11.2	LOS A	0.8	6.3	0.46	0.63	45.6
12	R	116	10.0	0.198	11.9	LOS A	0.8	6.3	0.46	0.75	45.5
Approach		118	9.8	0.198	11.9	LOS A	0.8	6.3	0.46	0.75	45.5
All Vehicles		427	4.4	0.198	6.3	NA	0.8	6.3	0.19	0.47	50.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
AM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	129	12.2	0.058	0.7	LOS A	0.4	2.7	0.27	0.00	71.0
3	R	4	0.0	0.058	11.1	LOS A	0.4	2.7	0.35	1.38	59.4
Approach		134	11.8	0.058	1.0	NA	0.4	2.7	0.27	0.04	70.6
East: Douglas Road											
4	L	4	0.0	0.054	15.1	LOS B	0.2	1.7	0.51	0.64	45.4
6	R	17	37.5	0.054	17.0	LOS B	0.2	1.7	0.51	0.80	45.5
Approach		21	30.0	0.054	16.6	LOS B	0.2	1.7	0.51	0.76	45.4
North: Berrima Road											
7	L	31	41.4	0.021	11.9	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	175	10.2	0.096	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		205	14.9	0.096	1.8	NA	0.0	0.0	0.00	0.11	76.0
All Vehicles		360	14.6	0.096	2.4	NA	0.4	2.7	0.13	0.12	71.2

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

Processed: Tuesday, 12 April 2016 11:58:07 AM
SIDRA INTERSECTION 5.1.13.2093

Project: R:\Transport Planning\SIDRA RESULTS\Hume Coal Intersections\Berrima Road and Moss Vale Intersections.sip
8001331, EMM CONSULTING, SINGLE

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
PM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	205	4.6	0.087	0.6	LOS A	0.6	4.1	0.26	0.00	71.1
3	R	5	0.0	0.087	11.0	LOS A	0.6	4.1	0.35	1.40	59.4
Approach		211	4.5	0.087	0.9	NA	0.6	4.1	0.27	0.04	70.8
East: Douglas Road											
4	L	3	0.0	0.134	14.5	LOS A	0.5	3.9	0.54	0.66	45.9
6	R	58	10.9	0.134	15.1	LOS B	0.5	3.9	0.54	0.83	45.9
Approach		61	10.3	0.134	15.0	LOS B	0.5	3.9	0.54	0.82	45.9
North: Berrima Road											
7	L	17	37.5	0.011	11.7	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	183	4.0	0.096	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		200	6.8	0.096	1.0	NA	0.0	0.0	0.00	0.06	77.7
All Vehicles		472	6.3	0.134	2.8	NA	0.6	4.1	0.19	0.15	68.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Waite Street intersection AM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	262	2.8	0.409	1.0	LOS A	2.6	18.9	0.12	0.00	48.0
6	R	280	4.1	0.409	11.9	LOS A	2.6	18.9	0.66	0.97	39.1
Approach		542	3.5	0.409	6.6	NA	2.6	18.9	0.40	0.50	43.0
North: Waite Street											
7	L	269	5.5	0.451	13.1	LOS A	2.5	18.0	0.65	0.97	38.1
9	R	12	18.2	0.143	51.1	LOS D	0.4	3.5	0.91	0.97	22.5
Approach		281	6.0	0.451	14.6	LOS B	2.5	18.0	0.66	0.97	37.1
West: Argyle Street											
10	L	81	6.5	0.046	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	557	2.3	0.290	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		638	2.8	0.290	0.8	NA	0.0	0.0	0.00	0.08	49.0
All Vehicles		1461	3.7	0.451	5.6	NA	2.6	18.9	0.28	0.41	44.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Processed: Friday, 26 February 2016 3:45:13 PM
SIDRA INTERSECTION 5.1.13.2093
Project: R:\Transport Planning\SIDRA RESULTS\Hume Coal Intersections\Moss Vale Intersections.sip
8001331, EMM CONSULTING, SINGLE

MOVEMENT SUMMARY

Site: Waite Street intersection PM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	412	2.3	0.424	2.2	LOS A	3.8	27.1	0.32	0.00	45.6
6	R	269	2.7	0.424	11.3	LOS A	3.8	27.1	0.69	1.00	40.0
Approach		681	2.5	0.424	5.8	NA	3.8	27.1	0.46	0.39	43.2
North: Waite Street											
7	L	329	3.8	0.478	11.9	LOS A	2.9	21.0	0.63	0.97	38.9
9	R	18	0.0	0.159	38.8	LOS C	0.5	3.5	0.89	0.96	25.8
Approach		347	3.6	0.478	13.3	LOS A	2.9	21.0	0.64	0.97	37.9
West: Argyle Street											
10	L	75	5.6	0.042	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	459	2.8	0.240	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		534	3.2	0.240	0.9	NA	0.0	0.0	0.00	0.09	48.9
All Vehicles		1562	3.0	0.478	5.8	NA	3.8	27.1	0.34	0.42	43.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Lackey Street intersection
AM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
							Vehicles veh	Distance m			
East: Argyle Street											
5	T	558	3.4	0.442	4.7	LOS A	5.3	38.7	0.51	0.00	42.8
6	R	173	6.1	0.442	15.7	LOS B	5.3	38.7	0.96	1.13	37.7
Approach		731	4.0	0.442	7.3	NA	5.3	38.7	0.62	0.27	41.5
North: Lackey Street											
7	L	221	3.3	0.451	18.1	LOS B	2.3	16.2	0.73	1.11	35.8
9	R	5	0.0	0.093	70.6	LOS F	0.3	1.8	0.94	1.00	18.8
Approach		226	3.3	0.451	19.3	LOS B	2.3	16.2	0.73	1.11	35.1
West: Argyle Street											
10	L	52	2.0	0.028	6.5	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	721	3.6	0.379	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		773	3.5	0.379	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1729	3.7	0.451	5.8	NA	5.3	38.7	0.36	0.28	43.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Lackey Street intersection
PM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	719	2.6	0.541	4.9	LOS A	7.7	55.2	0.55	0.00	42.5
6	R	234	1.8	0.541	15.6	LOS B	7.7	55.2	1.00	1.20	37.7
Approach		953	2.4	0.541	7.5	NA	7.7	55.2	0.66	0.29	41.2
North: Lackey Street											
7	L	227	0.9	0.406	16.0	LOS B	2.0	14.2	0.66	1.09	37.0
9	R	9	0.0	0.230	102.5	LOS F	0.6	4.5	0.96	1.01	14.6
Approach		237	0.9	0.406	19.5	LOS B	2.0	14.2	0.67	1.08	34.8
West: Argyle Street											
10	L	44	9.5	0.025	6.7	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	631	2.8	0.329	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		675	3.3	0.329	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1864	2.5	0.541	6.5	NA	7.7	55.2	0.42	0.30	42.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

Appendix C

SIDRA Intersection Delay Results for 2020 Baseline Traffic

MOVEMENT SUMMARY

Site: Medway Road Interchange East Side 2020 AM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	78	18.9	0.045	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		78	18.9	0.045	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	107	13.7	0.063	11.7	X	X	X	X	0.69	58.9
9	R	2	0.0	0.003	11.7	LOS A	0.0	0.1	0.26	0.66	57.8
Approach		109	13.5	0.063	11.7	LOS A	0.0	0.1	0.00	0.69	58.8
West: Medway Road											
11	T	21	5.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.011	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		208	14.6	0.063	6.1	NA	0.0	0.1	0.00	0.36	67.4

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Medway Road Interchange East Side 2020 PM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	126	6.7	0.068	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		126	6.7	0.068	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	71	13.4	0.042	11.7	X	X	X	X	0.69	58.9
9	R	1	0.0	0.001	12.0	LOS A	0.0	0.0	0.30	0.65	57.4
Approach		72	13.2	0.042	11.7	LOS A	0.0	0.0	0.00	0.69	58.8
West: Medway Road											
11	T	16	13.3	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		16	13.3	0.009	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		214	9.4	0.068	3.9	NA	0.0	0.0	0.00	0.23	71.5

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Medway Road Interchange West Side 2020 AM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	7	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	72	20.6	0.070	12.5	LOS A	0.2	2.0	0.10	0.73	58.3
Approach		79	18.7	0.070	11.3	NA	0.2	2.0	0.09	0.66	59.9
West: Medway Road											
10	L	2	0.0	0.001	11.1	X	X	X	X	0.69	58.9
11	T	24	4.3	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		26	4.0	0.013	0.9	NA	0.0	0.0	0.00	0.06	77.8
All Vehicles		105	15.0	0.070	8.7	NA	0.2	2.0	0.07	0.51	63.6

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Medway Road Interchange West Side 2020 PM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	22	4.8	0.012	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	111	6.7	0.093	11.5	LOS A	0.3	2.4	0.08	0.73	58.4
Approach		133	6.3	0.093	9.6	NA	0.3	2.4	0.06	0.61	61.2
West: Medway Road											
10	L	3	0.0	0.002	11.1	X	X	X	X	0.69	58.9
11	T	18	5.9	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.010	1.7	NA	0.0	0.0	0.00	0.10	76.0
All Vehicles		154	6.2	0.093	8.5	NA	0.3	2.4	0.05	0.54	62.9

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Mereworth Road Interchange East Side 2020 AM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	16	20.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	1	0.0	0.001	10.8	LOS A	0.0	0.0	0.00	0.74	59.0
Approach		17	18.8	0.009	0.7	NA	0.0	0.0	0.00	0.05	78.3
West: Mereworth Road											
10	L	61	8.6	0.035	11.5	X	X	X	X	0.69	58.9
12	R	2	50.0	0.005	14.7	LOS B	0.0	0.1	0.12	0.72	58.3
Approach		63	10.0	0.035	11.6	LOS A	0.0	0.1	0.00	0.69	58.8
All Vehicles		80	11.8	0.035	9.3	NA	0.0	0.1	0.00	0.55	62.1

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Mereworth Road Interchange East Side 2020 PM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	42	7.5	0.023	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	1	0.0	0.001	10.8	LOS A	0.0	0.0	0.00	0.74	59.0
Approach		43	7.3	0.023	0.3	NA	0.0	0.0	0.00	0.02	79.3
West: Mereworth Road											
10	L	38	8.3	0.022	11.4	X	X	X	X	0.69	58.9
12	R	1	0.0	0.002	11.3	LOS A	0.0	0.0	0.15	0.69	58.1
Approach		39	8.1	0.022	11.4	LOS A	0.0	0.0	0.00	0.69	58.8
All Vehicles		82	7.7	0.023	5.6	NA	0.0	0.0	0.00	0.34	68.1

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Mereworth Road Interchange
West Side 2020 AM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.00	0.73	58.9
3	R	60	10.5	0.071	11.8	LOS A	0.3	2.2	0.03	0.75	58.6
Approach		61	10.3	0.071	11.8	LOS A	0.3	2.2	0.03	0.75	58.6
East: Mereworth Road											
5	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		1	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	2	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		64	9.8	0.071	11.2	NA	0.3	2.2	0.03	0.72	59.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange
West Side 2020 PM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.00	0.73	58.9
3	R	44	19.0	0.056	12.4	LOS A	0.2	1.8	0.04	0.75	58.6
Approach		45	18.6	0.056	12.3	LOS A	0.2	1.8	0.04	0.75	58.6
East: Mereworth Road											
5	T	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		1	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	2	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	0.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		48	17.4	0.056	11.5	NA	0.2	1.8	0.03	0.71	59.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side 2020 AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	4	25.0	0.149	20.3	LOS B	0.6	3.9	0.71	0.92	46.6
5	T	45	0.0	0.149	16.9	LOS B	0.6	3.9	0.71	0.88	40.8
Approach		49	2.1	0.149	17.2	LOS B	0.6	3.9	0.71	0.88	41.4
North: Hume Highway											
7	L	27	11.5	0.016	13.2	LOS A	0.0	0.0	0.00	0.76	63.3
8	T	673	13.5	0.188	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	2	0.0	0.001	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		702	13.3	0.188	0.6	NA	0.0	0.0	0.00	0.03	98.2
West: Median Opening											
11	T	4	0.0	0.017	17.0	LOS B	0.1	0.4	0.70	0.79	40.6
12	R	1	0.0	0.017	19.2	LOS B	0.1	0.4	0.70	0.89	46.6
Approach		5	0.0	0.017	17.5	LOS B	0.1	0.4	0.70	0.81	42.0
All Vehicles		757	12.5	0.188	1.8	NA	0.6	3.9	0.05	0.09	91.0

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side 2020 PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	1	0.0	0.087	18.4	LOS B	0.3	2.2	0.69	0.90	46.9
5	T	28	0.0	0.087	16.4	LOS B	0.3	2.2	0.69	0.87	41.2
Approach		29	0.0	0.087	16.5	LOS B	0.3	2.2	0.69	0.87	41.5
North: Hume Highway											
7	L	48	0.0	0.026	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
8	T	607	22.4	0.178	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	4	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		660	20.6	0.178	1.0	NA	0.0	0.0	0.00	0.06	96.6
West: Median Opening											
11	T	3	0.0	0.014	16.9	LOS B	0.0	0.3	0.70	0.77	40.7
12	R	1	0.0	0.014	19.1	LOS B	0.0	0.3	0.70	0.86	46.7
Approach		4	0.0	0.014	17.4	LOS B	0.0	0.3	0.70	0.80	42.4
All Vehicles		694	19.6	0.178	1.8	NA	0.3	2.2	0.03	0.10	91.9

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side 2020 AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	519	32.5	0.161	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		523	32.2	0.161	0.1	NA	0.0	0.0	0.00	0.01	99.6
East: From Golden Vale Road											
5	T	1	0.0	0.152	17.1	LOS B	0.5	3.8	0.69	0.85	40.0
6	R	46	0.0	0.152	19.3	LOS B	0.5	3.8	0.69	0.92	46.1
Approach		47	0.0	0.152	19.2	LOS B	0.5	3.8	0.69	0.92	46.0
West: Private Access											
10	L	1	0.0	0.005	14.6	LOS B	0.0	0.1	0.58	0.71	50.0
11	T	1	0.0	0.005	12.6	LOS A	0.0	0.1	0.58	0.67	44.3
Approach		2	0.0	0.005	13.6	LOS A	0.0	0.1	0.58	0.69	47.3
All Vehicles		573	29.4	0.161	1.7	NA	0.5	3.8	0.06	0.08	90.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side 2020 PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	765	10.6	0.210	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		769	10.5	0.210	0.1	NA	0.0	0.0	0.00	0.00	99.8
East: From Golden Vale Road											
5	T	1	0.0	0.146	21.2	LOS B	0.5	3.5	0.77	0.89	37.2
6	R	34	0.0	0.146	23.4	LOS B	0.5	3.5	0.77	0.94	43.2
Approach		35	0.0	0.146	23.3	LOS B	0.5	3.5	0.77	0.94	43.1
West: Private Access											
10	L	1	0.0	0.006	16.8	LOS B	0.0	0.1	0.67	0.75	48.1
11	T	1	0.0	0.006	14.8	LOS B	0.0	0.1	0.67	0.73	42.3
Approach		2	0.0	0.006	15.8	LOS B	0.0	0.1	0.67	0.74	45.4
All Vehicles		806	10.1	0.210	1.1	NA	0.5	3.5	0.03	0.05	94.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout 2020 AM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	1	0.0	0.059	9.6	LOS A	0.3	2.1	0.28	0.58	59.5
2	T	59	0.0	0.059	8.5	LOS A	0.3	2.1	0.28	0.51	60.5
3	R	16	26.7	0.059	17.0	LOS B	0.3	2.1	0.28	0.82	54.3
Approach		76	5.6	0.059	10.3	LOS A	0.3	2.1	0.28	0.58	59.0
East: Taylor Avenue											
4	L	12	27.3	0.094	10.6	LOS A	0.5	3.9	0.14	0.57	60.6
5	T	72	22.1	0.094	9.1	LOS A	0.5	3.9	0.14	0.48	62.0
6	R	42	12.5	0.094	15.9	LOS B	0.5	3.9	0.14	0.82	54.3
Approach		125	19.3	0.094	11.5	LOS A	0.5	3.9	0.14	0.60	59.0
North: Old Hume Highway											
7	L	20	5.3	0.038	9.8	LOS A	0.2	1.4	0.28	0.57	59.4
8	T	21	5.0	0.038	8.7	LOS A	0.2	1.4	0.28	0.50	60.4
9	R	8	12.5	0.038	16.3	LOS B	0.2	1.4	0.28	0.78	54.1
Approach		49	6.4	0.038	10.4	LOS A	0.2	1.4	0.28	0.57	58.8
West: Medway Road											
10	L	18	5.9	0.102	9.9	LOS A	0.5	4.1	0.29	0.60	59.6
11	T	104	17.2	0.102	9.3	LOS A	0.5	4.1	0.29	0.53	60.6
12	R	2	0.0	0.102	15.8	LOS B	0.5	4.1	0.29	0.84	54.5
Approach		124	15.3	0.102	9.5	LOS A	0.5	4.1	0.29	0.54	60.3
All Vehicles		375	13.5	0.102	10.5	LOS A	0.5	4.1	0.23	0.57	59.4

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout 2020 PM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	5	0.0	0.034	9.7	LOS A	0.2	1.2	0.30	0.57	59.2
2	T	22	0.0	0.034	8.6	LOS A	0.2	1.2	0.30	0.50	60.2
3	R	14	30.8	0.034	17.3	LOS B	0.2	1.2	0.30	0.78	54.0
Approach		41	10.3	0.034	11.6	LOS A	0.2	1.2	0.30	0.60	57.8
East: Taylor Avenue											
4	L	15	21.4	0.101	10.4	LOS A	0.5	3.8	0.18	0.59	60.3
5	T	108	6.8	0.101	8.5	LOS A	0.5	3.8	0.18	0.50	61.6
6	R	20	0.0	0.101	15.4	LOS B	0.5	3.8	0.18	0.85	54.4
Approach		143	7.4	0.101	9.6	LOS A	0.5	3.8	0.18	0.56	60.3
North: Old Hume Highway											
7	L	32	3.3	0.063	9.5	LOS A	0.3	2.2	0.22	0.57	59.9
8	T	36	0.0	0.063	8.3	LOS A	0.3	2.2	0.22	0.49	61.0
9	R	20	5.3	0.063	15.8	LOS B	0.3	2.2	0.22	0.79	54.2
Approach		87	2.4	0.063	10.4	LOS A	0.3	2.2	0.22	0.59	58.8
West: Medway Road											
10	L	15	7.1	0.060	9.7	LOS A	0.3	2.3	0.18	0.59	60.3
11	T	61	15.5	0.060	8.9	LOS A	0.3	2.3	0.18	0.50	61.6
12	R	3	0.0	0.060	15.4	LOS B	0.3	2.3	0.18	0.86	54.5
Approach		79	13.3	0.060	9.3	LOS A	0.3	2.3	0.18	0.53	61.0
All Vehicles		351	7.8	0.101	10.0	LOS A	0.5	3.8	0.21	0.56	59.8

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
2020 AM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	78	17.6	0.081	8.8	LOS A	0.0	0.0	0.00	0.82	49.0
2	T	66	0.0	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		144	9.5	0.081	4.8	NA	0.0	0.0	0.00	0.44	53.5
North: Berrima Road											
8	T	57	1.9	0.030	0.6	LOS A	0.2	1.3	0.28	0.00	54.8
9	R	1	0.0	0.030	9.0	LOS A	0.2	1.3	0.28	0.99	49.0
Approach		58	1.8	0.030	0.7	NA	0.2	1.3	0.28	0.02	54.7
West: Taylor Avenue											
10	L	1	0.0	0.218	10.3	LOS A	1.0	7.3	0.39	0.60	46.6
12	R	144	10.2	0.218	10.9	LOS A	1.0	7.3	0.39	0.71	46.4
Approach		145	10.1	0.218	10.9	LOS A	1.0	7.3	0.39	0.71	46.4
All Vehicles		347	8.5	0.218	6.7	NA	1.0	7.3	0.21	0.48	50.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
2020 PM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	153	4.1	0.133	8.3	LOS A	0.0	0.0	0.00	0.78	49.0
2	T	94	0.0	0.133	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		246	2.6	0.133	5.2	NA	0.0	0.0	0.00	0.48	52.6
North: Berrima Road											
8	T	77	1.4	0.041	1.0	LOS A	0.3	1.9	0.38	0.00	53.2
9	R	1	0.0	0.041	9.5	LOS A	0.3	1.9	0.38	0.97	49.2
Approach		78	1.4	0.041	1.1	NA	0.3	1.9	0.38	0.01	53.1
West: Taylor Avenue											
10	L	2	0.0	0.214	11.5	LOS A	0.9	6.8	0.47	0.64	45.4
12	R	122	10.3	0.214	12.2	LOS A	0.9	6.8	0.47	0.76	45.3
Approach		124	10.2	0.214	12.1	LOS A	0.9	6.8	0.47	0.76	45.3
All Vehicles		448	4.5	0.214	6.4	NA	0.9	6.8	0.20	0.48	50.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
2020 AM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	136	12.4	0.061	0.7	LOS A	0.4	2.9	0.28	0.00	70.7
3	R	4	0.0	0.061	11.1	LOS A	0.4	2.9	0.36	1.37	59.5
Approach		140	12.0	0.061	1.0	NA	0.4	2.9	0.28	0.04	70.4
East: Douglas Road											
4	L	4	0.0	0.058	15.3	LOS B	0.2	1.8	0.52	0.65	45.1
6	R	18	35.3	0.058	17.1	LOS B	0.2	1.8	0.52	0.81	45.2
Approach		22	28.6	0.058	16.8	LOS B	0.2	1.8	0.52	0.78	45.2
North: Berrima Road											
7	L	33	41.9	0.023	11.9	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	184	10.3	0.101	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		217	15.0	0.101	1.8	NA	0.0	0.0	0.00	0.11	75.9
All Vehicles		379	14.7	0.101	2.4	NA	0.4	2.9	0.13	0.12	71.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
2020 PM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	215	4.4	0.091	0.7	LOS A	0.6	4.3	0.27	0.00	70.9
3	R	5	0.0	0.091	11.1	LOS A	0.6	4.3	0.36	1.40	59.5
Approach		220	4.3	0.091	0.9	NA	0.6	4.3	0.27	0.03	70.6
East: Douglas Road											
4	L	3	0.0	0.142	14.8	LOS B	0.5	4.1	0.55	0.67	45.6
6	R	60	10.5	0.142	15.4	LOS B	0.5	4.1	0.55	0.84	45.7
Approach		63	10.0	0.142	15.3	LOS B	0.5	4.1	0.55	0.83	45.7
North: Berrima Road											
7	L	18	35.3	0.012	11.6	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	192	3.8	0.101	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		209	6.5	0.101	1.0	NA	0.0	0.0	0.00	0.06	77.7
All Vehicles		493	6.0	0.142	2.8	NA	0.6	4.3	0.19	0.15	68.5

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Waite Street intersection
2020 AM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	275	2.7	0.444	0.9	LOS A	2.9	20.9	0.11	0.00	48.2
6	R	295	4.3	0.444	12.6	LOS A	2.9	20.9	0.69	1.00	38.6
Approach		569	3.5	0.444	7.0	NA	2.9	20.9	0.41	0.52	42.7
North: Waite Street											
7	L	283	5.6	0.495	14.0	LOS A	2.8	20.7	0.68	1.01	37.5
9	R	12	18.2	0.165	59.0	LOS E	0.5	4.0	0.93	0.98	20.7
Approach		295	6.1	0.495	15.8	LOS B	2.8	20.7	0.69	1.01	36.3
West: Argyle Street											
10	L	85	6.2	0.048	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	585	2.3	0.305	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		671	2.8	0.305	0.8	NA	0.0	0.0	0.00	0.08	49.0
All Vehicles		1535	3.7	0.495	6.0	NA	2.9	20.9	0.29	0.42	43.7

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Waite Street intersection
2020 PM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	432	2.2	0.452	2.4	LOS A	4.2	30.2	0.32	0.00	45.5
6	R	282	2.6	0.452	11.9	LOS A	4.2	30.2	0.72	1.03	39.6
Approach		714	2.4	0.452	6.2	NA	4.2	30.2	0.48	0.41	42.9
North: Waite Street											
7	L	346	4.0	0.519	12.7	LOS A	3.3	24.1	0.65	1.00	38.4
9	R	19	0.0	0.191	44.6	LOS D	0.6	4.2	0.91	0.98	24.1
Approach		365	3.7	0.519	14.3	LOS A	3.3	24.1	0.67	1.00	37.2
West: Argyle Street											
10	L	78	5.4	0.044	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	482	2.8	0.252	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		560	3.2	0.252	0.9	NA	0.0	0.0	0.00	0.08	48.9
All Vehicles		1639	3.0	0.519	6.2	NA	4.2	30.2	0.36	0.43	43.3

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Lackey Street intersection
2020 AM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	586	3.4	0.479	5.3	LOS A	5.9	42.6	0.51	0.00	42.3
6	R	182	6.4	0.479	17.1	LOS B	5.9	42.6	1.00	1.16	36.8
Approach		768	4.1	0.479	8.1	NA	5.9	42.6	0.63	0.28	40.8
North: Lackey Street											
7	L	232	3.2	0.499	19.3	LOS B	2.6	18.6	0.76	1.14	35.1
9	R	5	0.0	0.112	82.5	LOS F	0.3	2.2	0.95	1.00	17.0
Approach		237	3.1	0.499	20.7	LOS B	2.6	18.6	0.76	1.13	34.3
West: Argyle Street											
10	L	54	2.0	0.029	6.5	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	757	3.6	0.397	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		811	3.5	0.397	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1816	3.7	0.499	6.3	NA	5.9	42.6	0.37	0.28	43.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Lackey Street intersection
2020 PM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	755	2.6	0.580	5.6	LOS A	8.3	59.0	0.54	0.00	41.9
6	R	245	1.7	0.580	17.0	LOS B	8.3	59.0	1.00	1.24	36.8
Approach		1000	2.4	0.580	8.4	NA	8.3	59.0	0.65	0.30	40.5
North: Lackey Street											
7	L	239	0.9	0.446	16.9	LOS B	2.3	16.2	0.69	1.11	36.4
9	R	9	0.0	0.282	129.3	LOS F	0.8	5.5	0.97	1.02	12.3
Approach		248	0.8	0.446	21.2	LOS B	2.3	16.2	0.70	1.10	33.9
West: Argyle Street											
10	L	46	9.1	0.027	6.7	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	662	2.9	0.346	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		708	3.3	0.346	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1957	2.5	0.580	7.1	NA	8.3	59.0	0.42	0.31	42.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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Appendix D

SIDRA Intersection Delay results for early construction

MOVEMENT SUMMARY

Site: Medway Road Interchange East Side Early Construction AM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	81	20.8	0.047	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		81	20.8	0.047	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	114	14.8	0.068	11.8	X	X	X	X	0.69	58.9
9	R	2	0.0	0.003	11.7	LOS A	0.0	0.1	0.26	0.66	57.8
Approach		116	14.5	0.068	11.8	LOS A	0.0	0.1	0.00	0.69	58.8
West: Medway Road											
11	T	21	5.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.011	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		218	15.9	0.068	6.2	NA	0.0	0.1	0.00	0.36	67.2

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Medway Road Interchange East Side Early Construction PM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	139	6.8	0.074	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		139	6.8	0.074	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	72	14.7	0.043	11.8	X	X	X	X	0.69	58.9
9	R	1	0.0	0.001	12.1	LOS A	0.0	0.0	0.32	0.65	57.3
Approach		73	14.5	0.043	11.8	LOS A	0.0	0.0	0.00	0.69	58.8
West: Medway Road											
11	T	16	13.3	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		16	13.3	0.009	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		227	9.7	0.074	3.8	NA	0.0	0.0	0.00	0.22	71.8

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Medway Road Interchange West Side Early Construction AM Peak

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Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	7	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	75	22.5	0.074	12.6	LOS A	0.3	2.1	0.10	0.73	58.3
Approach		82	20.5	0.074	11.5	NA	0.3	2.1	0.09	0.66	59.8
West: Medway Road											
10	L	2	0.0	0.001	11.1	X	X	X	X	0.69	58.9
11	T	24	4.3	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		26	4.0	0.013	0.9	NA	0.0	0.0	0.00	0.06	77.8
All Vehicles		108	16.5	0.074	8.9	NA	0.3	2.1	0.07	0.51	63.4

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Medway Road Interchange West Side Early Construction PM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	23	4.5	0.012	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	122	6.9	0.103	11.5	LOS A	0.4	2.7	0.08	0.73	58.4
Approach		145	6.5	0.103	9.7	NA	0.4	2.7	0.06	0.61	61.1
West: Medway Road											
10	L	3	0.0	0.002	11.1	X	X	X	X	0.69	58.9
11	T	18	5.9	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.010	1.7	NA	0.0	0.0	0.00	0.10	76.0
All Vehicles		166	6.3	0.103	8.7	NA	0.4	2.7	0.06	0.55	62.7

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange East Side Early Construction AM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	16	20.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	16	26.7	0.010	12.5	LOS A	0.0	0.0	0.00	0.74	59.0
Approach		32	23.3	0.010	6.3	NA	0.0	0.0	0.00	0.37	68.0
West: Mereworth Road											
10	L	66	14.3	0.039	11.7	X	X	X	X	0.69	58.9
12	R	3	66.7	0.009	16.2	LOS B	0.0	0.3	0.18	0.71	57.7
Approach		69	16.7	0.039	11.9	LOS A	0.0	0.3	0.01	0.69	58.8
All Vehicles		101	18.8	0.039	10.2	NA	0.0	0.3	0.01	0.59	61.4

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange East Side Early Construction PM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	42	7.5	0.023	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	2	50.0	0.002	14.0	LOS A	0.0	0.0	0.00	0.75	59.0
Approach		44	9.5	0.023	0.7	NA	0.0	0.0	0.00	0.04	78.7
West: Mereworth Road											
10	L	65	6.5	0.037	11.4	X	X	X	X	0.69	58.9
12	R	11	0.0	0.016	11.4	LOS A	0.0	0.3	0.16	0.70	58.1
Approach		76	5.6	0.037	11.4	LOS A	0.0	0.3	0.02	0.69	58.8
All Vehicles		120	7.0	0.037	7.4	NA	0.0	0.3	0.01	0.45	64.9

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange West Side Early Construction AM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	5	20.0	0.011	12.2	LOS A	0.0	0.1	0.08	0.69	58.4
3	R	60	10.5	0.074	12.1	LOS A	0.3	2.2	0.14	0.71	58.1
Approach		65	11.3	0.074	12.1	LOS A	0.3	2.2	0.13	0.71	58.1
East: Mereworth Road											
5	T	16	26.7	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		16	26.7	0.010	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	8	62.5	0.006	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		8	62.5	0.006	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		89	18.8	0.074	8.8	NA	0.3	2.2	0.10	0.52	62.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange West Side Early Construction PM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.02	0.71	58.8
3	R	44	19.0	0.060	12.8	LOS A	0.2	1.9	0.17	0.71	58.0
Approach		45	18.6	0.060	12.8	LOS A	0.2	1.9	0.16	0.71	58.0
East: Mereworth Road											
5	T	2	50.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	50.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	39	2.7	0.020	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		39	2.7	0.020	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		86	12.2	0.060	6.7	NA	0.2	1.9	0.09	0.37	66.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side Early Construction AM Peak

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Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	4	25.0	0.149	20.4	LOS B	0.6	3.9	0.71	0.92	46.5
5	T	45	0.0	0.149	17.0	LOS B	0.6	3.9	0.71	0.88	40.8
Approach		49	2.1	0.149	17.3	LOS B	0.6	3.9	0.71	0.88	41.3
North: Hume Highway											
7	L	27	11.5	0.016	13.2	LOS A	0.0	0.0	0.00	0.76	63.3
8	T	674	13.6	0.188	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	2	0.0	0.001	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		703	13.5	0.188	0.6	NA	0.0	0.0	0.00	0.03	98.2
West: Median Opening											
11	T	4	0.0	0.017	17.1	LOS B	0.1	0.4	0.70	0.79	40.6
12	R	1	0.0	0.017	19.3	LOS B	0.1	0.4	0.70	0.89	46.6
Approach		5	0.0	0.017	17.5	LOS B	0.1	0.4	0.70	0.81	41.9
All Vehicles		758	12.6	0.188	1.8	NA	0.6	3.9	0.05	0.09	91.0

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side Early Construction PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	1	0.0	0.089	18.6	LOS B	0.3	2.3	0.70	0.91	46.8
5	T	28	0.0	0.089	16.6	LOS B	0.3	2.3	0.70	0.88	41.1
Approach		29	0.0	0.089	16.7	LOS B	0.3	2.3	0.70	0.88	41.3
North: Hume Highway											
7	L	49	0.0	0.027	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
8	T	616	22.1	0.181	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	4	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		669	20.3	0.181	1.0	NA	0.0	0.0	0.00	0.06	96.5
West: Median Opening											
11	T	3	0.0	0.014	17.1	LOS B	0.0	0.3	0.70	0.78	40.5
12	R	1	0.0	0.014	19.3	LOS B	0.0	0.3	0.70	0.87	46.5
Approach		4	0.0	0.014	17.6	LOS B	0.0	0.3	0.70	0.80	42.2
All Vehicles		703	19.3	0.181	1.8	NA	0.3	2.3	0.03	0.10	91.9

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side Early Construction AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	523	32.4	0.162	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		527	32.1	0.162	0.1	NA	0.0	0.0	0.00	0.01	99.6
East: From Golden Vale Road											
5	T	1	0.0	0.153	17.2	LOS B	0.6	3.9	0.69	0.86	39.9
6	R	46	0.0	0.153	19.4	LOS B	0.6	3.9	0.69	0.92	46.0
Approach		47	0.0	0.153	19.4	LOS B	0.6	3.9	0.69	0.92	45.9
West: Private Access											
10	L	1	0.0	0.005	14.6	LOS B	0.0	0.1	0.59	0.71	49.9
11	T	1	0.0	0.005	12.6	LOS A	0.0	0.1	0.59	0.67	44.3
Approach		2	0.0	0.005	13.6	LOS A	0.0	0.1	0.59	0.69	47.3
All Vehicles		577	29.4	0.162	1.7	NA	0.6	3.9	0.06	0.08	90.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side Early Construction PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	765	10.6	0.210	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		769	10.5	0.210	0.1	NA	0.0	0.0	0.00	0.00	99.8
East: From Golden Vale Road											
5	T	1	0.0	0.146	21.2	LOS B	0.5	3.5	0.77	0.89	37.2
6	R	34	0.0	0.146	23.4	LOS B	0.5	3.5	0.77	0.94	43.2
Approach		35	0.0	0.146	23.3	LOS B	0.5	3.5	0.77	0.94	43.1
West: Private Access											
10	L	1	0.0	0.006	16.8	LOS B	0.0	0.1	0.67	0.75	48.1
11	T	1	0.0	0.006	14.8	LOS B	0.0	0.1	0.67	0.73	42.3
Approach		2	0.0	0.006	15.8	LOS B	0.0	0.1	0.67	0.74	45.4
All Vehicles		806	10.1	0.210	1.1	NA	0.5	3.5	0.03	0.05	94.3

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout Early Construction AM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	4	50.0	0.067	12.3	LOS A	0.3	2.5	0.29	0.61	59.4
2	T	59	0.0	0.067	8.6	LOS A	0.3	2.5	0.29	0.51	60.4
3	R	18	35.3	0.067	17.5	LOS B	0.3	2.5	0.29	0.81	54.2
Approach		81	10.4	0.067	10.7	LOS A	0.3	2.5	0.29	0.58	58.8
East: Taylor Avenue											
4	L	17	31.3	0.100	10.9	LOS A	0.5	4.2	0.16	0.57	60.4
5	T	72	22.1	0.100	9.2	LOS A	0.5	4.2	0.16	0.48	61.7
6	R	42	12.5	0.100	16.0	LOS B	0.5	4.2	0.16	0.81	54.3
Approach		131	20.2	0.100	11.6	LOS A	0.5	4.2	0.16	0.60	58.8
North: Old Hume Highway											
7	L	20	5.3	0.040	9.9	LOS A	0.2	1.5	0.30	0.57	59.3
8	T	24	4.3	0.040	8.7	LOS A	0.2	1.5	0.30	0.50	60.2
9	R	8	12.5	0.040	16.3	LOS B	0.2	1.5	0.30	0.79	54.1
Approach		53	6.0	0.040	10.4	LOS A	0.2	1.5	0.30	0.57	58.8
West: Medway Road											
10	L	18	5.9	0.109	10.0	LOS A	0.5	4.4	0.29	0.59	59.5
11	T	104	17.2	0.109	9.4	LOS A	0.5	4.4	0.29	0.52	60.4
12	R	8	25.0	0.109	17.0	LOS B	0.5	4.4	0.29	0.83	54.4
Approach		131	16.1	0.109	9.9	LOS A	0.5	4.4	0.29	0.55	59.9
All Vehicles		395	14.9	0.109	10.7	LOS A	0.5	4.4	0.25	0.58	59.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout Early Construction PM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	18	5.9	0.054	10.0	LOS A	0.3	2.0	0.30	0.57	59.2
2	T	29	0.0	0.054	8.6	LOS A	0.3	2.0	0.30	0.50	60.1
3	R	21	20.0	0.054	16.7	LOS B	0.3	2.0	0.30	0.78	54.0
Approach		68	7.7	0.054	11.4	LOS A	0.3	2.0	0.30	0.60	57.8
East: Taylor Avenue											
4	L	15	21.4	0.101	10.4	LOS A	0.5	3.8	0.19	0.59	60.3
5	T	108	6.8	0.101	8.5	LOS A	0.5	3.8	0.19	0.50	61.5
6	R	20	0.0	0.101	15.4	LOS B	0.5	3.8	0.19	0.85	54.4
Approach		143	7.4	0.101	9.7	LOS A	0.5	3.8	0.19	0.56	60.2
North: Old Hume Highway											
7	L	32	3.3	0.063	9.6	LOS A	0.3	2.2	0.23	0.57	59.8
8	T	36	0.0	0.063	8.3	LOS A	0.3	2.2	0.23	0.49	60.9
9	R	20	5.3	0.063	15.8	LOS B	0.3	2.2	0.23	0.79	54.1
Approach		87	2.4	0.063	10.5	LOS A	0.3	2.2	0.23	0.59	58.7
West: Medway Road											
10	L	15	7.1	0.063	9.7	LOS A	0.3	2.4	0.21	0.58	60.1
11	T	61	15.5	0.063	9.0	LOS A	0.3	2.4	0.21	0.50	61.3
12	R	4	25.0	0.063	16.7	LOS B	0.3	2.4	0.21	0.84	54.4
Approach		80	14.5	0.063	9.5	LOS A	0.3	2.4	0.21	0.54	60.7
All Vehicles		379	7.8	0.101	10.1	LOS A	0.5	3.8	0.22	0.57	59.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
Early Construction AM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	83	19.0	0.085	8.9	LOS A	0.0	0.0	0.00	0.81	49.0
2	T	66	0.0	0.085	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		149	10.6	0.085	4.9	NA	0.0	0.0	0.00	0.45	53.3
North: Berrima Road											
8	T	57	1.9	0.030	0.6	LOS A	0.2	1.3	0.29	0.00	54.6
9	R	1	0.0	0.030	9.0	LOS A	0.2	1.3	0.29	0.99	49.0
Approach		58	1.8	0.030	0.7	NA	0.2	1.3	0.29	0.02	54.5
West: Taylor Avenue											
10	L	1	0.0	0.226	10.4	LOS A	1.0	7.6	0.40	0.60	46.5
12	R	146	11.5	0.226	11.1	LOS A	1.0	7.6	0.40	0.71	46.3
Approach		147	11.4	0.226	11.1	LOS A	1.0	7.6	0.40	0.71	46.3
All Vehicles		355	9.5	0.226	6.8	NA	1.0	7.6	0.21	0.49	50.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
Early Construction PM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	153	4.1	0.133	8.3	LOS A	0.0	0.0	0.00	0.78	49.0
2	T	94	0.0	0.133	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		246	2.6	0.133	5.2	NA	0.0	0.0	0.00	0.48	52.6
North: Berrima Road											
8	T	77	1.4	0.041	1.0	LOS A	0.3	1.9	0.38	0.00	53.2
9	R	1	0.0	0.041	9.5	LOS A	0.3	1.9	0.38	0.97	49.2
Approach		78	1.4	0.041	1.1	NA	0.3	1.9	0.38	0.01	53.1
West: Taylor Avenue											
10	L	2	0.0	0.223	11.5	LOS A	0.9	7.2	0.48	0.64	45.4
12	R	128	9.8	0.223	12.1	LOS A	0.9	7.2	0.48	0.77	45.3
Approach		131	9.7	0.223	12.1	LOS A	0.9	7.2	0.48	0.76	45.3
All Vehicles		455	4.4	0.223	6.5	NA	0.9	7.2	0.20	0.48	50.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
Early Construction AM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	140	12.8	0.063	0.8	LOS A	0.4	3.0	0.28	0.00	70.6
3	R	4	0.0	0.063	11.2	LOS A	0.4	3.0	0.37	1.37	59.5
Approach		144	12.4	0.063	1.1	NA	0.4	3.0	0.28	0.04	70.3
East: Douglas Road											
4	L	4	0.0	0.065	16.1	LOS B	0.2	2.1	0.54	0.65	44.6
6	R	19	38.9	0.065	18.0	LOS B	0.2	2.1	0.54	0.82	44.6
Approach		23	31.8	0.065	17.7	LOS B	0.2	2.1	0.54	0.79	44.6
North: Berrima Road											
7	L	34	43.8	0.024	12.0	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	185	10.8	0.102	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		219	15.9	0.102	1.8	NA	0.0	0.0	0.00	0.11	75.8
All Vehicles		386	15.5	0.102	2.5	NA	0.4	3.0	0.14	0.12	70.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
Early Construction PM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	215	4.4	0.091	0.7	LOS A	0.6	4.3	0.28	0.00	70.7
3	R	5	0.0	0.091	11.1	LOS A	0.6	4.3	0.36	1.40	59.6
Approach		220	4.3	0.091	0.9	NA	0.6	4.3	0.28	0.03	70.5
East: Douglas Road											
4	L	3	0.0	0.143	14.9	LOS B	0.5	4.2	0.55	0.67	45.5
6	R	60	10.5	0.143	15.5	LOS B	0.5	4.2	0.55	0.85	45.6
Approach		63	10.0	0.143	15.5	LOS B	0.5	4.2	0.55	0.84	45.5
North: Berrima Road											
7	L	18	35.3	0.012	11.6	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	198	3.7	0.104	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		216	6.3	0.104	1.0	NA	0.0	0.0	0.00	0.06	77.7
All Vehicles		499	5.9	0.143	2.8	NA	0.6	4.3	0.19	0.15	68.5

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Waite Street intersection
Early Construction AM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	275	2.7	0.447	0.9	LOS A	2.9	21.0	0.10	0.00	48.2
6	R	297	4.6	0.447	12.6	LOS A	2.9	21.0	0.70	1.00	38.6
Approach		572	3.7	0.447	7.0	NA	2.9	21.0	0.41	0.52	42.7
North: Waite Street											
7	L	284	5.9	0.500	14.1	LOS A	2.9	21.1	0.68	1.01	37.4
9	R	12	18.2	0.166	59.4	LOS E	0.5	4.0	0.93	0.98	20.6
Approach		296	6.4	0.500	15.9	LOS B	2.9	21.1	0.69	1.01	36.3
West: Argyle Street											
10	L	86	6.1	0.049	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	585	2.3	0.305	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		672	2.8	0.305	0.8	NA	0.0	0.0	0.00	0.08	49.0
All Vehicles		1539	3.8	0.500	6.0	NA	2.9	21.1	0.29	0.42	43.7

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Waite Street intersection
Early Construction PM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	432	2.2	0.452	2.4	LOS A	4.2	30.2	0.32	0.00	45.5
6	R	282	2.6	0.452	11.9	LOS A	4.2	30.2	0.72	1.03	39.6
Approach		714	2.4	0.452	6.2	NA	4.2	30.2	0.48	0.41	42.9
North: Waite Street											
7	L	348	3.9	0.522	12.7	LOS A	3.4	24.3	0.66	1.01	38.3
9	R	21	0.0	0.213	45.5	LOS D	0.7	4.7	0.91	0.98	23.8
Approach		369	3.7	0.522	14.6	LOS B	3.4	24.3	0.67	1.01	37.1
West: Argyle Street											
10	L	78	5.4	0.044	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	482	2.8	0.252	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		560	3.2	0.252	0.9	NA	0.0	0.0	0.00	0.08	48.9
All Vehicles		1643	2.9	0.522	6.3	NA	4.2	30.2	0.36	0.43	43.2

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Lackey Street intersection
Early Construction AM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	588	3.6	0.481	5.3	LOS A	5.9	42.8	0.51	0.00	42.2
6	R	182	6.4	0.481	17.2	LOS B	5.9	42.8	1.00	1.16	36.7
Approach		771	4.2	0.481	8.1	NA	5.9	42.8	0.63	0.27	40.8
North: Lackey Street											
7	L	232	3.2	0.500	19.3	LOS B	2.6	18.7	0.76	1.14	35.1
9	R	5	0.0	0.113	83.1	LOS F	0.3	2.2	0.95	1.00	16.9
Approach		237	3.1	0.500	20.8	LOS B	2.6	18.7	0.77	1.13	34.3
West: Argyle Street											
10	L	54	2.0	0.029	6.5	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	758	3.8	0.398	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		812	3.6	0.398	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1819	3.8	0.500	6.3	NA	5.9	42.8	0.37	0.28	43.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Lackey Street intersection
Early Construction PM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	755	2.6	0.581	5.6	LOS A	8.3	59.0	0.54	0.00	41.9
6	R	245	1.7	0.581	17.0	LOS B	8.3	59.0	1.00	1.24	36.8
Approach		1000	2.4	0.581	8.4	NA	8.3	59.0	0.65	0.30	40.5
North: Lackey Street											
7	L	239	0.9	0.448	17.0	LOS B	2.3	16.3	0.69	1.11	36.4
9	R	9	0.0	0.283	130.1	LOS F	0.8	5.5	0.97	1.02	12.2
Approach		248	0.8	0.448	21.3	LOS B	2.3	16.3	0.70	1.10	33.9
West: Argyle Street											
10	L	46	9.1	0.027	6.7	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	664	2.9	0.347	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		711	3.3	0.347	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1959	2.5	0.581	7.1	NA	8.3	59.0	0.42	0.31	42.2

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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Appendix E

SIDRA Intersection Delay Results for peak construction

MOVEMENT SUMMARY

Site: Medway Road Interchange East Side Peak Construction AM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	83	22.8	0.049	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		83	22.8	0.049	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	116	15.5	0.069	11.8	X	X	X	X	0.69	58.9
9	R	2	0.0	0.003	11.7	LOS A	0.0	0.1	0.27	0.66	57.7
Approach		118	15.2	0.069	11.8	LOS A	0.0	0.1	0.00	0.69	58.8
West: Medway Road											
11	T	21	5.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.011	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		222	17.1	0.069	6.3	NA	0.0	0.1	0.00	0.36	67.2

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Medway Road Interchange East Side Peak Construction PM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	129	7.3	0.070	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		129	7.3	0.070	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	72	14.7	0.043	11.8	X	X	X	X	0.69	58.9
9	R	1	0.0	0.001	12.0	LOS A	0.0	0.0	0.31	0.65	57.4
Approach		73	14.5	0.043	11.8	LOS A	0.0	0.0	0.00	0.69	58.8
West: Medway Road											
11	T	16	13.3	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		16	13.3	0.009	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		218	10.1	0.070	3.9	NA	0.0	0.0	0.00	0.23	71.5

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Medway Road Interchange West Side Peak Construction AM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	7	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	77	24.7	0.078	12.8	LOS A	0.3	2.3	0.10	0.73	58.3
Approach		84	22.5	0.078	11.7	NA	0.3	2.3	0.09	0.66	59.8
West: Medway Road											
10	L	2	0.0	0.001	11.1	X	X	X	X	0.69	58.9
11	T	24	4.3	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		26	4.0	0.013	0.9	NA	0.0	0.0	0.00	0.06	77.8
All Vehicles		111	18.1	0.078	9.1	NA	0.3	2.3	0.07	0.52	63.3

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Medway Road Interchange West Side Peak Construction PM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	22	4.8	0.012	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	114	7.4	0.097	11.6	LOS A	0.3	2.6	0.08	0.73	58.4
Approach		136	7.0	0.097	9.7	NA	0.3	2.6	0.06	0.61	61.2
West: Medway Road											
10	L	3	0.0	0.002	11.1	X	X	X	X	0.69	58.9
11	T	18	5.9	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.010	1.7	NA	0.0	0.0	0.00	0.10	76.0
All Vehicles		157	6.7	0.097	8.6	NA	0.3	2.6	0.06	0.54	62.8

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange East Side Peak Construction AM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	16	20.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	33	19.4	0.020	12.1	LOS A	0.0	0.0	0.00	0.74	59.0
Approach		48	19.6	0.020	8.1	NA	0.0	0.0	0.00	0.50	64.6
West: Mereworth Road											
10	L	75	18.3	0.046	11.9	X	X	X	X	0.69	58.9
12	R	5	60.0	0.014	16.1	LOS B	0.0	0.4	0.23	0.70	57.3
Approach		80	21.1	0.046	12.2	LOS A	0.0	0.4	0.01	0.69	58.8
All Vehicles		128	20.5	0.046	10.7	NA	0.0	0.4	0.01	0.62	60.8

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange East Side Peak Construction PM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	42	7.5	0.023	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	2	50.0	0.002	14.0	LOS A	0.0	0.0	0.00	0.75	59.0
Approach		44	9.5	0.023	0.7	NA	0.0	0.0	0.00	0.04	78.7
West: Mereworth Road											
10	L	48	10.9	0.028	11.6	X	X	X	X	0.69	58.9
12	R	2	0.0	0.003	11.4	LOS A	0.0	0.1	0.16	0.69	58.1
Approach		51	10.4	0.028	11.6	LOS A	0.0	0.1	0.01	0.69	58.8
All Vehicles		95	10.0	0.028	6.5	NA	0.0	0.1	0.00	0.38	66.7

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Mereworth Road Interchange West Side Peak Construction AM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	6	33.3	0.016	13.2	LOS A	0.0	0.2	0.13	0.68	58.2
3	R	60	10.5	0.078	12.4	LOS A	0.3	2.4	0.21	0.71	57.8
Approach		66	12.7	0.078	12.5	LOS A	0.3	2.4	0.20	0.70	57.8
East: Mereworth Road											
5	T	33	19.4	0.019	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		33	19.4	0.019	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	19	55.6	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		19	55.6	0.013	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		118	21.4	0.078	7.0	NA	0.3	2.4	0.11	0.40	65.9

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
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MOVEMENT SUMMARY

Site: Mereworth Road Interchange West Side Peak Construction PM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.02	0.71	58.8
3	R	44	19.0	0.058	12.5	LOS A	0.2	1.8	0.10	0.73	58.3
Approach		45	18.6	0.058	12.5	LOS A	0.2	1.8	0.10	0.73	58.3
East: Mereworth Road											
5	T	2	50.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		2	50.0	0.001	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	14	15.4	0.008	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		14	15.4	0.008	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		61	19.0	0.058	9.3	NA	0.2	1.8	0.07	0.54	62.7

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side Peak Construction AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	4	25.0	0.150	20.5	LOS B	0.6	4.0	0.71	0.92	46.5
5	T	45	0.0	0.150	17.1	LOS B	0.6	4.0	0.71	0.88	40.7
Approach		49	2.1	0.150	17.3	LOS B	0.6	4.0	0.71	0.89	41.3
North: Hume Highway											
7	L	27	11.5	0.016	13.2	LOS A	0.0	0.0	0.00	0.76	63.3
8	T	676	13.7	0.189	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	2	0.0	0.001	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		705	13.6	0.189	0.6	NA	0.0	0.0	0.00	0.03	98.2
West: Median Opening											
11	T	4	0.0	0.017	17.1	LOS B	0.1	0.4	0.70	0.79	40.6
12	R	1	0.0	0.017	19.3	LOS B	0.1	0.4	0.70	0.89	46.5
Approach		5	0.0	0.017	17.6	LOS B	0.1	0.4	0.70	0.81	41.9
All Vehicles		760	12.7	0.189	1.8	NA	0.6	4.0	0.05	0.09	91.0

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side Peak Construction PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	1	0.0	0.087	18.4	LOS B	0.3	2.2	0.69	0.90	46.9
5	T	28	0.0	0.087	16.5	LOS B	0.3	2.2	0.69	0.87	41.2
Approach		29	0.0	0.087	16.5	LOS B	0.3	2.2	0.69	0.88	41.5
North: Hume Highway											
7	L	48	0.0	0.026	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
8	T	608	22.3	0.179	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	4	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		661	20.5	0.179	1.0	NA	0.0	0.0	0.00	0.06	96.6
West: Median Opening											
11	T	3	0.0	0.014	16.9	LOS B	0.0	0.3	0.70	0.78	40.7
12	R	1	0.0	0.014	19.1	LOS B	0.0	0.3	0.70	0.86	46.7
Approach		4	0.0	0.014	17.5	LOS B	0.0	0.3	0.70	0.80	42.3
All Vehicles		695	19.5	0.179	1.8	NA	0.3	2.2	0.03	0.10	91.9

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side Peak Construction AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	524	32.5	0.163	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		528	32.3	0.163	0.1	NA	0.0	0.0	0.00	0.01	99.6
East: From Golden Vale Road											
5	T	1	0.0	0.154	17.3	LOS B	0.6	3.9	0.70	0.86	39.9
6	R	46	0.0	0.154	19.5	LOS B	0.6	3.9	0.70	0.92	46.0
Approach		47	0.0	0.154	19.4	LOS B	0.6	3.9	0.70	0.92	45.9
West: Private Access											
10	L	1	0.0	0.005	14.7	LOS B	0.0	0.1	0.59	0.71	49.9
11	T	1	0.0	0.005	12.7	LOS A	0.0	0.1	0.59	0.67	44.2
Approach		2	0.0	0.005	13.7	LOS A	0.0	0.1	0.59	0.69	47.3
All Vehicles		578	29.5	0.163	1.7	NA	0.6	3.9	0.06	0.08	90.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side Peak Construction PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	765	10.6	0.210	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		769	10.5	0.210	0.1	NA	0.0	0.0	0.00	0.00	99.8
East: From Golden Vale Road											
5	T	1	0.0	0.146	21.2	LOS B	0.5	3.5	0.77	0.89	37.2
6	R	34	0.0	0.146	23.4	LOS B	0.5	3.5	0.77	0.94	43.2
Approach		35	0.0	0.146	23.3	LOS B	0.5	3.5	0.77	0.94	43.1
West: Private Access											
10	L	1	0.0	0.006	16.8	LOS B	0.0	0.1	0.67	0.75	48.1
11	T	1	0.0	0.006	14.8	LOS B	0.0	0.1	0.67	0.73	42.3
Approach		2	0.0	0.006	15.8	LOS B	0.0	0.1	0.67	0.74	45.4
All Vehicles		806	10.1	0.210	1.1	NA	0.5	3.5	0.03	0.05	94.3

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout Peak Construction AM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	6	66.7	0.077	13.3	LOS A	0.4	2.9	0.30	0.61	59.3
2	T	61	0.0	0.077	8.6	LOS A	0.4	2.9	0.30	0.51	60.2
3	R	22	38.1	0.077	17.7	LOS B	0.4	2.9	0.30	0.80	54.2
Approach		89	14.1	0.077	11.2	LOS A	0.4	2.9	0.30	0.59	58.5
East: Taylor Avenue											
4	L	24	26.1	0.108	10.7	LOS A	0.5	4.5	0.19	0.57	60.2
5	T	72	22.1	0.108	9.2	LOS A	0.5	4.5	0.19	0.48	61.4
6	R	42	12.5	0.108	16.0	LOS B	0.5	4.5	0.19	0.80	54.2
Approach		138	19.8	0.108	11.6	LOS A	0.5	4.5	0.19	0.60	58.7
North: Old Hume Highway											
7	L	20	5.3	0.046	9.9	LOS A	0.2	1.7	0.31	0.58	59.2
8	T	32	3.3	0.046	8.7	LOS A	0.2	1.7	0.31	0.51	60.2
9	R	8	12.5	0.046	16.4	LOS B	0.2	1.7	0.31	0.79	54.2
Approach		60	5.3	0.046	10.2	LOS A	0.2	1.7	0.31	0.57	58.9
West: Medway Road											
10	L	18	5.9	0.112	10.0	LOS A	0.6	4.5	0.31	0.59	59.4
11	T	104	17.2	0.112	9.4	LOS A	0.6	4.5	0.31	0.53	60.3
12	R	11	30.0	0.112	17.3	LOS B	0.6	4.5	0.31	0.83	54.4
Approach		133	16.7	0.112	10.1	LOS A	0.6	4.5	0.31	0.56	59.6
All Vehicles		420	15.5	0.112	10.8	LOS A	0.6	4.5	0.27	0.58	59.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout Peak Construction PM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	8	12.5	0.043	10.4	LOS A	0.2	1.6	0.30	0.57	59.2
2	T	25	0.0	0.043	8.6	LOS A	0.2	1.6	0.30	0.50	60.1
3	R	18	29.4	0.043	17.2	LOS B	0.2	1.6	0.30	0.77	54.0
Approach		52	12.2	0.043	11.9	LOS A	0.2	1.6	0.30	0.61	57.6
East: Taylor Avenue											
4	L	15	21.4	0.101	10.4	LOS A	0.5	3.8	0.19	0.59	60.3
5	T	108	6.8	0.101	8.5	LOS A	0.5	3.8	0.19	0.50	61.5
6	R	20	0.0	0.101	15.4	LOS B	0.5	3.8	0.19	0.85	54.4
Approach		143	7.4	0.101	9.7	LOS A	0.5	3.8	0.19	0.56	60.2
North: Old Hume Highway											
7	L	32	3.3	0.063	9.6	LOS A	0.3	2.2	0.23	0.57	59.8
8	T	36	0.0	0.063	8.3	LOS A	0.3	2.2	0.23	0.49	60.9
9	R	20	5.3	0.063	15.8	LOS B	0.3	2.2	0.23	0.79	54.1
Approach		87	2.4	0.063	10.5	LOS A	0.3	2.2	0.23	0.59	58.8
West: Medway Road											
10	L	15	7.1	0.062	9.7	LOS A	0.3	2.4	0.20	0.58	60.2
11	T	61	15.5	0.062	9.0	LOS A	0.3	2.4	0.20	0.50	61.4
12	R	4	25.0	0.062	16.6	LOS B	0.3	2.4	0.20	0.85	54.4
Approach		80	14.5	0.062	9.5	LOS A	0.3	2.4	0.20	0.53	60.8
All Vehicles		362	8.4	0.101	10.1	LOS A	0.5	3.8	0.22	0.57	59.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
Peak Construction AM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	89	18.8	0.089	8.9	LOS A	0.0	0.0	0.00	0.80	49.0
2	T	66	0.0	0.089	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		156	10.8	0.089	5.1	NA	0.0	0.0	0.00	0.46	53.1
North: Berrima Road											
8	T	57	1.9	0.030	0.6	LOS A	0.2	1.3	0.30	0.00	54.5
9	R	1	0.0	0.030	9.1	LOS A	0.2	1.3	0.30	0.98	49.1
Approach		58	1.8	0.030	0.8	NA	0.2	1.3	0.30	0.02	54.4
West: Taylor Avenue											
10	L	1	0.0	0.236	10.5	LOS A	1.0	8.1	0.41	0.60	46.3
12	R	151	12.6	0.236	11.3	LOS A	1.0	8.1	0.41	0.72	46.2
Approach		152	12.5	0.236	11.3	LOS A	1.0	8.1	0.41	0.72	46.2
All Vehicles		365	10.1	0.236	7.0	NA	1.0	8.1	0.22	0.50	50.2

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue
Peak Construction PM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	153	4.1	0.133	8.3	LOS A	0.0	0.0	0.00	0.78	49.0
2	T	94	0.0	0.133	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		246	2.6	0.133	5.2	NA	0.0	0.0	0.00	0.48	52.6
North: Berrima Road											
8	T	77	1.4	0.041	1.0	LOS A	0.3	1.9	0.38	0.00	53.2
9	R	1	0.0	0.041	9.5	LOS A	0.3	1.9	0.38	0.97	49.2
Approach		78	1.4	0.041	1.1	NA	0.3	1.9	0.38	0.01	53.1
West: Taylor Avenue											
10	L	2	0.0	0.222	11.5	LOS A	0.9	7.2	0.48	0.64	45.3
12	R	126	10.8	0.222	12.2	LOS A	0.9	7.2	0.48	0.77	45.2
Approach		128	10.7	0.222	12.2	LOS A	0.9	7.2	0.48	0.76	45.2
All Vehicles		453	4.7	0.222	6.5	NA	0.9	7.2	0.20	0.48	50.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
Peak Construction AM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	145	12.3	0.065	0.8	LOS A	0.4	3.1	0.28	0.00	70.5
3	R	4	0.0	0.065	11.2	LOS A	0.4	3.1	0.37	1.37	59.6
Approach		149	12.0	0.065	1.1	NA	0.4	3.1	0.29	0.04	70.2
East: Douglas Road											
4	L	4	0.0	0.073	16.8	LOS B	0.3	2.4	0.55	0.66	43.9
6	R	20	42.1	0.073	19.0	LOS B	0.3	2.4	0.55	0.84	44.0
Approach		24	34.8	0.073	18.6	LOS B	0.3	2.4	0.55	0.81	44.0
North: Berrima Road											
7	L	35	45.5	0.025	12.1	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	188	11.2	0.104	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		223	16.5	0.104	1.9	NA	0.0	0.0	0.00	0.11	75.8
All Vehicles		397	15.9	0.104	2.6	NA	0.4	3.1	0.14	0.13	70.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Douglas Road
Peak Construction PM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	215	4.4	0.091	0.7	LOS A	0.6	4.3	0.27	0.00	70.8
3	R	5	0.0	0.091	11.1	LOS A	0.6	4.3	0.36	1.40	59.6
Approach		220	4.3	0.091	0.9	NA	0.6	4.3	0.28	0.03	70.5
East: Douglas Road											
4	L	3	0.0	0.143	14.9	LOS B	0.5	4.1	0.55	0.67	45.5
6	R	60	10.5	0.143	15.4	LOS B	0.5	4.1	0.55	0.85	45.6
Approach		63	10.0	0.143	15.4	LOS B	0.5	4.1	0.55	0.84	45.6
North: Berrima Road											
7	L	18	35.3	0.012	11.6	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	196	4.3	0.103	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		214	6.9	0.103	1.0	NA	0.0	0.0	0.00	0.06	77.7
All Vehicles		497	6.1	0.143	2.8	NA	0.6	4.3	0.19	0.15	68.5

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Waite Street intersection
Peak Construction AM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	275	2.7	0.450	0.9	LOS A	2.9	21.2	0.10	0.00	48.3
6	R	299	4.6	0.450	12.7	LOS A	2.9	21.2	0.70	1.01	38.6
Approach		574	3.7	0.450	7.0	NA	2.9	21.2	0.41	0.52	42.7
North: Waite Street											
7	L	285	5.9	0.502	14.2	LOS A	2.9	21.3	0.69	1.02	37.4
9	R	13	16.7	0.174	57.8	LOS E	0.5	4.2	0.92	0.98	21.0
Approach		298	6.4	0.502	16.0	LOS B	2.9	21.3	0.70	1.01	36.2
West: Argyle Street											
10	L	88	6.0	0.050	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	585	2.3	0.305	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		674	2.8	0.305	0.9	NA	0.0	0.0	0.00	0.08	49.0
All Vehicles		1545	3.8	0.502	6.1	NA	2.9	21.3	0.29	0.42	43.6

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Waite Street intersection
Peak Construction PM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	432	2.2	0.452	2.4	LOS A	4.2	30.2	0.32	0.00	45.5
6	R	282	2.6	0.452	11.9	LOS A	4.2	30.2	0.72	1.03	39.6
Approach		714	2.4	0.452	6.2	NA	4.2	30.2	0.48	0.41	42.9
North: Waite Street											
7	L	348	4.2	0.522	12.7	LOS A	3.4	24.4	0.66	1.01	38.3
9	R	20	0.0	0.202	45.1	LOS D	0.6	4.4	0.91	0.98	23.9
Approach		368	4.0	0.522	14.5	LOS A	3.4	24.4	0.67	1.01	37.1
West: Argyle Street											
10	L	78	5.4	0.044	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	482	2.8	0.252	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		560	3.2	0.252	0.9	NA	0.0	0.0	0.00	0.08	48.9
All Vehicles		1642	3.0	0.522	6.2	NA	4.2	30.2	0.36	0.43	43.2

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Lackey Street intersection
Peak Construction AM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	591	3.6	0.482	5.4	LOS A	5.9	43.0	0.51	0.00	42.2
6	R	182	6.4	0.482	17.2	LOS B	5.9	43.0	1.00	1.16	36.7
Approach		773	4.2	0.482	8.2	NA	5.9	43.0	0.63	0.27	40.8
North: Lackey Street											
7	L	232	3.2	0.502	19.4	LOS B	2.6	18.7	0.76	1.14	35.1
9	R	5	0.0	0.114	83.8	LOS F	0.3	2.2	0.95	1.00	16.8
Approach		237	3.1	0.502	20.8	LOS B	2.6	18.7	0.77	1.13	34.2
West: Argyle Street											
10	L	54	2.0	0.029	6.5	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	760	3.9	0.400	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		814	3.8	0.400	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1823	3.9	0.502	6.4	NA	5.9	43.0	0.37	0.28	43.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Lackey Street intersection
Peak Construction PM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	755	2.6	0.581	5.6	LOS A	8.3	59.0	0.54	0.00	41.9
6	R	245	1.7	0.581	17.0	LOS B	8.3	59.0	1.00	1.24	36.8
Approach		1000	2.4	0.581	8.4	NA	8.3	59.0	0.65	0.30	40.5
North: Lackey Street											
7	L	239	0.9	0.448	17.0	LOS B	2.3	16.3	0.69	1.11	36.4
9	R	9	0.0	0.283	130.1	LOS F	0.8	5.5	0.97	1.02	12.2
Approach		248	0.8	0.448	21.3	LOS B	2.3	16.3	0.70	1.10	33.9
West: Argyle Street											
10	L	46	9.1	0.027	6.7	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	664	3.0	0.347	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		711	3.4	0.347	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1959	2.6	0.581	7.1	NA	8.3	59.0	0.42	0.31	42.2

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

SIDRA INTERSECTION

Appendix F

SIDRA Intersection Delay Results for project operations

MOVEMENT SUMMARY

Site: Medway Road Interchange
East Side Operations AM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	86	17.1	0.049	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		86	17.1	0.049	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	108	14.6	0.064	11.7	X	X	X	X	0.69	58.9
9	R	2	0.0	0.003	11.7	LOS A	0.0	0.1	0.27	0.66	57.8
Approach		111	14.3	0.064	11.7	LOS A	0.0	0.1	0.01	0.69	58.8
West: Medway Road											
11	T	21	5.0	0.011	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.011	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		218	14.5	0.064	6.0	NA	0.0	0.1	0.00	0.35	67.7

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Medway Road Interchange
East Side Operations PM Peak

Interchange East Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	138	6.9	0.074	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		138	6.9	0.074	0.0	NA	0.0	0.0	0.00	0.00	80.0
North: Hume Highway Exit											
7	L	72	14.7	0.043	11.8	X	X	X	X	0.69	58.9
9	R	1	0.0	0.001	12.1	LOS A	0.0	0.0	0.32	0.65	57.3
Approach		73	14.5	0.043	11.8	LOS A	0.0	0.0	0.00	0.69	58.8
West: Medway Road											
11	T	16	13.3	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		16	13.3	0.009	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		226	9.8	0.074	3.8	NA	0.0	0.0	0.00	0.22	71.8

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Medway Road Interchange
West Side Operations AM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	7	0.0	0.004	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	80	18.4	0.077	12.4	LOS A	0.3	2.1	0.10	0.73	58.4
Approach		87	16.9	0.077	11.3	NA	0.3	2.1	0.09	0.66	59.7
West: Medway Road											
10	L	2	0.0	0.001	11.1	X	X	X	X	0.69	58.9
11	T	24	4.3	0.013	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		26	4.0	0.013	0.9	NA	0.0	0.0	0.00	0.06	77.8
All Vehicles		114	13.9	0.077	8.9	NA	0.3	2.1	0.07	0.52	63.2

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Medway Road Interchange West Side Operations PM Peak

Interchange West Side Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Medway Road											
5	T	22	4.8	0.012	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
6	R	122	6.9	0.103	11.5	LOS A	0.4	2.7	0.08	0.73	58.4
Approach		144	6.6	0.103	9.8	NA	0.4	2.7	0.07	0.62	61.0
West: Medway Road											
10	L	3	0.0	0.002	11.1	X	X	X	X	0.69	58.9
11	T	18	5.9	0.010	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		21	5.0	0.010	1.7	NA	0.0	0.0	0.00	0.10	76.0
All Vehicles		165	6.4	0.103	8.7	NA	0.4	2.7	0.06	0.55	62.6

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange
East Side Operations AM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	16	20.0	0.009	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	5	40.0	0.004	13.4	LOS A	0.0	0.0	0.00	0.75	59.0
Approach		21	25.0	0.009	3.3	NA	0.0	0.0	0.00	0.19	73.6
West: Mereworth Road											
10	L	100	5.3	0.056	11.3	X	X	X	X	0.69	58.9
12	R	7	14.3	0.013	12.2	LOS A	0.0	0.3	0.12	0.71	58.3
Approach		107	5.9	0.056	11.4	LOS A	0.0	0.3	0.01	0.69	58.8
All Vehicles		128	9.0	0.056	10.1	NA	0.0	0.3	0.01	0.61	60.8

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange
East Side Operations PM Peak

Interchange Ramp Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
North: Old Hume Highway											
8	T	42	7.5	0.023	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
9	R	3	33.3	0.002	13.0	LOS A	0.0	0.0	0.00	0.75	59.0
Approach		45	9.3	0.023	0.9	NA	0.0	0.0	0.00	0.05	78.1
West: Mereworth Road											
10	L	88	4.8	0.049	11.3	X	X	X	X	0.69	58.9
12	R	7	0.0	0.011	11.4	LOS A	0.0	0.2	0.16	0.70	58.1
Approach		96	4.4	0.049	11.3	LOS A	0.0	0.2	0.01	0.69	58.8
All Vehicles		141	6.0	0.049	8.0	NA	0.0	0.2	0.01	0.48	63.9

X: Not applicable for Continuous movement.

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange
West Side Operations AM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.04	0.70	58.7
3	R	60	10.5	0.076	12.3	LOS A	0.3	2.3	0.18	0.71	57.9
Approach		61	10.3	0.076	12.3	LOS A	0.3	2.3	0.18	0.71	57.9
East: Mereworth Road											
5	T	5	40.0	0.003	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		5	40.0	0.003	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	46	0.0	0.024	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		46	0.0	0.024	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		113	7.5	0.076	6.6	NA	0.3	2.3	0.10	0.38	66.4

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Mereworth Road Interchange
West Side Operations PM Peak

With Intersection Reconfigured to New E-W Priority
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway Exiit											
1	L	1	0.0	0.002	10.9	LOS A	0.0	0.0	0.02	0.71	58.8
3	R	44	19.0	0.062	13.1	LOS A	0.2	2.0	0.21	0.71	57.7
Approach		45	18.6	0.062	13.0	LOS A	0.2	2.0	0.21	0.71	57.7
East: Mereworth Road											
5	T	3	33.3	0.002	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		3	33.3	0.002	0.0	NA	0.0	0.0	0.00	0.00	80.0
West: Mereworth Road											
11	T	59	1.8	0.031	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		59	1.8	0.031	0.0	NA	0.0	0.0	0.00	0.00	80.0
All Vehicles		107	9.8	0.062	5.5	NA	0.2	2.0	0.09	0.30	68.9

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side Operations AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Golden Vale Road											
4	L	4	25.0	0.150	20.4	LOS B	0.6	4.0	0.71	0.92	46.5
5	T	45	0.0	0.150	17.0	LOS B	0.6	4.0	0.71	0.88	40.8
Approach		49	2.1	0.150	17.3	LOS B	0.6	4.0	0.71	0.89	41.3
North: Hume Highway											
7	L	29	10.7	0.017	13.1	LOS A	0.0	0.0	0.00	0.76	63.3
8	T	676	13.4	0.188	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	2	0.0	0.001	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		707	13.2	0.188	0.6	NA	0.0	0.0	0.00	0.03	98.1
West: Median Opening											
11	T	4	0.0	0.017	17.1	LOS B	0.1	0.4	0.70	0.79	40.6
12	R	1	0.0	0.017	19.3	LOS B	0.1	0.4	0.70	0.89	46.6
Approach		5	0.0	0.017	17.6	LOS B	0.1	0.4	0.70	0.81	41.9
All Vehicles		762	12.4	0.188	1.8	NA	0.6	4.0	0.05	0.09	90.9

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Golden Vale Road Intersection East Side Operations
PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
							Vehicles veh	Distance m			
East: Golden Vale Road											
4	L	1	0.0	0.088	18.5	LOS B	0.3	2.3	0.70	0.91	46.9
5	T	28	0.0	0.088	16.5	LOS B	0.3	2.3	0.70	0.87	41.2
Approach		29	0.0	0.088	16.6	LOS B	0.3	2.3	0.70	0.88	41.4
North: Hume Highway											
7	L	51	0.0	0.027	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
8	T	612	22.2	0.179	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
9	R	4	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		666	20.4	0.179	1.0	NA	0.0	0.0	0.00	0.06	96.5
West: Median Opening											
11	T	3	0.0	0.014	17.0	LOS B	0.0	0.3	0.70	0.78	40.6
12	R	1	0.0	0.014	19.2	LOS B	0.0	0.3	0.70	0.86	46.6
Approach		4	0.0	0.014	17.6	LOS B	0.0	0.3	0.70	0.80	42.3
All Vehicles		700	19.4	0.179	1.8	NA	0.3	2.3	0.03	0.10	91.8

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side Operations
AM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	519	32.5	0.161	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		523	32.2	0.161	0.1	NA	0.0	0.0	0.00	0.01	99.6
East: From Golden Vale Road											
5	T	1	0.0	0.152	17.1	LOS B	0.5	3.8	0.69	0.85	40.0
6	R	46	0.0	0.152	19.3	LOS B	0.5	3.8	0.69	0.92	46.1
Approach		47	0.0	0.152	19.2	LOS B	0.5	3.8	0.69	0.92	46.0
West: Private Access											
10	L	1	0.0	0.005	14.6	LOS B	0.0	0.1	0.58	0.71	50.0
11	T	1	0.0	0.005	12.6	LOS A	0.0	0.1	0.58	0.67	44.3
Approach		2	0.0	0.005	13.6	LOS A	0.0	0.1	0.58	0.69	47.3
All Vehicles		573	29.4	0.161	1.7	NA	0.5	3.8	0.06	0.08	90.7

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Golden Vale Road Intersection West Side Operations PM Peak

Highway At Grade Access With Median Opening
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Hume Highway											
1	L	1	0.0	0.001	12.5	LOS A	0.0	0.0	0.00	0.75	63.3
2	T	765	10.6	0.210	0.0	LOS A	0.0	0.0	0.00	0.00	100.0
3	R	3	0.0	0.002	13.0	LOS A	0.0	0.0	0.00	0.80	62.5
Approach		769	10.5	0.210	0.1	NA	0.0	0.0	0.00	0.00	99.8
East: From Golden Vale Road											
5	T	1	0.0	0.146	21.2	LOS B	0.5	3.5	0.77	0.89	37.2
6	R	34	0.0	0.146	23.4	LOS B	0.5	3.5	0.77	0.94	43.2
Approach		35	0.0	0.146	23.3	LOS B	0.5	3.5	0.77	0.94	43.1
West: Private Access											
10	L	1	0.0	0.006	16.8	LOS B	0.0	0.1	0.67	0.75	48.1
11	T	1	0.0	0.006	14.8	LOS B	0.0	0.1	0.67	0.73	42.3
Approach		2	0.0	0.006	15.8	LOS B	0.0	0.1	0.67	0.74	45.4
All Vehicles		806	10.1	0.210	1.1	NA	0.5	3.5	0.03	0.05	94.3

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout Operations AM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	9	0.0	0.088	9.6	LOS A	0.4	3.1	0.29	0.58	59.4
2	T	75	0.0	0.088	8.5	LOS A	0.4	3.1	0.29	0.51	60.4
3	R	31	13.8	0.088	16.4	LOS B	0.4	3.1	0.29	0.80	54.2
Approach		115	3.7	0.088	10.7	LOS A	0.4	3.1	0.29	0.59	58.4
East: Taylor Avenue											
4	L	14	30.8	0.096	10.8	LOS A	0.5	4.0	0.14	0.57	60.5
5	T	72	22.1	0.096	9.1	LOS A	0.5	4.0	0.14	0.48	61.9
6	R	42	12.5	0.096	15.9	LOS B	0.5	4.0	0.14	0.82	54.3
Approach		127	19.8	0.096	11.6	LOS A	0.5	4.0	0.14	0.60	58.9
North: Old Hume Highway											
7	L	20	5.3	0.039	9.9	LOS A	0.2	1.4	0.30	0.57	59.2
8	T	22	4.8	0.039	8.7	LOS A	0.2	1.4	0.30	0.50	60.2
9	R	8	12.5	0.039	16.3	LOS B	0.2	1.4	0.30	0.78	54.1
Approach		51	6.3	0.039	10.5	LOS A	0.2	1.4	0.30	0.58	58.7
West: Medway Road											
10	L	18	5.9	0.107	10.1	LOS A	0.5	4.3	0.32	0.60	59.3
11	T	104	17.2	0.107	9.5	LOS A	0.5	4.3	0.32	0.54	60.2
12	R	3	33.3	0.107	17.5	LOS B	0.5	4.3	0.32	0.84	54.4
Approach		125	16.0	0.107	9.8	LOS A	0.5	4.3	0.32	0.55	59.9
All Vehicles		418	12.6	0.107	10.7	LOS A	0.5	4.3	0.26	0.58	59.0

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Old Hume Highway Roundabout Operations PM Peak

Four Way Roundabout
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Hume Highway											
1	L	17	6.3	0.071	10.0	LOS A	0.4	2.6	0.30	0.57	59.2
2	T	42	0.0	0.071	8.6	LOS A	0.4	2.6	0.30	0.50	60.1
3	R	33	12.9	0.071	16.4	LOS B	0.4	2.6	0.30	0.77	53.9
Approach		92	5.7	0.071	11.6	LOS A	0.4	2.6	0.30	0.61	57.5
East: Taylor Avenue											
4	L	15	21.4	0.101	10.4	LOS A	0.5	3.8	0.19	0.59	60.3
5	T	108	6.8	0.101	8.5	LOS A	0.5	3.8	0.19	0.50	61.5
6	R	20	0.0	0.101	15.4	LOS B	0.5	3.8	0.19	0.84	54.4
Approach		143	7.4	0.101	9.7	LOS A	0.5	3.8	0.19	0.56	60.2
North: Old Hume Highway											
7	L	32	3.3	0.065	9.6	LOS A	0.3	2.3	0.25	0.57	59.7
8	T	37	0.0	0.065	8.3	LOS A	0.3	2.3	0.25	0.49	60.7
9	R	20	5.3	0.065	15.8	LOS B	0.3	2.3	0.25	0.79	54.1
Approach		88	2.4	0.065	10.5	LOS A	0.3	2.3	0.25	0.59	58.7
West: Medway Road											
10	L	15	7.1	0.064	9.8	LOS A	0.3	2.5	0.25	0.58	59.9
11	T	61	15.5	0.064	9.1	LOS A	0.3	2.5	0.25	0.51	60.9
12	R	4	25.0	0.064	16.8	LOS B	0.3	2.5	0.25	0.83	54.4
Approach		80	14.5	0.064	9.6	LOS A	0.3	2.5	0.25	0.54	60.3
All Vehicles		403	7.3	0.101	10.3	LOS A	0.5	3.8	0.24	0.57	59.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue Operations AM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	80	18.4	0.083	8.9	LOS A	0.0	0.0	0.00	0.81	49.0
2	T	66	0.0	0.083	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		146	10.1	0.083	4.8	NA	0.0	0.0	0.00	0.45	53.4
North: Berrima Road											
8	T	57	1.9	0.030	0.6	LOS A	0.2	1.3	0.29	0.00	54.7
9	R	1	0.0	0.030	9.0	LOS A	0.2	1.3	0.29	0.99	49.0
Approach		58	1.8	0.030	0.7	NA	0.2	1.3	0.29	0.02	54.6
West: Taylor Avenue											
10	L	1	0.0	0.235	10.3	LOS A	1.0	7.9	0.40	0.60	46.6
12	R	157	9.4	0.235	10.9	LOS A	1.0	7.9	0.40	0.71	46.4
Approach		158	9.3	0.235	10.9	LOS A	1.0	7.9	0.40	0.71	46.4
All Vehicles		362	8.4	0.235	6.8	NA	1.0	7.9	0.22	0.49	50.3

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Berrima Road Taylor Avenue Operations PM Peak

T Intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
1	L	153	4.1	0.133	8.3	LOS A	0.0	0.0	0.00	0.78	49.0
2	T	94	0.0	0.133	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		246	2.6	0.133	5.2	NA	0.0	0.0	0.00	0.48	52.6
North: Berrima Road											
8	T	77	1.4	0.041	1.0	LOS A	0.3	1.9	0.38	0.00	53.2
9	R	1	0.0	0.041	9.5	LOS A	0.3	1.9	0.38	0.97	49.2
Approach		78	1.4	0.041	1.1	NA	0.3	1.9	0.38	0.01	53.1
West: Taylor Avenue											
10	L	2	0.0	0.239	11.5	LOS A	1.0	7.7	0.48	0.65	45.4
12	R	139	9.1	0.239	12.1	LOS A	1.0	7.7	0.48	0.77	45.3
Approach		141	9.0	0.239	12.1	LOS A	1.0	7.7	0.48	0.77	45.3
All Vehicles		465	4.3	0.239	6.6	NA	1.0	7.7	0.21	0.49	50.3

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Berrima Road Douglas Road Operations AM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	138	13.0	0.062	0.8	LOS A	0.4	3.0	0.28	0.00	70.5
3	R	4	0.0	0.062	11.2	LOS A	0.4	3.0	0.37	1.37	59.6
Approach		142	12.6	0.062	1.1	NA	0.4	3.0	0.29	0.04	70.1
East: Douglas Road											
4	L	4	0.0	0.060	15.7	LOS B	0.2	1.9	0.53	0.65	44.8
6	R	18	35.3	0.060	17.5	LOS B	0.2	1.9	0.53	0.81	44.9
Approach		22	28.6	0.060	17.2	LOS B	0.2	1.9	0.53	0.78	44.9
North: Berrima Road											
7	L	33	41.9	0.023	11.9	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	197	9.6	0.107	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		229	14.2	0.107	1.7	NA	0.0	0.0	0.00	0.10	76.1
All Vehicles		394	14.4	0.107	2.3	NA	0.4	3.0	0.13	0.12	71.2

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Berrima Road Douglas Road Operations PM Peak

T intersection
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Berrima Road											
2	T	215	4.4	0.091	0.7	LOS A	0.6	4.4	0.28	0.00	70.5
3	R	5	0.0	0.091	11.1	LOS A	0.6	4.4	0.37	1.39	59.6
Approach		220	4.3	0.091	1.0	NA	0.6	4.4	0.28	0.03	70.3
East: Douglas Road											
4	L	3	0.0	0.146	15.1	LOS B	0.6	4.2	0.56	0.68	45.3
6	R	60	10.5	0.146	15.7	LOS B	0.6	4.2	0.56	0.85	45.4
Approach		63	10.0	0.146	15.7	LOS B	0.6	4.2	0.56	0.84	45.4
North: Berrima Road											
7	L	18	35.3	0.012	11.6	LOS A	0.0	0.0	0.00	0.71	57.1
8	T	208	3.5	0.109	0.0	LOS A	0.0	0.0	0.00	0.00	80.0
Approach		226	6.0	0.109	0.9	NA	0.0	0.0	0.00	0.06	77.8
All Vehicles		509	5.8	0.146	2.8	NA	0.6	4.4	0.19	0.14	68.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

SIDRA INTERSECTION

MOVEMENT SUMMARY

Site: Waite Street intersection
Operations AM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	275	2.7	0.446	0.9	LOS A	2.9	21.0	0.10	0.00	48.2
6	R	297	4.6	0.446	12.6	LOS A	2.9	21.0	0.70	1.00	38.6
Approach		572	3.7	0.446	7.0	NA	2.9	21.0	0.41	0.52	42.7
North: Waite Street											
7	L	288	5.5	0.503	14.1	LOS A	2.9	21.3	0.68	1.02	37.4
9	R	16	13.3	0.194	53.3	LOS D	0.6	4.6	0.92	0.98	21.9
Approach		304	5.9	0.503	16.1	LOS B	2.9	21.3	0.70	1.01	36.1
West: Argyle Street											
10	L	85	6.2	0.048	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	585	2.3	0.305	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		671	2.8	0.305	0.8	NA	0.0	0.0	0.00	0.08	49.0
All Vehicles		1546	3.7	0.503	6.1	NA	2.9	21.3	0.29	0.43	43.6

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

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MOVEMENT SUMMARY

Site: Waite Street intersection
Operations PM Peak

T Intersection with Argyle Street
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	432	2.2	0.452	2.4	LOS A	4.2	30.2	0.32	0.00	45.5
6	R	282	2.6	0.452	11.9	LOS A	4.2	30.2	0.72	1.03	39.6
Approach		714	2.4	0.452	6.2	NA	4.2	30.2	0.48	0.41	42.9
North: Waite Street											
7	L	353	3.9	0.528	12.8	LOS A	3.4	24.9	0.66	1.01	38.3
9	R	24	0.0	0.245	46.9	LOS D	0.8	5.5	0.91	0.99	23.4
Approach		377	3.6	0.528	15.0	LOS B	3.4	24.9	0.67	1.01	36.8
West: Argyle Street											
10	L	78	5.4	0.044	6.6	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	482	2.8	0.252	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		560	3.2	0.252	0.9	NA	0.0	0.0	0.00	0.08	48.9
All Vehicles		1651	2.9	0.528	6.4	NA	4.2	30.2	0.36	0.44	43.1

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Lackey Street intersection
Operations AM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	588	3.6	0.482	5.4	LOS A	5.9	42.8	0.51	0.00	42.2
6	R	182	6.4	0.482	17.3	LOS B	5.9	42.8	1.00	1.16	36.7
Approach		771	4.2	0.482	8.2	NA	5.9	42.8	0.63	0.28	40.8
North: Lackey Street											
7	L	232	3.2	0.503	19.5	LOS B	2.6	18.8	0.76	1.14	35.0
9	R	5	0.0	0.114	83.8	LOS F	0.3	2.2	0.95	1.00	16.8
Approach		237	3.1	0.503	20.9	LOS B	2.6	18.8	0.77	1.14	34.2
West: Argyle Street											
10	L	54	2.0	0.029	6.5	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	762	3.6	0.400	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		816	3.5	0.400	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1823	3.8	0.503	6.4	NA	5.9	42.8	0.36	0.28	43.1

Level of Service (LOS) Method: Delay (RTA NSW).

Vehicle movement LOS values are based on average delay per movement

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: Lackey Street intersection
Operations PM Peak

T-intersection with Argyle Street
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Argyle Street											
5	T	755	2.6	0.582	5.7	LOS A	8.3	59.0	0.54	0.00	41.9
6	R	245	1.7	0.582	17.1	LOS B	8.3	59.0	1.00	1.24	36.7
Approach		1000	2.4	0.582	8.5	NA	8.3	59.0	0.65	0.30	40.5
North: Lackey Street											
7	L	239	0.9	0.450	17.1	LOS B	2.3	16.4	0.70	1.11	36.4
9	R	9	0.0	0.287	131.8	LOS F	0.8	5.6	0.97	1.02	12.1
Approach		248	0.8	0.450	21.4	LOS B	2.3	16.4	0.71	1.11	33.8
West: Argyle Street											
10	L	46	9.1	0.027	6.7	LOS A	0.0	0.0	0.00	0.61	43.3
11	T	668	2.8	0.349	0.0	LOS A	0.0	0.0	0.00	0.00	50.0
Approach		715	3.2	0.349	0.4	NA	0.0	0.0	0.00	0.04	49.5
All Vehicles		1963	2.5	0.582	7.2	NA	8.3	59.0	0.42	0.31	42.2

Level of Service (LOS) Method: Delay (RTA NSW).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Processed: Friday, 29 April 2016 11:53:18 AM
SIDRA INTERSECTION 5.1.13.2093

Project: R:\Transport Planning\SIDRA RESULTS\Hume Coal Intersections\Berrima Road and Moss Vale Intersections Operations.sip
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Appendix N

Visual Amenity Assessment Report

Hume Coal Project

Environmental Impact Statement | Appendix N | Visual Amenity Assessment Report

Prepared for Hume Coal Pty Limited | 7 March 2017

Hume Coal Project

Environmental Impact Statement | Appendix N | Visual Amenity Assessment Report

Prepared for Hume Coal Pty Limited | 7 March 2017

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Hume Coal Project

Final

Report J12055RP1 | Prepared for Hume Coal Pty Limited | 7 March 2017

Prepared by	**Susan May-Raynes**	Approved by	**Paul Mitchell**
Position	Senior Urban Planner	Position	Director
Signature	Susan May-Raynes	Signature	
Date	7 March 2017	Date	7 March 2017

Document Control

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1	10/11/2015	Susan May-Raynes	Paul Mitchell
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Executive Summary

EMM prepared a qualitative visual impact assessment for the project. It assessed the likely visual impacts of the project on the surrounding private residences and public roads.

The assessment analysed the potential for visual impacts of the project from six viewpoints in and around the project area. These viewpoints were chosen as representative of the likely impacts of the project on receptors within the areas surrounding the project.

It was found that without mitigation, stockpiles, mine infrastructure and lighting would be visible from different viewpoints to varying degrees. Hume Coal has undertaken a substantial tree planting program to screen areas identified as providing views of the project infrastructure once constructed. Once matured, these vegetation screens will substantially reduce or eliminate views of project infrastructure.

Additional measures will be incorporated into the project during construction and operations to minimise visual impacts on surrounding viewers. These mitigation measures may include the use of appropriate colours for mine infrastructure and operational/lighting management protocols to minimise light spill and sky glow associated with mining activities.

Overall, it was determined that with appropriate controls and mitigation measures, the visual impact of the Hume Coal project will be low.

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Acronyms

CPP	Coal Preparation Plant
DoP	NSW Department of Planning (now known as Department of Planning and Environment)
DoEE	Commonwealth Department of the Environment and Energy (formerly the Department of the Environment)
DP&E	NSW Department of Planning and Environment
EIS	Environmental impact statement
EMM	EMM Consulting Pty Limited Pty Ltd
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
kms	kilometres
ha	hectares
LEP	Local Environmental Plan
LGA	Local Government Area
Mtpa	Million tonnes per annum
SEARs	Secretary's environmental assessment requirements
SSD	State significant development
The project	Hume Coal Project
VIA	Visual Impact Assessment
VP	Viewpoint

1 Introduction

1.1 Overview

Hume Coal Pty Limited (Hume Coal) is seeking State significant development consent to develop and operate an underground coal mine and associated mine infrastructure (the 'Hume Coal Project') in the Southern Coalfield of New South Wales (NSW). Hume Coal holds exploration Authorisation 349 (A349) to the west of Moss Vale, in the Wingecarribee local government area (LGA). The underground mine will be developed within A349 and associated surface infrastructure facilities will be developed within and north of A349. The project area and its regional and local setting are shown in Figures 1.1 and 1.2.

The project has been developed following several years of technical investigations to define the mineable resource and identify and address potential environmental, social and economic constraints. Low impact mining methods will be used which will have negligible subsidence impacts and thereby protect surface features, and allow existing land uses to continue on the surface. Post-mining, all mine surface infrastructure will be decommissioned and areas rehabilitated to a state where they can support land uses similar to the current land uses.

Approval for the Hume Coal Project (the project) is being sought under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An environmental impact statement (EIS) is a requirement of the approval processes. This Visual Impact Assessment (VIA) report forms part of the EIS. It documents the visual assessment methods and results, the initiatives built into the project design to avoid and minimise visual associated impacts, and the additional mitigation, management and measures proposed to address any residual impacts not able to be avoided.

1.2 Project description

The project involves developing and operating an underground coal mine and associated infrastructure over a total estimated project life of 23 years. Indicative mine and surface infrastructure plans are provided in Figure 1.3 and Figure 1.4. A full description of the project, as assessed in this report, is provided in Chapter 2 of the main EIS report (EMM 2017a).

In summary it involves:

- Ongoing resource definition activities, along with geotechnical and engineering testing, and other fieldwork to facilitate detailed design.

- Establishment of a temporary construction accommodation village.

- Development and operation of an underground coal mine, comprising of approximately two years of construction and 19 years of mining, followed by a closure and rehabilitation phase of up to two years, leading to a total project life of 23 years. Some coal extraction will commence during the second year of construction and hence there will be some overlap between the construction and operational phases.

- Extraction of approximately 50 million tonnes (Mt) of run-of-mine (ROM) coal from the Wongawilli Seam, at a rate of up to 3.5 million tonnes per annum (Mtpa). Low impact mining methods will be used, which will have negligible subsidence impacts.

- Following processing of ROM coal in the coal preparation plant (CPP), production of up to 3 Mtpa of metallurgical and thermal coal for sale to international and domestic markets.

- Construction and operation of associated mine infrastructure, mostly on cleared land, including:

  - one personnel and materials drift access and one conveyor drift access from the surface to the coal seam;

  - ventilation shafts, comprising one upcast ventilation shaft and fans, and up to two downcast shafts installed over the life of the mine, depending on ventilation requirements as the mine progresses;

  - a surface infrastructure area, including administration, bathhouse, washdown and workshop facilities, fuel and lubrication storage, warehouses, laydown areas, and other facilities. The surface infrastructure area will also comprise the CPP and ROM coal, product coal and emergency reject stockpiles;

  - surface and groundwater management and treatment facilities, including storages, pipelines, pumps and associated infrastructure;

  - overland conveyors;

  - rail load-out facilities;

  - a small explosives magazine;

  - ancillary facilities, including fences, access roads, car parking areas, helipad and communications infrastructure; and

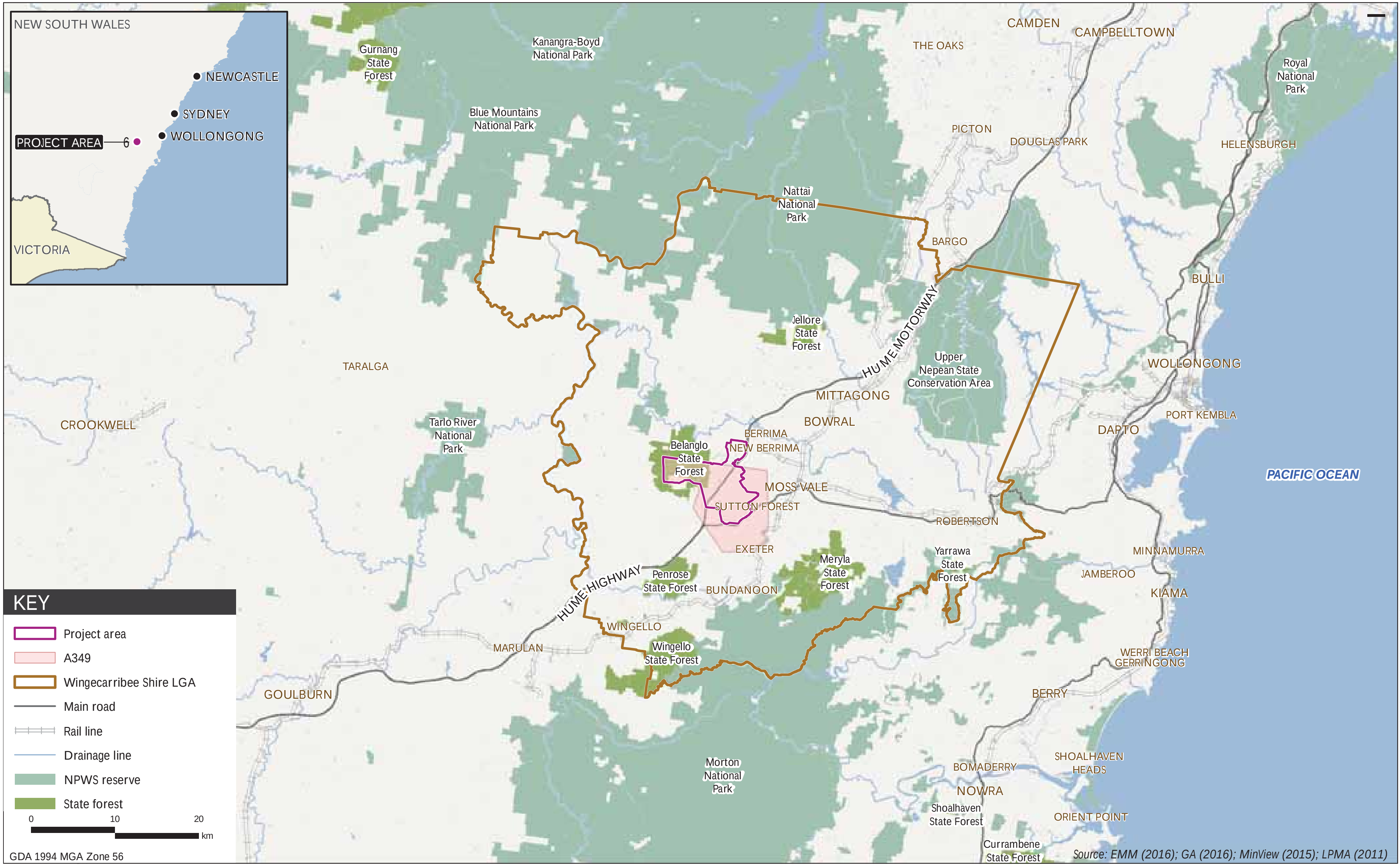
  - environmental management and monitoring equipment.

- Establishment of site access from Mereworth Road, and construction of minor internal roads.

- Coal reject emplacement underground, in the mined-out voids.

- Peak workforces of approximately 414 full-time equivalent employees during construction and approximately 300 full-time equivalent employees during operations.

- Decommissioning of mine infrastructure and rehabilitating the area once mining is complete, so that it can support land uses similar to current land uses.



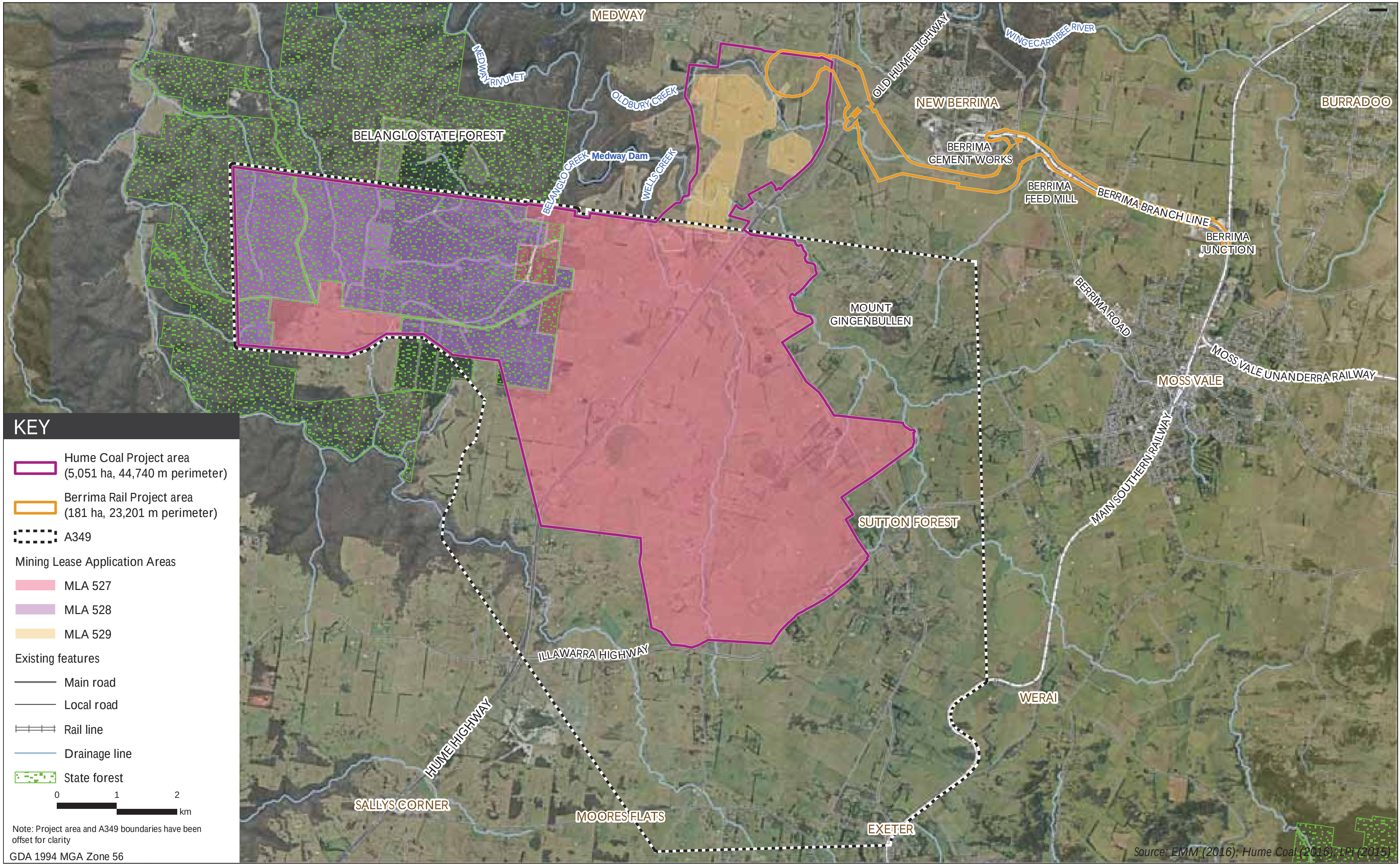
Source: EMM (2016); GA (2016); MinView (2015); LPMA (2011)

Regional context

Hume Coal Project

Visual and Lighting Impact Assessment

Figure 1.1



Note: Project area and A349 boundaries have been offset for clarity

GDA 1994 MGA Zone 56

Source: EMM (2016); Hume Coal (2016); LPI (2015)

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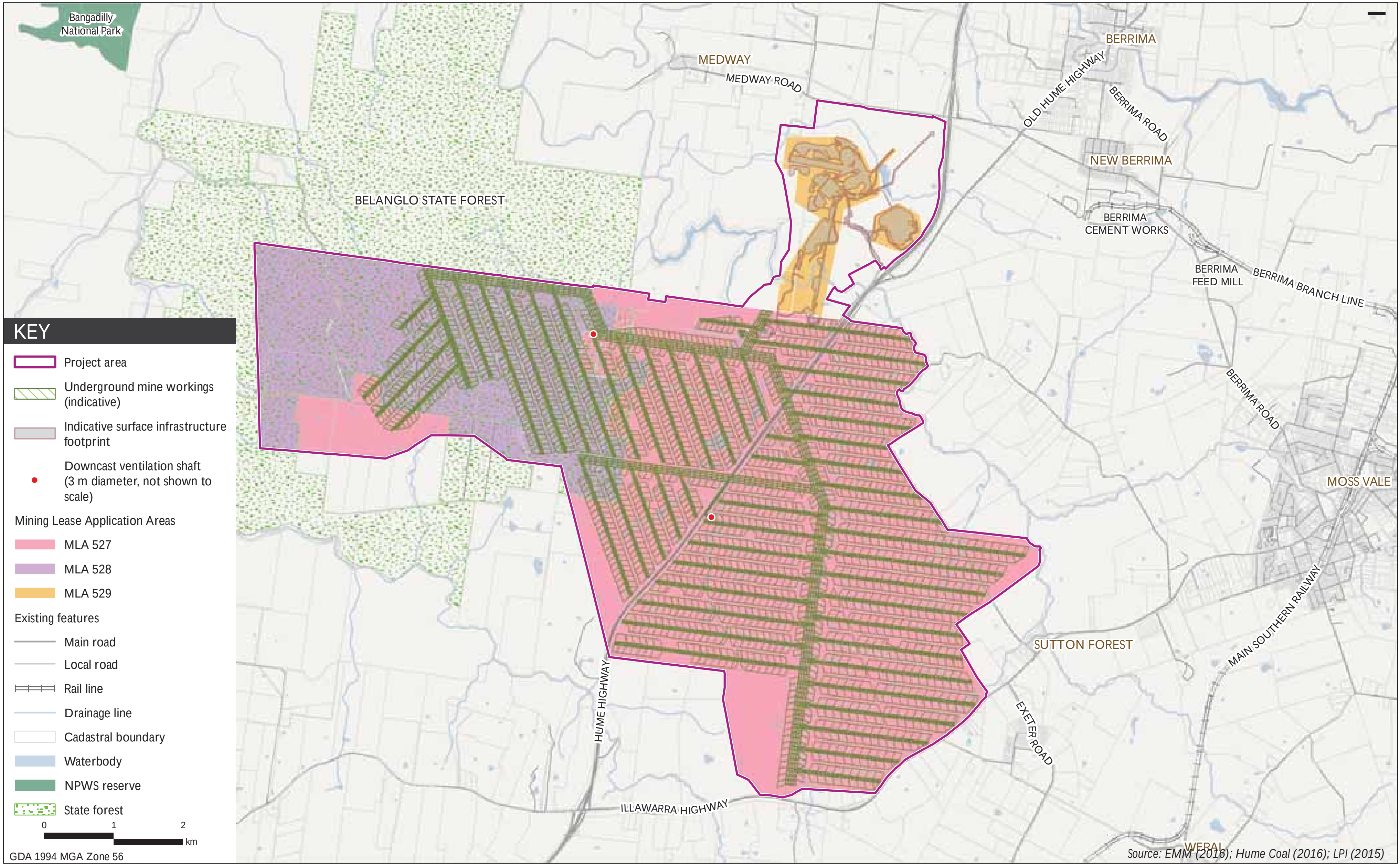
Local context

Hume Coal Project

Visual and Lighting Impact Assessment

Figure 1.2



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Indicative project layout

Hume Coal Project

Visual and Lighting Impact Assessment

Figure 1.3

Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Indicative surface infrastructure layout

Hume Coal Project
Visual and Lighting Impact Assessment

Figure 1.4

The project area, shown in Figure 1.2 is approximately 5,051 hectares (ha). Surface disturbance will mainly be restricted to the surface infrastructure areas shown indicatively on Figure 1.4 though will include some other areas above the underground mine, such as drill pads and access tracks. The project area generally comprises direct surface disturbance areas of up to approximately 117 ha, and an underground mining area of approximately 3,472 ha, where negligible subsidence impacts are anticipated.

A construction buffer zone will be provided around the direct disturbance areas. The buffer zone will provide an area for construction vehicle and equipment movements, minor stockpiling and equipment laydown, as well as allowing for minor realignments of surface infrastructure. Ground disturbance will generally be minor and associated with temporary vehicle tracks and sediment controls as well as minor works such as backfilled trenches associated with realignment of existing services. Notwithstanding, environmental features identified in the relevant technical assessments will be marked as avoidance zones so that activities in this area do not have an environmental impact.

Product coal will be transported by rail, primarily to Port Kembla terminal for the international market, and possibly to the domestic market depending on market demand. Rail works and use are the subject of a separate EIS and State significant development application for the Berrima Rail Project.

Project elements relevant to the visual assessment include:

- mine infrastructure area;
- mine access and ventilation systems and shaft(s);
- water management and treatment facilities;
- coal handling and preparation plant;
- overland conveyor system;
- rail load-out facilities;
- environmental management and monitoring equipment;
- lighting elements; and
- a temporary accommodation village for construction workers.

1.3 Adoption of leading practices

Hume Coal is committed to adopting leading practices in the planning, construction, operation and closure of the project. This includes leading practice measures to avoid, minimise and/or mitigate potential environmental and social impacts and deliver socio-economic benefits to the local community. In relation to visual amenity, a key aspect of the project designed to specifically reduce the surface disturbance associated with the project, and therefore impacts on visual amenity, is the emplacement of coal reject material (the stone separated out of the coal during processing) underground to partially backfill the mined-out void. This removes the need for a large coal reject emplacement area on the surface.

1.4 Assessment guidelines and requirements

This VIA has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

There are no Australian Federal, NSW State Government or Local Government Authority planning policies, guidelines or standards policies applicable to this assessment. The VIA was therefore prepared with regard to industry standards included within the UK document *Guidelines for Landscape and Visual Impact Assessment (GLVIA) Third Edition* (2013), prepared by the Landscape Institute and Institute of Environmental Management and Assessment. The VIA was also prepared with regard to Standards Australia (AS4282) Control of Obtrusive Effects of Outdoor Lighting.

The VIA was prepared in accordance with the requirements of the Commonwealth Department of the Environment and Energy (DoEE) and the NSW Department of Planning and Environment (DP&E). These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for the project, issued on 20 August 2015, and the supplementary SEARs issued on 18 January 2016. The SEARs identify matters which must be addressed in the EIS and essentially form its terms of reference. A copy of the SEARs is attached to the EIS as Appendix B, while Table 1.1 lists the individual requirements relevant to this visual assessment and where they are addressed in this report.

Table 1.1 Visual assessment – related SEARs

Requirement	Section addressed
Visual – including:	
• An assessment of the likely visual impacts of the development on private landowners in the vicinity of the development and key vantage points in the public domain, paying particular attention to the creation of any new landforms and minimising the lighting impacts of the development.	Chapter 5

To inform preparation of the SEARs, DP&E invited other government agencies to recommend matters for address in the EIS. These matters were taken into account by the Secretary for DP&E when preparing the SEARs. Copies of the government agencies' advice to DP&E was attached to the SEARs.

One agency, the NSW Roads and Maritime Services (RMS), raised a matter relevant to the visual assessment. This is a standard requirement for a project of this nature. The matter raised is listed in Table 1.2.

Table 1.2 RMS's comments: assessment recommendations

Requirement	Section addressed
The visual amenity impact of the mine works with regard to driver behaviour	Chapter 5 – viewpoint 4 and 5

1.5 Structure of the report

This report is structured as follows:

- Chapter 2 describes the visual impact methodology used in the preparation of this report;
- Chapter 3 describes the existing landscape within which the project will be sited;
- Chapter 4 describes the character of the visual components of the project and the staging of project development;
- Chapter 5 describes the impacts of the project from representative viewpoints in and around the project area;
- Chapter 6 provides a cumulative assessment of impacts with other developments in the area;
- Chapter 7 provides measures to mitigate visual impacts of the project; and
- Chapter 8 provides conclusions.

2 Visual impact method

2.1 Overview

In essence visual impact assessments compare an existing landscape to that which will eventuate as a project develops and matures. It is also an iterative process involving modifications to the locations, design, size and colour of various project components so as to reduce the extent and significance of visual change.

The assessment involves information review, consultations, fieldwork observations and photography, computer-based data processing and analysis, and subjective professional judgement.

The assessment method used in this report is that outlined in the GLVIA. Accordingly, the assessment involved the following seven stages:

Stage 1: **View type and context** – the existing landscape baseline is described noting its character and complexity;

Stage 2: **Visibility baseline assessment** – the zone of visual influence of the project is established, where appropriate through the use of computer generated zones of theoretical visibility, based on topographical data, or through fieldwork analysis. This establishes the locations where views of the project may be possible. Fieldwork is undertaken to establish the types and locations of receptors within this theoretical zone;

Stage 3: **Viewpoint and photomontage selection** – key public and private viewpoints of the project area are selected and the project's level of exposure to them is determined;

Stage 4: **Magnitude of change** - the magnitude of visual change and the changes arising from the project are assessed and the need for project modifications or other mitigation measures evaluated;

Stage 5: **Visual sensitivity** – the capacity of the landscape to absorb change without a loss of quality (its visual sensitivity) is determined;

Stage 6: **Evaluation of significance** – the significance of change in the landscape is a function of the magnitude of change when considered against the view type/context and the sensitivity of a receptor; and

Stage 7: **Mitigation** – the modified and mitigated project (if applicable) is assessed and final visual impacts are described and illustrated and their significance documented.

Details of each of the above stages is provided below.

2.2 Stages in the assessment methodology

2.2.1 Stage 1 - View type and context

The purpose of this stage is to record and analyse the existing landscape features, characteristics, the way in which the landscape is experienced and the value or importance of the landscape and visual resource in the project area. The landscape character is determined by the number, size, type and contrast of elements present. Typically the key elements are topography, vegetation, water features and built elements. Other factors that are important are the consistency of these elements and whether they have developed progressively overtime and become well integrated into a harmonious landscape. In addition, the presence of change and whether the landscape is experiencing large scale development, such as residential growth on the urban fringe, needs to be considered.

The context is a primary factor in the visual sensitivity of the view. Generally sites within higher contrasting landscapes have greater ability to absorb change, whereas sites within a uniform or highly ordered landscape have higher sensitivity.

The GLVIA sets out guidance in relation to landscape baseline at paragraph 5.3:

> Baseline studies for assessing landscape effects require a mix of desk study and field work to identify and record the character of the landscape and the elements, features and aesthetic and perceptual factors which contribute to it. They should also deal with the value attached to the landscape (see paragraph 5.19). The methods used should be appropriate to the context into which the development proposal will be introduced and in line with current guidance and terminology.

2.2.2 Stage 2 - Visibility baseline assessment

Baseline studies for visual effects establish the area in which the development may be visible, who will see the development, the viewpoints that will be affected and the nature of the views at those points.

2.2.3 Stage 3 - Viewpoint and photomontage selection

Viewpoints are selected to provide a representative sample of the likely impacts on the different users of the areas surrounding the project and their visual exposure to various project elements. Viewpoints that are considered to have potential exposure to various project elements or areas available to public access such as roads should be selected for detailed assessment.

It may also be appropriate to consider private viewpoints, mainly from residential properties surrounding the project. These properties will be identified through GIS mapping, fieldwork and desktop analysis.

Photomontages are an essential part of a VIA helping to simulate the expected visual changes and providing an illustration of the project from a particular viewpoint. They help determine the magnitude of change and illustrate effects at key locations within and surrounding the project area.

The GLVIA provides comprehensive guidance on the subject of photomontages, noting that:

> The objective of a photomontage is to simulate the likely visual changes that would result from a proposed development, and to produce printed images of a size and resolution sufficient to match the perspective in the same view in the field. (Landscape Institute, 2011: 3)

2.2.4 Stage 4 - Magnitude of change

The magnitude of change on the visual landscape is one factor in determining the significance of visual impacts of the project. In accordance with GLVIA, this visual assessment considered the following criteria in determining the magnitude of change on a receptor:

- whether the impact is temporal or permanent – impacts that are for a limited duration are considered less significant than those which occur for an extended period or are permanent;

- scale of change – the loss or addition of features in the view and changes in the proportion of the view affected by the project;

- degree of contrast – level of integration of new features with existing or remaining landscape elements, having regard to form, scale, height, colour, and texture;

- distance of the viewer from the altered elements in the landscape – close proximity to an altered landscape will increase the significance for private residences. In the case of motorists, mid ground changes can be greater than foreground elements as they can result in longer viewing times;

- viewing direction – whether the change is to the primary view from the receptor;

- extent of view affected – impacts that are visible over a greater portion of a view are more significant than those where only a part of the view is impacted. Intervening topography and vegetation will also affect the magnitude of change; and

- length of viewing time – views from a residence are constant whereas some views from roadways as experienced by motorists may be brief dependent upon speed and viewing direction.

2.2.5 Stage 5 - Visual sensitivity

Visual sensitivity is a measure of the landscape's ability to absorb development without a significant change in the character. It is a function of the view type and context. In this assessment, the major factor influencing visual sensitivity is the level of contrast between the project related infrastructure and the rural landscape setting in which it will be set.

Visual sensitivity is rated on a scale of high to low (refer Table 2.1 below). The physical characteristics of the landscape, including existing development features, are integral components in determining the visual sensitivity. For example, a low visual sensitivity would enable a modification or addition to be made to the landscape which would only cause minimal contrast and result in a high level of integration with the surrounding landscape. Similarly, a high visual sensitivity would mean the same modification or addition to the surrounding landscape would cause high contrast to the surrounding landscape.

In accordance with GLVIA, the visual sensitivity of a receptor has been assessed based on the following criteria:

- importance of the view – changes to views from private residences or main tourist roads are considered more sensitive than from secondary roads;

- length of view – transient nature of a view by motorists from roads is considered less sensitive compared to a long term view from a private residence;

- receptor viewer expectation – communities where development results in changes in the landscape setting or view they were expecting; and
- location and context of the viewpoint – natural and modified elements that make up the visual landscape and contribute to the composition, and hence sensitivity of a viewscape.

2.2.6 Stage 6 - Evaluation of significance

The significance of a change in the landscape is a function of the magnitude of that change when considered against the view type/context and the sensitivity of a receptor. Typically, a noticeable change in the landscape in an unmodified rural or natural landscape, combined with a high visual sensitivity, would be considered to be significant, whereas a change in an already heavily modified landscape be considered slight or moderate.

Table 2.1 illustrates how the magnitude of a change in the landscape is assessed, and its significance rated, against the sensitivity of a receptor.

Table 2.1 Evaluation of significance matrix

Magnitude of change	**Visual sensitivity**		
	High	Moderate	Low
High	Substantial	Moderate/ Substantial	Moderate
Medium	Moderate/ Substantial	Moderate	Slight/ Moderate
Low	Moderate	Slight/ Moderate	Slight
Negligible	Slight	Slight	Negligible
Key:	🟥 Significant	🟩 Not significant	

The primary assessment tools for determining the significance of impact of the project were the site inspections, photographs of the views from the selected viewpoints and preparation of photomontages to determine the level of change. This enabled an assessment of potential visual impact, taking into consideration the nature of the landscape, topography, the distance between the viewpoint and the proposed infrastructure, as well as the type of view experienced.

2.2.7 Stage 7 - Mitigation

The final step in the assessment process is to determine measures that can be incorporated into the design of the project to ameliorate, or, where possible, eliminate the visual impact of the proposed activity.

Mitigation measures can be in several forms including:

- design of mine infrastructure to reduce the contrast with the surrounding environment;
- use of visual buffers and screening by planting vegetation; and
- designing infrastructure to screen surface operations and lighting.

Proposed mitigation measures are given in Chapter 7 of this report.

3 Site description

3.1 Overview

The project area is approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre in the Wingecarribee LGA (refer to Figure 1.1 and Figure 1.2). The nearest area of surface disturbance will be associated with the surface infrastructure area, which will be 7.2 km north-west of Moss Vale town centre. It is in the Southern Highlands region of NSW and the Sydney Basin Biogeographic Region.

The project area is in a semi-rural setting, with the wider region characterised by grazing properties, small-scale farm businesses, natural areas, forestry, scattered rural residences, villages and towns, industrial activities such as the Berrima Cement Works and Berrima Feedmill, and some extractive industry and major transport infrastructure such as the Hume Highway.

Surface infrastructure is proposed to be developed on predominately cleared land owned by Hume Coal or affiliated entities, or for which there are appropriate access agreements in place with the landowner. Over half of the remainder of the project area (principally land above the underground mining area) comprises cleared land that is, and will continue to be, used for livestock grazing, small-scale farm businesses and hobby farms. Belanglo State Forest covers the north-western portion of the study area and contains introduced pine forest plantations, areas of native vegetation and several creeks that flow through deep sandstone gorges. Native vegetation within the project area is largely restricted to parts of Belanglo State Forest and riparian corridors along some watercourses.

The project area is traversed by several drainage lines including Oldbury Creek, Medway Rivulet, Wells Creek, Wells Creek Tributary, Belanglo Creek and Longacre Creek, all of which ultimately discharge to the Wingecarribee River. The Wingecarribee River's catchment forms part of the broader Warragamba Dam and Hawkesbury-Nepean catchments. Medway Dam is also adjacent to the northern portion of the project area.

Most of the central and eastern parts of the project area have very low rolling hills with occasional elevated ridge lines. However, there are steeper slopes and deep gorges in the west in Belanglo State Forest.

Existing built features across the project area include scattered rural residences and farm improvements such as outbuildings, dams, access tracks, fences, yards and gardens, as well as infrastructure and utilities including roads, electricity lines, communications cables and water and gas pipelines. Key roads that traverse the project area are the Hume Highway and Golden Vale Road. The Illawarra Highway borders the south-east section of the project area. Refer photographs 3.1 and 3.2 which show the existing site.

Industrial and manufacturing facilities adjacent to the project area include the Berrima Cement Works and Berrima Feedmill on the fringe of New Berrima. Berrima Colliery's mining lease (CCL 748) also adjoins the project area's northern boundary. Berrima Colliery is currently undergoing closure.

Photograph 3.1 View from the north-eastern corner of the project area looking south-west

Photograph 3.2 The project area looking south towards the product stockpile area from south of Oldbury Creek on 'Mereworth'

3.2 Local context

3.2.1 Moss Vale, Berrima, Bowral, Sutton Forest, Medway and other townships

The township of Moss Vale is located approximately 7.4 km to the south east of the surface infrastructure and is a significant commercial and industrial centre in the region. It has a population of approximately 7,792 (2011 census) and is sited on the Illawarra Highway, which connects to Wollongong and the Illawarra. Moss Vale has several heritage buildings, including Leighton Gardens in the centre of the main street. Agricultural rural holdings in the area specialise in dairy herds and there is an assortment of beef studs and sheep properties.

Berrima is a historic village in the Southern Highlands and approximately 4.4 km from the ROM coal stockpile in the surface infrastructure area. It is located on the Old Hume Highway between Canberra and Sydney. It has a population of 600 (2011 census). There are a number of historic buildings in the town and the village as a whole is listed on the Register of the National Estate. Prominent buildings in Berrima include the Berrima Court House and the Old Berrima Gaol. Berrima's main industry is tourism.

Bowral is the largest town in the Southern Highlands and has a population of approximately 9,765 (2011 census). The town is located around 10.5 km north-east of the project area. It is the largest commercial, retail and entertainment precinct in the Southern Highlands.

Other smaller townships near to the site include Sutton Forest and Medway. Sutton Forest is a small village in the Southern Highlands and is located around 5.7 km from the surface infrastructure.

At the 2011 census, Sutton Forest had a population of 579 people. It is an agrarian setting and is surrounded by farms, vineyards and is home to manor homes and estates. Medway is a small village in the Southern Highlands and is around 1.8 km to the west of the surface infrastructure. Medway has a population of approximately 386 people and has low density residential dwellings.

3.2.2 Traffic routes

The road network in and around the project area consists a range of roadways from State Highways through to minor unsealed rural property access roads. The Hume Highway, which is a four lane dual carriageway, runs north-south through the project area. It is known as the Hume Motorway north of its intersection with Mereworth Road, and forms part of the main inland arterial route between Sydney, Canberra and Melbourne.

The Illawarra Highway branches off the Hume Highway and runs along the southern boundary of the project area. Golden Vale Road, which is a local collector road, traverses the project area between the Hume Highway and Sutton Forest. Mereworth Road is also a local road which provides access into the project area.

The project area is also traversed by a number of unsealed farm and forestry tracks.

3.2.3 Night lighting

Existing sources of night lighting in the immediate vicinity of the project area (west of the Hume Highway) are minimal due to its rural setting. The main sources are rural residential properties, farm machinery and vehicles on roads. Motorists travelling north-south along the Hume Highway provide a moderate source of lighting in the evening hours.

In the wider context, the Berrima Cement Works, which is approximately 2.5 km east of the surface infrastructure area, at New Berrima, is a source of significant lighting in the evening hours, as is the Inghams Berrima Feedmill, located further east on Berrima Road, although to a lesser degree.

4 Visual elements of the project

4.1 Surface infrastructure area

Surface infrastructure required to service the mine will be constructed in the northern portion of the project area, on land owned by Hume Coal and its subsidiaries. It will have a disturbance footprint of around 117 ha and will include the CPP, main mine office buildings and workshop area, water management structures, conveyor network, and main ventilation shaft site.

The CPP, stockpiles and coal handling infrastructure will include:

- ROM coal stockpile, with a capacity of approximately 60,000 t;
- coal sizing and screening plant;
- coal preparation plant (CPP) with a nominal capacity of 450 tonnes per hour (tph);
- conveyors, breaker station, transfer points and surge bin;
- coal washery reject crushing, screening and pumping plant;
- coal washery reject stockpiles and associated plant and equipment, including temporary reject storage facilities;
- product stockpiles with a capacity of approximately 300,000 t;
- product coal reclaim system;
- product coal bin and train loading system;
- water management infrastructure;
- dust suppression and firefighting systems;
- services including compressed air, power and water;
- offices, car parking, ablutions facilities, storage for spare parts; and
- other minor buildings, plant and equipment associated with, or ancillary to, the coal handling and processing operation.

The main mine office area will include:

- administration offices, bathhouse and carpark;
- control room;
- workshop facilities;
- warehouse/store and laydown area;
- fuel and lubrication storage and refuelling facilities;
- washdown facilities;
- security fencing;
- internal access roads;
- sewage treatment facility;
- water supply, storage, treatment and management infrastructure;
- electricity supply and communications infrastructure;
- air compressors and back-up generators;
- and firefighting systems;
- emergency response facilities;
- helipad;
- other minor plant, equipment and facilities required to service the mine; and
- environmental management and monitoring equipment.

A surface facility will be required at the main ventilation shaft site, at the southern end of the surface infrastructure area and directly above the mine workings, including the following infrastructure:

- main ventilation fans and associated motor control room(s), power supply, transformers and switch gear;
- hard stand area around the shaft and fans, and vehicle parking for around five to 10 vehicles;
- borehole compound to allow the supply of services such as power and water and bulk materials such as concrete and ballast between the surface and underground;
- surface water management infrastructure; and
- access roads/tracks, security fencing, lighting, and other ancillary plant and equipment.

4.2 Communications and electricity reticulation infrastructure

The project will include installation of electricity reticulation infrastructure, including high voltage electricity lines and substations.

A series of substations, buried and overhead electricity lines will be constructed within the project area to supply power to the mine, including the train load-out area, overland conveyors, surface infrastructure area, and underground workings.

4.3 Accommodation village for construction workers

A temporary construction accommodation village will be developed prior to the major construction activities commencing. It will accommodate approximately 414 workers for the construction phase of the project and the associated Berrima Rail Project. The village will be located within the mine surface infrastructure area in the northern portion of the project area as show on Figure 1.4, on land owned by Hume Coal and its subsidiaries.

The village will be a temporary facility that will operate for a maximum of 36 months, and will contain a dining hall, gym, library and games room. It will be single storey in height, be in colours that are compatible with the surrounding landscape such as green and brown, and will consist of a series of demountable buildings. The village will be dismantled once construction works are complete and the project moves into its operational phase.

4.4 Visual elements of mine staging

There are three defined phases in the life of the project as described below (and described in further detail in Chapter 2 of the main report).

i Phase 1 – Construction phase

The construction phase of the project will run for approximately 24 months and will include the development of the accommodation village for the construction workers. It will consist of two main stages, namely:

- early works and construction of surface infrastructure; and
- construction of underground drifts and associated infrastructure.

The early works will include construction of site access roads, the temporary construction accommodation village and water supply works. The early works program will extend for approximately 8 months.

Surface infrastructure construction includes development of the surface infrastructure area including bulk earthworks, drainage and civil works.

Construction of buildings, workshops, stores, amenities and other ancillary facilities, located in the surface infrastructure area will involve vegetation clearing, removal and stockpiling of topsoil and subsoil and civil works.

ii Phase 2 – Operational phase

The project will operate over an approximate 19 year-period. The appearance and extent of surface infrastructure will not change over this period and therefore the visual effects of the project will remain the same.

iii Phase 3 – Rehabilitation and closure phase

The closure and rehabilitation phase will be undertaken over a period of approximately two years. During this phase, the mine infrastructure will be decommissioned and the area rehabilitated such that it can support land uses similar to the current land uses. Proposed rehabilitation activities are described in detail in the main EIS (EMM 2017).

4.5 Berrima Rail Project

Hume Coal is also seeking approval for the construction and operation of a new rail spur and loop under a separate development application (refer Chapter 15 in the EIS for further detail). The new rail spur line will connect the Berrima Branch Line to the Hume Coal Project coal loading facility. It involves the construction of a rail loop and noise wall adjacent to Medway Road in the north eastern corner of the project area. Both the rail loop and the noise wall associated with the Berrima Rail Project have been assessed as part of the visual impact assessment for the Hume Coal Project. The key components of the Berrima Rail Project area shown in Figure 7.1.

5 Viewpoint assessment

5.1 Assessed viewpoints

Following the desktop analysis, a site survey was undertaken on Friday 2 October 2015, 17 December 2015, 30 August 2016 and 24 October 2016 to confirm potentially affected viewpoints of varying degrees as a result of the project, based on line of sight analysis to the surface infrastructure area.

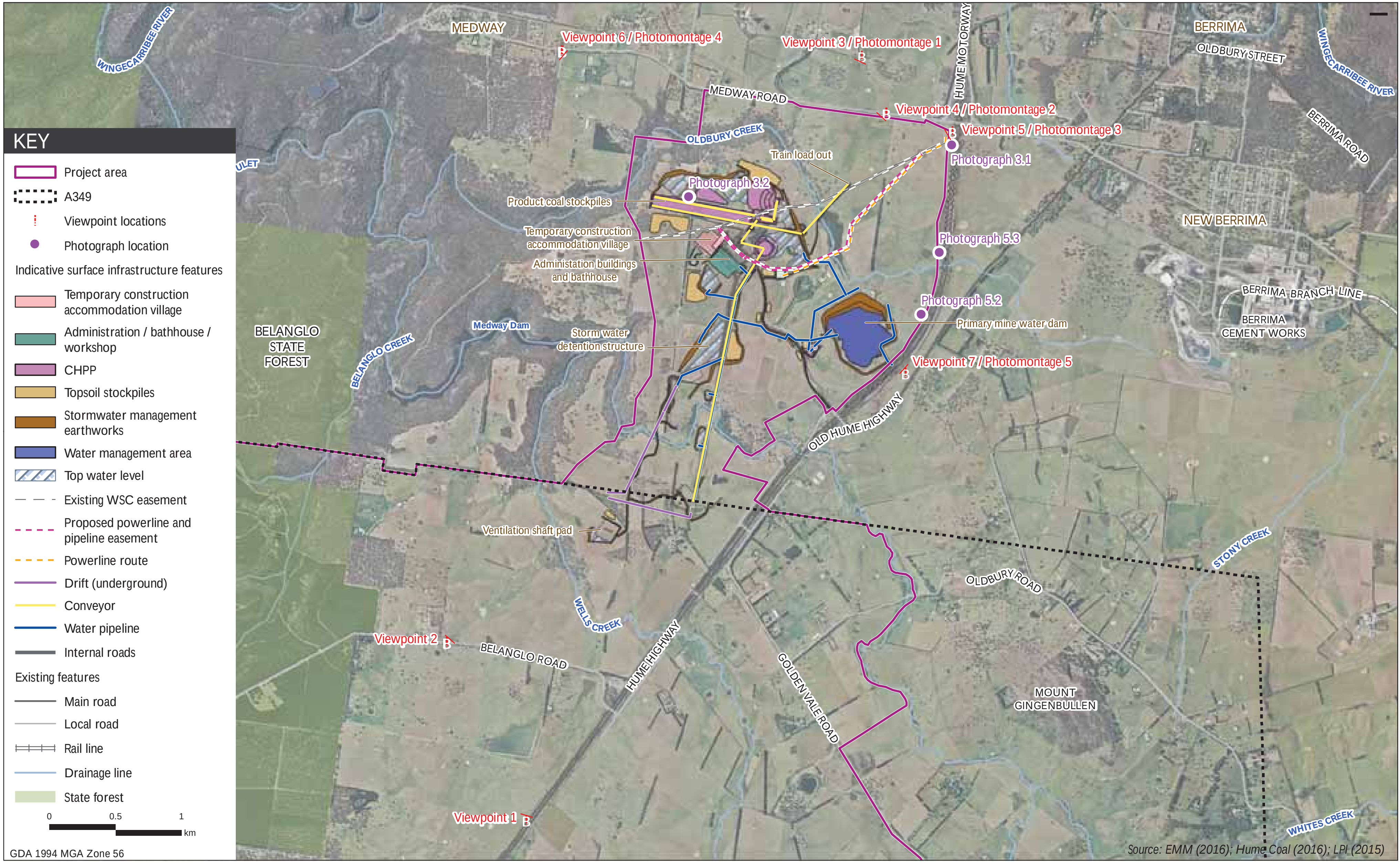
These locations were chosen as they were considered to have the greatest potential for experiencing visual impact due to potential exposure to stockpiles or other surface infrastructure. Additionally, these locations are representative of likely visual impact to surrounding private residential landowners or potential exposure to the project for motorists travelling in the vicinity of the mine.

Each of the seven viewpoints and three photomontage locations are illustrated in Figure 5.1. The reasons for choosing each of the viewpoints analysed are summarised in Table 5.1.

Table 5.1 Assessed viewpoints

Viewpoint	Reason for assessment
1	This is representative of the view to the project for motorists travelling north along the Hume Highway. It is the closest position on the highway south of the surface infrastructure area that a motorist travelling north could safely stop to view the surface infrastructure in a forward facing manner. Further north along the Hume Highway, closer to the surface infrastructure area, there is dense tree planting which provides a substantial landscaped screen on the western side of the highway. Therefore, if motorists travelling north were to look left towards the surface infrastructure area, without stopping, it is unlikely that any elements of the project would be visible until they reach approximately viewpoint 5 (which is assessed in Table 5.6).
2	The view from this location is typical of the view for motorists travelling along Belanglo Road and from a limited number of rural-residential properties that are located on the northern side of the road. This viewpoint was selected on the basis that Belanglo Road is the nearest public road to the south of the infrastructure area.
3	The view from this location is typical of the view from a private rural residential property on the northern side of Medway Road and is located outside of the project area. This viewpoint was selected on the basis that this property is the nearest and most exposed property to the north of the project area.
4	The view from this receptor is typical of the view for motorists travelling east and west along Medway Road, alongside the project area's northern boundary, and from the rural-residential properties located on the northern side of the road.
5	This view is typical of the view from the western side of the Hume Highway travelling north (being the main transport corridor which runs through the project area) in closest proximity to the surface infrastructure area and the proposed rail loop and noise wall associated with the Berrima Rail Project. This viewpoint is in an elevated position looking towards the surface infrastructure.
6	This view is typical of the view from a private rural residential property on the southern side of Medway Road. This viewpoint was selected on the basis that this property is the nearest and most exposed property to the north-west of the project area.
7	This view is an elevated position on a main transport route which allows views across the project area in a westerly direction.

The outcomes of the viewpoint analysis are presented in Section 5.2.



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Viewpoint, photomontage and photograph locations

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Figure 5.1

5.2 Viewpoint analysis

The following tables provide an overview of the seven selected viewpoints, and include an assessment of these viewpoints in accordance with the methodology outlined in Section 2.2 of this report.

Table 5.2 Viewpoint 1 – Hume Highway looking north towards the surface infrastructure area

Viewpoint details	This viewpoint, shown in Photograph 5.1, is located on the western side of the Hume Highway looking north and taken from a rural agricultural access point situated approximately 1.3 km to the south of Belanglo Road. The relevant viewing direction is north.
View type and context	Views from this location represent a typical rural setting with a large expanse of predominantly flat, cleared farmland. A minimal amount of tree planting exists in the foreground with increased mature tree planting present in the background.
Magnitude of change	Viewers at this location will not have views of the project due to the distance from the highway at this point to the surface infrastructure area, the topography and intermittent tree planting within the landscape (refer photograph 5.1). Therefore no change to the view will occur. Further, views towards the project surface infrastructure area from the Hume Highway travelling north (beyond this viewpoint) would be limited, with significant stretches of mature vegetation and steep rock embankments on the western side of the highway providing a natural landscaped buffer (refer photograph 5.2 and 5.3).
Visual sensitivity	The viewpoint is considered to have a moderate visual sensitivity due to its rural landscape character; combined with the transient nature of the view experienced by motorists.
Evaluation of significance	Visual impacts from this viewpoint will be negligible due to the distance from the project as well as intervening topography and vegetation that will obstruct views.
Mitigation	No mitigation measures will be necessary.

Photograph 5.1 **Viewpoint 1 – Hume Highway looking north towards the surface infrastructure area**

Photograph 5.2 Typical view from the Hume Highway travelling north with vegetated buffers on the western side of the highway

Photograph 5.3 Typical view from the Hume Highway travelling north with steep embankment on the western side of the highway

Table 5.3 Viewpoint 2 - Belanglo Road looking north-east towards the surface infrastructure area

Viewpoint details	This viewpoint is located on the northern side of Belanglo Road looking towards the project surface infrastructure area in a north-easterly direction, approximately 1.5 kms from the southern end of the surface infrastructure area (comprising the main ventilation shaft site).
View type and context	Views towards the surface infrastructure at the southern end of the project area, namely the ventilation shaft, will be screened by topography and existing tree planting within the landscape. Specifically, a windrow of pine trees obstructs views of the project (refer Photograph 5.4).
Magnitude of change	Viewers at this location will not have views of the project infrastructure due to the distance from the main surface infrastructure area, the topography and existing intermittent tree planting within the landscape. In addition the nearest infrastructure element is the main ventilation shaft, which is of a low height and will therefore not be seen. Therefore there will be no changes to the view from this location.
Visual sensitivity	The viewpoint for motorists and residents is considered to have low to moderate visual sensitivity respectively in consideration of its rural landscape character and transient nature of the view on this local road.
Evaluation of significance	Visual impacts from this viewpoint will be negligible as the project will not be seen due to intervening topography and vegetation.
Mitigation	No mitigation measures will be necessary.

Photograph 5.4 Viewpoint 2 – Photograph from Belanglo Road looking north-east towards the surface infrastructure area

Table 5.4 Viewpoint 3 - Private residence on the northern side of Medway Road looking south towards the surface infrastructure area

Viewpoint details	This viewpoint is located on the northern side of Medway Road from a private residential property, approximately 980 metres north of the surface infrastructure area.
View type and context	Immediate views from this location represent a typical rural setting with a large expanse of predominantly flat and cleared farmland. A ridgeline incorporating scattered vegetation exists in the background.
Magnitude of change	Viewers from this location will have partial views of the coal loading facility within the landscape. Existing and new tree planting along Medway Road will provide substantial screening to a majority of the surface infrastructure (refer Figures 5.2 and 5.3). Therefore the change will be medium from an open rural landscaped setting to a densely planted vegetated screen once the trees have grown to full maturity with intermittent views of the coal loading facility.
Visual sensitivity	The viewpoint is considered to have a high visual sensitivity due to the residential nature of the receptor and rural nature of the view (refer Section 2.2.5 of this report).
Evaluation of significance	Visual impacts will be of moderate to substantial significance within the landscaped setting as the coal loading facility will be partially seen and the open views will be altered (refer Figures 5.2 and 5.3).
Mitigation	Once matured the tree screen that has been already planted (accompanied with existing tree planting) will minimise the visual impacts to a moderate level (refer Figure 5.3).

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Viewpoint 3 photomontage - existing and unmitigated view

Hume Coal Project
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Figure 5.2

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Viewpoint 3 photomontage - year 5 and year 15

Hume Coal Project
Visual and Lighting Impact Assessment
Figure 5.3

Table 5.5 Viewpoint 4 - Medway Road looking south-west towards the surface infrastructure area

Viewpoint details	This viewpoint is located on the northern side of Medway Road looking in a south-westerly direction approximately 460 m west of the Hume Highway overpass. The existing and proposed views are shown in Figures 5.4 and 5.5.
View type and context	The landscape visible from this viewpoint is dominated by predominantly flat grazing land with scattered vegetation throughout. Mature tree planting exists in the foreground and background (refer Figure 5.4).
Magnitude of change	The magnitude of change is considered to be medium at this viewpoint. The mature vegetation that exists between this viewpoint and the surface infrastructure area will provide a significant level of screening to the visible project components (refer Figure 5.5).
Visual sensitivity	This viewpoint is considered to have a high visual sensitivity due to its rural landscape character and permanent nature of the view from this residential location. The topography is predominantly flat with existing vegetation providing limited capacity to absorb change. In addition to this, the distance between the road and the infrastructure is at its closest point.
Evaluation of significance	Visual impacts from this viewpoint will commence during the construction phase and throughout the duration of the operation phase of the project. Unmitigated visual impacts from this viewpoint are considered to be moderate to substantial. There will be intermittent views of the construction phase of the project.
Mitigation	The tree planting that has already been undertaken will provide screening of the noise wall and will reduce the visual impacts to moderate to low. Therefore, no further mitigation measures are considered necessary.

Viewpoint 4 photomontage - existing and unmitigated view

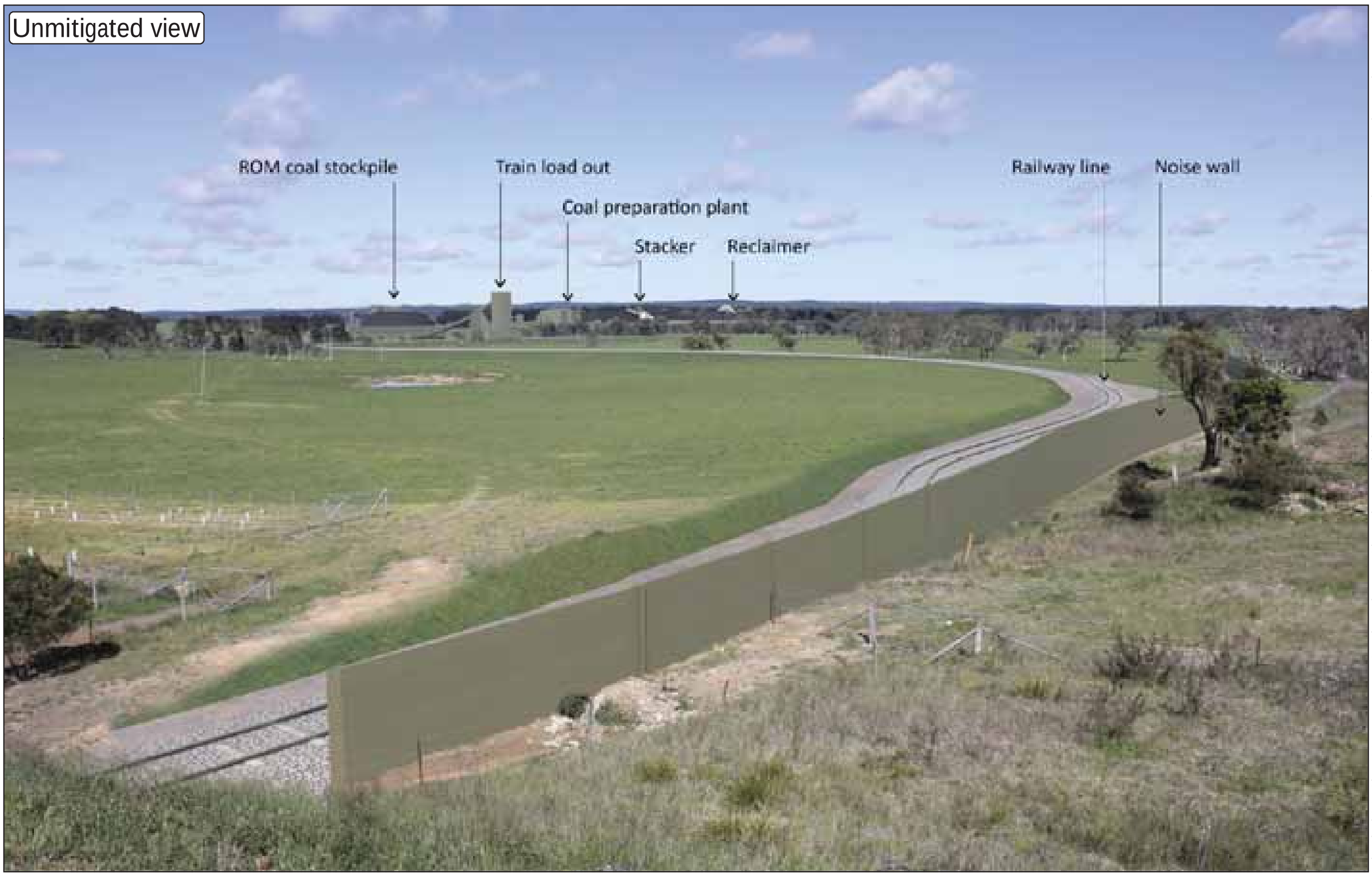
Hume Coal Project
Visual and Lighting Impact Assessment
Figure 5.4

Viewpoint 4 photomontage - year 5 and year 15

Hume Coal Project
Visual and Lighting Impact Assessment
Figure 5.5

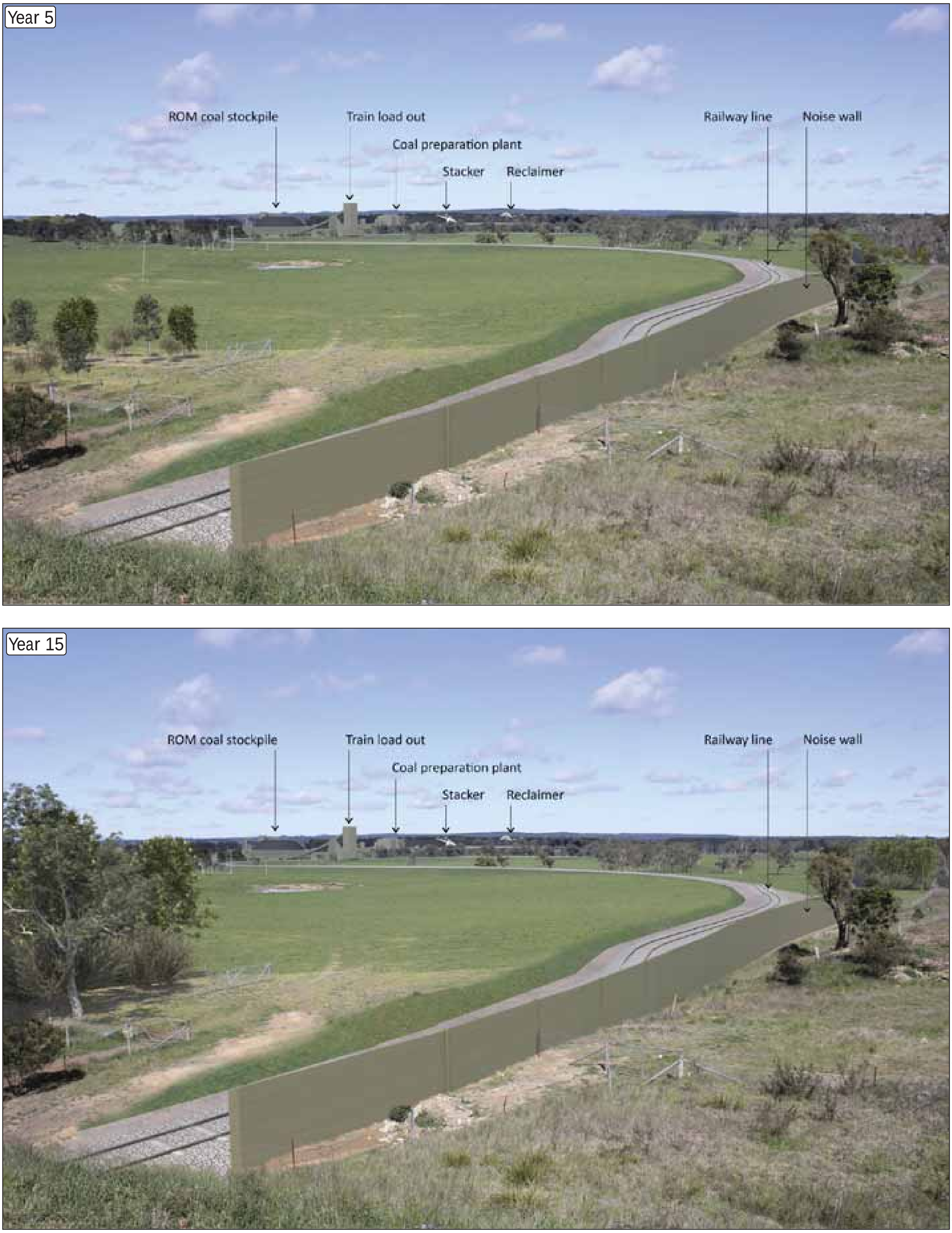
Table 5.6 Viewpoint 5 - Corner of the Hume Highway and Medway Road looking south- west towards the surface infrastructure area

Viewpoint details	This viewpoint is located on the western side of the Hume Highway near to its intersection with Medway Road, facing south-west. The photograph in Figure 5.6 is taken from the embankment alongside the Hume Highway, just outside the boundary of the project area at its north-eastern corner.
View type and context	The landscape is dominated by predominantly flat grazing land with scattered vegetation throughout. It provides a scenic rural view from the Hume Highway. Mature tree planting exists in the background.
Magnitude of change	Due to the viewpoint's higher elevation, views to surface infrastructure will be possible, in particular the stockpiles, overland conveyor system and coal loading facility. The stacker will also be visible, which will be up to 20 m high. All of these elements will appear as new visual elements within the landscape and will be visible from its construction in Year 1 to the end of operations in Year 21 (refer to Figures 5.6 and 5.7). However, only temporal glimpses of the project will be possible to passing motorists as they travel through this viewpoint. This is due to the speed at which motorists travel on the highway (which has a speed limit of 110 km/hr) and the distance to the visible components, being approximately 1.4 km. It is also unlikely that motorists and passengers travelling northbound on the Hume Highway would look back towards the site. In addition, views from southbound traffic will be prevented by existing trees between the north and south bound lanes on the highway. Therefore, the magnitude of change is considered to be medium.
Visual sensitivity	This viewpoint is considered to have a moderate visual sensitivity due to the existing landscape having little in the way of modifications, although cleared land, fences and electricity power poles are visible. Although it is also a main tourist road the view experienced by motorists is transient and less sensitive compared to a long term view from a private residence.
Evaluation of significance	Unmitigated visual impacts from this viewpoint will be moderate.
Mitigation	To reduce impacts the visible components of the surface infrastructure area will be coloured in natural tones that are compatible with the surrounding landscape.



Viewpoint 5 photomontage - existing and unmitigated view

Hume Coal Project
Visual and Lighting Impact Assessment
Figure 5.6



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Viewpoint 5 photomontage - year 5 and year 15

Hume Coal Project
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Figure 5.7

Table 5.7 Viewpoint 6 - Western end of Medway Road looking south-east towards the surface infrastructure area

Viewpoint details	This viewpoint is located on the southern side and towards the northern end of Medway Road, approximately 1.6 km from the proposed surface infrastructure area. The relevant viewing direction is facing south-east and the existing view is shown in the photograph Figure 5.8.
View type and context	The landscape is dominated by predominantly flat open paddocks and presents a rural character. Mature tree planting exists in the background and along the eastern and southern property boundary of this rural residential property.
Magnitude of change	Viewers from this location will have limited views of the project infrastructure due to the mature tree planting in the background, resulting in a low magnitude of change (refer Figure 5.8).
Visual sensitivity	The viewpoint is considered to have a moderate to high visual sensitivity due to its rural-residential character.
Evaluation of significance	Visual impacts from this viewpoint will be low to moderate.
Mitigation	No mitigation measures are proposed as only a very small portion of the reclaimer will be seen due to distance as well as intervening vegetation. It is noted that the stacker/reclaimer moves along the stockpile and will only be intermittently visible.

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Viewpoint 6 photomontage - existing and year 5

Hume Coal Project
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Figure 5.8

Table 5.8 Viewpoint 7 – Eastern side of Old Hume Highway looking north-west towards the surface infrastructure area

Viewpoint details	This viewpoint is located on the eastern side of the Old Hume Highway and adjacent to the surface infrastructure area. The relevant viewing direction is facing north-west and the existing view is shown in the photograph in Figure 5.9.
View type and context	The landscape is dominated by predominantly flat open paddocks and presents a rural character. Existing mature tree planting exists in the background and surrounding Mereworth House.
Magnitude of change	Viewers from this location will have limited views of the project due to the topography, distance and mature tree planting, resulting in a medium magnitude of change (refer to Figure 5.10).
Visual sensitivity	The viewpoint is considered to have a low sensitivity due to the transient nature of the view by motorists.
Evaluation of significance	Visual impacts from this viewpoint will commence during the construction phase and throughout the duration of the operation phase of the project. Unmitigated visual impacts from this viewpoint are considered to be moderate to low due to distance and existing mature tree planting in the background. Prior to the tree planting maturing there will be intermittent views of the construction phase of the project.
Mitigation	Native tree planting has already been introduced adjacent to the highway. Once matured the tree screen will reduce the visual impact to low (refer Figure 5.10).

Viewpoint 7 photomontage - existing and unmitigated view

Hume Coal Project

Visual and Lighting Impact Assessment

Figure 5.9

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Viewpoint 7 photomontage - year 5 and year 15

Hume Coal Project

Visual and Lighting Impact Assessment

Figure 5.10

6 Other development

6.1 Existing industrial development

The area surrounding the project is predominantly rural-residential in character. Although contains a number of industrial and manufacturing facilities, including cement works, brickworks, metal fabrication, mining equipment manufacture and quarries, as listed below.

- Berrima Cement Works – located in New Berrima, the Boral Cement Limited (Boral) Berrima cement works have been operating since 1929 and produce cement products (cement and clinker) for sale in NSW, the ACT and for export. The cement works have approval to produce up to 1.56 Mtpa of cement products, which are dispatched by rail and road transport to domestic customers and to international customers via Port Kembla.
- Berrima Feedmill – the Ingham poultry feedmill is also located on Berrima Road on the fringe of New Berrima, and has been operating for approximately 15 years.
- Omya – Omya's Moss Vale plant was originally established in 1961. In recent years the incorporation of technology and high levels of automation have resulted in the plant being a high volume producer of bulk products for glass, agriculture, mining and manufacturing industries.
- Dux – The Dux hot water plant is located on Collins Road in Moss Vale.
- Resource recovery centre – The WSC resource recovery centre is off Berrima Road, Moss Vale and comprises a waste recycling, collection and transfer facility.

6.2 Cumulative impact assessment

The 2002 edition of the GLVIA defines cumulative landscape and visual effects as those that:

> Result from additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments (associated or separate to it), or actions that occurred in the past, present or are likely to occur in the foreseeable future.

The GVLIA also outlines the types of landscape and visual cumulative effects that may need to be considered, including:

- 'temporal effects, referring to the cumulative impacts of simultaneous and/or successive projects that may affect communities and localities over an extended period of time;
- the interaction between different types of development, each of which may have different landscape and/or visual effects and where the total effect is greater than the sum of the parts;
- effects of development which have indirect effects on other development, either by enabling it – for example a road development enabling new warehouses to be constructed at a roundabout – or disabling it – for example by sterilising land; both may in turn have landscape and or visual effects.'

The majority of the existing industrial facilities listed above in Section 6.1 above are not located within immediate proximity to each other or the project area. It is only the cement works, Omya and the feed mill that would have a visual significance in the locality due to their height. Given that the visual impacts arising from the proposed surface infrastructure are negligible (as outlined in Chapter 5 of this report), it is considered that the cumulative impact of the project and the existing industrial facilities within the locality will be minimal.

As discussed in Section 4.5, the Berrima Rail project is also relevant in the cumulative impact assessment. It is noted that the anticipated cumulative impact of the Berrima Rail Project and the Hume Coal Project were influential in the viewpoint selection. The visual effects of the adjoining Berrima Rail Project have been considered in the viewpoint assessment in Chapter 5 of this report, in particular the noise wall, railway line and tree planting. These are the 'inter-project' cumulative effects (GVLIA).

Figures 5.3, 5.4, 5.5, 5.6 and 5.7 included within Chapter 5 illustrate the cumulative impacts of the two projects.

6.3 Current development applications

The project will be located within close proximity (approximately 1.2 km to the south), to a property which is the subject of a current development application for a two-storey function centre. The Statement of Environmental Effects accompanying the development application for the proposal, prepared by Bureaucracy Busters Town Planning Consultants, states that *'the proposed location of the new structure is central on the subject site, being screened by a substantial landscaping scheme.'* The function centre maintains the existing floor area of 4,495m².

The visual influence of the proposed function centre within the landscape is considered negligible given the distance from surface infrastructure area of the project, its isolated positioning within the landscape and the proposed landscaping scheme. In addition, the existing building footprint will not be increased and it is therefore unlikely that cumulative visual effects would arise if both projects were to proceed.

The visual impacts of the project on the function centre are also considered to be low. The railway line will be intermittently visible from the ground level of the function centre due to existing tree planting and topography to the south of the property. The function centre includes window openings on the second floor level of the southern elevation, facing the project area, which would only allow partial views of the railway line and the surface infastructure.

7 Management and mitigation measures

7.1 Mitigation of visual impacts

The project's design has evolved considerably since the original concept was developed. Design developments include specifically locating the CPP to areas which will be less exposed to viewers surrounding the project area. All of these amendments have reduced the overall visual impacts. This detailed assessment has led to further refinement of the project to reduce visual impacts. Various mitigation measures have been recommended to address residual impacts both generally and from specific viewpoints surrounding the project as described in Chapter 5.

Importantly, Hume Coal has already completed an extensive tree planting program, to establish a series of tree screens around the project area. This program, as well as additional recommended measures, is described below.

7.1.1 Visual screening

Screening in the form of foreground and mid-ground tree and shrub planting is a very effective way of reducing exposure of a receptor to various aspects of the surface infrastructure. Once established, such planting provides a permanent and natural screen to the various element of the mine from either roadways or private landholdings.

Hume Coal has already planted visual screens around the project area, as illustrated on Figure 7.1 and photographs 5.17. The location and extent of these tree screens were chosen to mitigate potential views from Medway Road and the Hume Highway. A list of the type of species, age to maturity and maximum growth height of tree species planted is provided in Table 7.2 below. The species chosen include those common to the ecological community into which they have been planted. With planting already complete, there will be sufficient time for some species to reach maturity, or be well progressed towards maturity, by the time construction commences.

Table 7.2 Tree planting species

Botanical name	Habit	Age to maturity	Height
Acacia decurrens	Small tree	5-7 years	12m
Acacia floribunda	Small tree	5-7 years	4m
Acacia implexa	Small tree	10 years	6-12m
Acacia melanoxylon	Small tree	10 years	8-12m
Acacia rubida	Small tree	5 years	3-4m
Allocasuarina littoralis	Tree	10 years	10m
Banksia marginate	Small tree	5 years	5-6m
Casuarina cunninghamiana	Tree	15 years	20m
Eucalyptus amplifolia	Tree	15 years	8-15m
Eucalyptus elata	Tree	15 years	10-12m
Eucalyptus ovata	Tree	15 years	12-20m
Eucalyptus pauciflora	Tree	15 years	7-12m
Eucalyptus radiata	Tree	15 years	15-30m
Eucalyptus rubida	Tree	15 years	15-20m
Eucalyptus stellulata	Small tree	15 years	5-7m

Table 7.2 Tree planting species

Botanical name	Habit	Age to maturity	Height
Eucalyptus viminalis	Tree	15 years	20m
Hakea dactyloides	Shrub	5 years	2-3m
Hakea salicifolia	Shrub	5 years	3-8m
Leptospermum morrisonii	Shrub	5 years	4m
Leptospermum obovatum	Shrub	5 years	2-4m
Leptospermum polygalifolium	Shrub	5 years	2-4m
Melaleuca linariifolia	Small tree	10 years	6-8m

The proposed screening and its effectiveness at viewpoints/photomontages 4, 5, 6 and 7 is addressed below:

i. Viewpoint 3 and photomontages no. 1a and 1b - Private residence off Medway Road to the north of the surface infrastructure area – proposed view

The proposed tree planting (accompanied with the noise wall) will substantially screen a majority of the surface infrastructure. The coal loading facility will be partially seen above the tree planting.

ii. Viewpoint 4 and photomontages no. 2a and 2b - Medway Road looking south-west

The proposed tree planting (accompanied with the noise wall) will substantially screen the proposed surface infrastructure at this viewpoint, reducing the significance of the potential visual impact from moderate to slight.

iii. Viewpoint 6 and photomontages no. 4a and 4b - Western end of Medway Road looking south-east

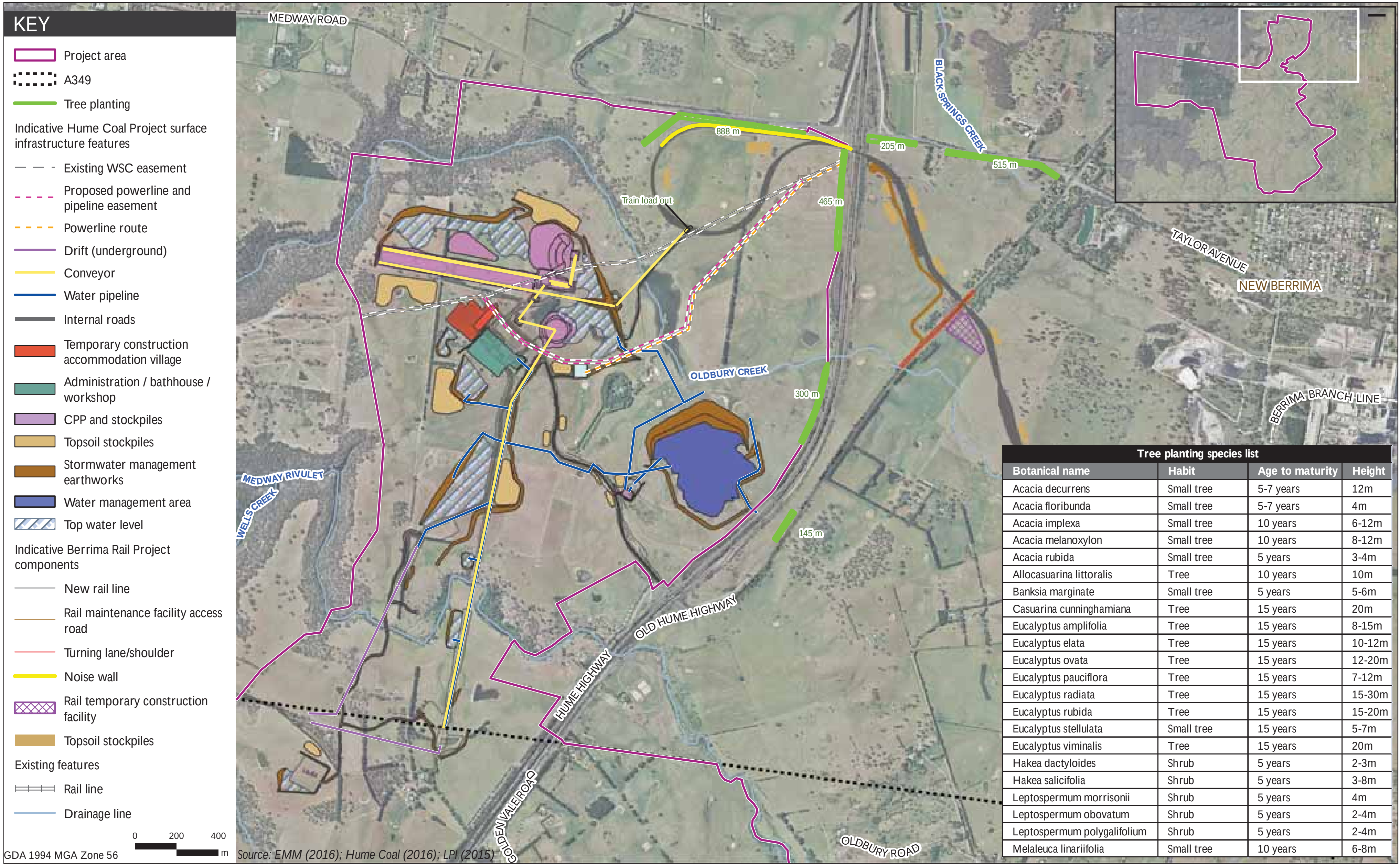
The proposed tree planting does not extend this far along Medway Road. However, given the limited exposure to the stockpile at this viewpoint it is considered that tree planting will not be necessary.

iv. Viewpoint 7 and photomontages no. 5a and 5b – Old Hume Highway

The proposed tree planting will fully screen the proposed infrastructure from this viewpoint, reducing the significance of the potential visual impact from moderate to low/negligible.

7.1.2 Colour of surface infrastructure

Suitable colours will be chosen for project infrastructure to minimise visual impacts (refer to the photomontages in Chapter 5).



Tree planting species list			
Botanical name	**Habit**	**Age to maturity**	**Height**
Acacia decurrens	Small tree	5-7 years	12m
Acacia floribunda	Small tree	5-7 years	4m
Acacia implexa	Small tree	10 years	6-12m
Acacia melanoxylon	Small tree	10 years	8-12m
Acacia rubida	Small tree	5 years	3-4m
Allocasuarina littoralis	Tree	10 years	10m
Banksia marginate	Small tree	5 years	5-6m
Casuarina cunninghamiana	Tree	15 years	20m
Eucalyptus amplifolia	Tree	15 years	8-15m
Eucalyptus elata	Tree	15 years	10-12m
Eucalyptus ovata	Tree	15 years	12-20m
Eucalyptus pauciflora	Tree	15 years	7-12m
Eucalyptus radiata	Tree	15 years	15-30m
Eucalyptus rubida	Tree	15 years	15-20m
Eucalyptus stellulata	Small tree	15 years	5-7m
Eucalyptus viminalis	Tree	15 years	20m
Hakea dactyloides	Shrub	5 years	2-3m
Hakea salicifolia	Shrub	5 years	3-8m
Leptospermum morrisonii	Shrub	5 years	4m
Leptospermum obovatum	Shrub	5 years	2-4m
Leptospermum polygalifolium	Shrub	5 years	2-4m
Melaleuca linariifolia	Small tree	10 years	6-8m

Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Tree planting

Hume Coal Project
Visual and Lighting Impact Assessment

Figure 7.1

7.1.3 Night lighting

Australia Standard 4282 (AS4282) *Control of Obtrusive Effects of Outdoor Lighting* sets out guidelines for control of the obtrusive effects of outdoor lighting and gives recommended limits for relevant lighting levels to contain these effects within tolerable levels.

Lighting associated with the surface infrastructure will remain throughout the life of the project and will be visible to residents surrounding the project area and motorists travelling along roads in the immediate vicinity.

Sky glow from operational machinery, mine infrastructure and associated lighting will be present throughout the life of the project. The amount of sky glow will vary depending on factors such as cloud cover and the location of operational mining activities at a given time.

A detailed assessment of potential light spill from the project will be undertaken as part of detailed design.

However, lighting protocols will be developed which adopt the following principles:

- establish operational protocols for setting up of mobile lighting plant such that lighting is directed away from external private receptors;
- establish design and operational protocols such that lighting sources are directed below the horizontal to minimise potential light spill;
- design light systems that minimise wastage;
- screening of lighting where possible for viewers external to the project; and
- avoid lighting of light coloured surfaces which have greater reflectivity.

8 Conclusion

A visual assessment has been conducted from a number of representative viewpoints from within and surrounding the project area. The viewpoints were selected to represent worst case scenarios, including views from private residential properties, a main transport route (the Hume Highway) and local streets nearest to, or within, the project area. Four photomontages have been prepared to demonstrate the visual impacts of the project. Due to existing mature vegetation in the landscape, the tree screens already planted by Hume Coal, and the area's topography the project will be relatively shielded from view.

The project design has progressively evolved to reduce its scale and attendant impacts, including visual impacts. Nonetheless, the development of the project will result in some changes to the landscape especially in the early stages prior to maturation of screen landscaping. Such changes will be noticeable to viewers and generally perceived as intruding into a rural landscape from certain viewpoints surrounding the project area.

However, in most instances, distance combined with intervening topography and/or vegetation means that visual impacts will be minimised. Elsewhere, measures have been proposed to reduce exposure to project elements at viewer locations, and/or minimise the contrast between the element concerned and the surrounding landscape.

An extensive tree planting scheme undertaken by Hume Coal will reduce exposure to project elements at viewer locations, and/or minimise the contrast between the element concerned and the surrounding landscape. Although the tree planting will take time to become established and fully effective, once established, it will assist to substantially mitigate visual impacts such that they will be generally acceptable to residents in the locality and to motorists. Notably, the tree screens have already been planted to provide time for the trees to become established prior to construction commencing.

This VIA concludes that the project will not have any significant adverse visual impacts on the locality.

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Appendix O

Rehabilitation and Closure Strategy

Hume Coal Project

Environmental Impact Statement | Appendix O | Closure and Rehabilitation Strategy

Prepared for Hume Coal Pty Limited | 7 March 2017

Hume Coal Project

Environmental Impact Statement | Appendix O | Closure and Rehabilitation Strategy

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Hume Coal Project

Final

Report J12055RP1 | Prepared for Hume Coal Pty Limited | 7 March 2017

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Date	7 March 2017	Date	7 March 2017

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Executive Summary

This Closure and Rehabilitation Strategy (the strategy) forms part of the environmental impact statement to support a development application for the Hume Coal Project (the project); for which approval is sought under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979.*

The overarching rehabilitation objective of the project is to restore the land to its pre-mining land use at the end of its operational life; that is, an agricultural land use comprising grazing on improved pasture. Being an underground mine, disturbed areas on the surface requiring rehabilitation will be minimal, with the disturbance footprint comprising only 2.3% of the entire project area.

There will be opportunities for progressive rehabilitation of areas containing early and temporary works or facilities such as the construction accommodation village, once vacated. During operations, wherever possible disturbed areas no longer required for mining activities, such as drill pads and access tracks, will be progressively rehabilitated.

The project area has been divided into a series of primary domains, in accordance with *ESG3 Mining Operations Plan (MOP) Guidelines* (NSW Department of Trade and Investment – Division of Resources and Energy 2013). The primary domains form the basis of conceptual rehabilitation and project closure planning for this strategy. The primary domains identified across the project area are infrastructure areas; water management areas; stockpiled material; and underground mining area. All of the project primary domains have been assigned a secondary domain (post-mining land use) of "D – Rehabilitation Area – Pasture."

Preliminary completion criteria have been developed for each of the domains as part of this strategy. Rehabilitation monitoring will be undertaken throughout the mine life and post-closure (until lease relinquishment) to assess progress towards meeting this criteria. Whether rehabilitation criteria have been met depends on the trending of measurements over time compared to pre-mining or reference site conditions. The criteria will be refined and confirmed in the MOP and in the detailed closure plan as the project progresses towards closure.

Closure of the mine will involve decommissioning and removal of infrastructure and services; soil testing of potentially contaminated areas such as coal stockpile areas and hydrocarbon storage areas; and remediation or removal of any contaminated soil if required. Compacted areas will be deep ripped, contouring earthworks will be undertaken to blend disturbed surfaces into surrounding topography; and stockpiled soil applied to promote establishment of improved pasture suited to the future land use of grazing land.

As underground mining progresses, the mined out voids will be progressively sealed, enabling the progressive emplacement of rejects underground, and assisting with groundwater management by allowing water injection as well as natural recharge to occur. When mining is completed in each panel, the panel will be sealed through the installation of water-retaining rated bulkhead seals, in accordance with the requirements of *Work Health and Safety (Mines and Petroleum sites) Regulation 2014*, and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February 2012*.

Spontaneous combustion is not expected to be a risk during operation or at closure.

There risks of subsidence related impacts occurring above the underground mine are negligible, due to the first workings mining method which retains pillars of coal to support the overlying strata. No rehabilitation activities as a result of mine subsidence impacts will therefore be required.

Post-mining, the land and soil capability class for the vast majority of the project area (ie 4,969 hectares (ha)) will remain unchanged due to the underground nature of the project and the first workings mining method, with negligible associated subsidence, to be employed. Of the 117 ha to be disturbed, 59 ha will be rehabilitated back to the original land and soil capability, as the soil profile will not be significantly altered. There will be a change to the land and soil capability class over 58 ha of land disturbed by the surface infrastructure area and water management areas. The original land class of these areas (3 ha of Class 3, 37 ha of Class 4 and 18 ha of Class 5) will change to Class 6 because the soil depth will be 0.3 m as the replaced topsoil will overlie re-profiled fill materials. However, Class 6 land will still be suitable for grazing and improved pasture, allowing the continuation of an agricultural land-use post-mining, as it is now.

Final rehabilitation and project closure requirements will ultimately be developed as part of a detailed closure plan, which will be produced within five years of closure in consideration of input from key government agencies and relevant stakeholders at the time.

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Appendices

Tables

Figures

1 Introduction

1.1 Overview

Hume Coal Pty Limited (Hume Coal) is seeking State significant development consent to construct and operate an underground coal mine and associated mine infrastructure (the 'Hume Coal Project') in the Southern Coalfield of New South Wales (NSW). Hume Coal holds exploration Authorisation 349 (A349) to the west of Moss Vale, in the Wingecarribee local government area (LGA). The underground mine will be developed within part of A349 and associated surface facilities will be developed immediately north of A349. The project area and its regional and local setting are shown in Figure 1.1 and Figure 1.2.

The project has been developed following several years of technical investigations to define the mineable resource and identify and address environmental and other constraints. Low impact mining methods will be used which will have negligible subsidence impacts and thereby protect the overlying aquifer and surface features and allow existing land uses to continue at the surface. Post-mining, the mine infrastructure will be decommissioned and these areas rehabilitated to a state where they can support land uses similar to the current land uses.

Approval for the Hume Coal Project (the project) is being sought under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). An environmental impact statement (EIS) is a requirement of the approval processes. This Mine Closure and Rehabilitation Strategy forms part of the EIS.

1.2 Project description

The project involves developing and operating an underground coal mine and associated infrastructure over a total estimated project life of 23 years. Indicative mine and surface infrastructure plans are provided in Figure 1.3 and Figure 1.4. A full description of the project, as assessed in this report, is provided in Chapter 2 of the main EIS report (EMM 2017a).

In summary it involves:

- Ongoing resource definition activities, along with geotechnical and engineering testing, and other fieldwork to facilitate detailed design.
- Establishment of a temporary construction accommodation village.
- Development and operation of an underground coal mine, comprising of approximately two years of construction and 19 years of mining, followed by a closure and rehabilitation phase of up to two years, leading to a total project life of 23 years. Some coal extraction will commence during the second year of construction and hence there will be some overlap between the construction and operational phases.
- Extraction of approximately 50 million tonnes (Mt) of run-of-mine (ROM) coal from the Wongawilli Seam, at a rate of up to 3.5 million tonnes per annum (Mtpa). Low impact mining methods will be used, which will have negligible subsidence impacts.
- Following processing of ROM coal in the coal preparation plant (CPP), production of up to 3 Mtpa of metallurgical and thermal coal for sale to international and domestic markets.

- Construction and operation of associated mine infrastructure, mostly on cleared land, including:
    - one personnel and materials drift access and one conveyor drift access from the surface to the coal seam;
    - ventilation shafts, comprising one upcast ventilation shaft and fans, and up to two downcast shafts installed over the life of the mine, depending on ventilation requirements as the mine progresses;
    - a surface infrastructure area, including administration, bathhouse, washdown and workshop facilities, fuel and lubrication storage, warehouses, laydown areas, and other facilities. The surface infrastructure area will also comprise the CPP and ROM coal, product coal and emergency reject stockpiles;
    - surface and groundwater management and treatment facilities, including storages, pipelines, pumps and associated infrastructure;
    - overland conveyors;
    - rail load-out facilities;
    - a small explosives magazine;
    - ancillary facilities, including fences, access roads, car parking areas, helipad and communications infrastructure; and
    - environmental management and monitoring equipment.
- Establishment of site access from Mereworth Road, and construction of minor internal roads.
- Coal reject emplacement underground, in the mined-out voids.
- Peak workforces of approximately 414 full-time equivalent employees during construction and approximately 300 full-time equivalent employees during operations.
- Decommissioning of mine infrastructure and rehabilitating the area once mining is complete, so that it can support land uses similar to current land uses.

The project area, shown in Figure 1.2 is approximately 5,051 hectares (ha). Surface disturbance will mainly be restricted to the surface infrastructure areas shown indicatively on Figure 1.4 though will include some other areas above the underground mine, such as drill pads and access tracks. The project area generally comprises direct surface disturbance areas of up to approximately 117 ha, and an underground mining area of approximately 3,472 ha, where negligible subsidence impacts are anticipated.

A construction buffer zone will be provided around the direct disturbance areas. The buffer zone will provide an area for construction vehicle and equipment movements, minor stockpiling and equipment laydown, as well as allowing for minor realignments of surface infrastructure. Ground disturbance will generally be minor and associated with temporary vehicle tracks and sediment controls as well as minor works such as backfilled trenches associated with realignment of existing services. Notwithstanding, environmental features identified in the relevant technical assessments will be marked as avoidance zones so that activities in this area do not have an environmental impact.

Product coal will be transported by rail, primarily to Port Kembla terminal for the international market, and possibly to the domestic market depending on market demand. Rail works and use are the subject of a separate EIS and State significant development application for the Berrima Rail Project.

1.3 Project area and study area

The surface and underground mining infrastructure areas within the project area are addressed as part of this rehabilitation and closure assessment. The impact assessment focuses on the infrastructure areas within the project area as these areas will experience the greatest level of disturbance.

1.4 General site description

The project area is approximately 100 km south-west of Sydney and 4.5 km west of Moss Vale town centre in the Wingecarribee LGA (refer to Figure 1.1 and Figure 1.2). The nearest area of surface disturbance will be associated with the surface infrastructure area, which will be 7.2 km north-west of Moss Vale town centre. It is in the Southern Highlands region of NSW and the Sydney Basin Biogeographic Region.

The project area is in a semi-rural setting, with the wider region characterised by grazing properties, small-scale farm businesses, natural areas, forestry, scattered rural residences, villages and towns, industrial activities such as the Berrima Cement work and Berrima Feed Mill, and some extractive industry and major transport infrastructure such as the Hume Highway.

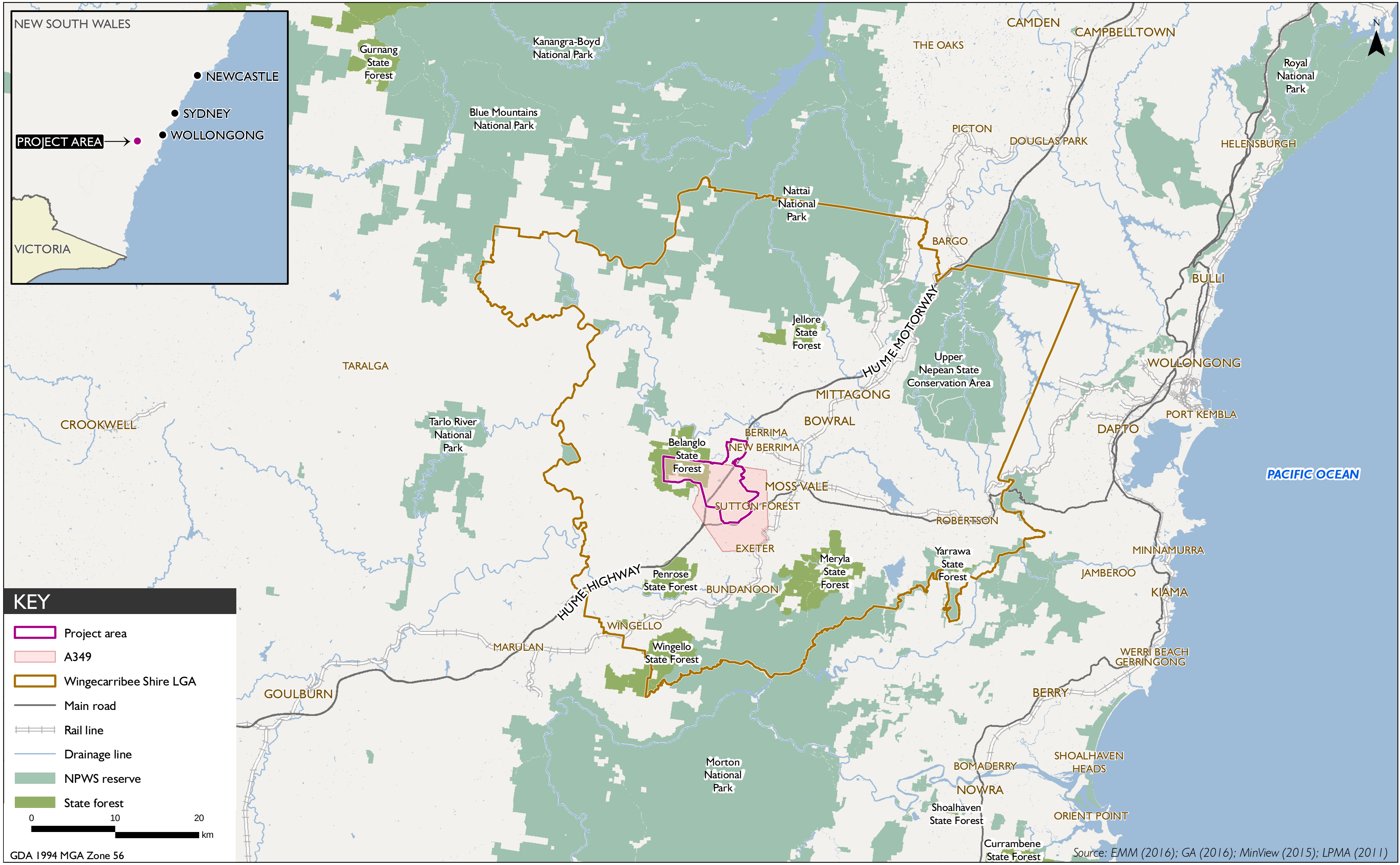
Surface infrastructure is proposed to be developed on predominately cleared land owned by Hume Coal or affiliated entities, or for which there are appropriate access agreements in place with the landowner. Over half of the remainder of the project area (principally land above the underground mining area) comprises cleared land that is, and will continue to be, used for livestock grazing and small-scale farm businesses. Belanglo State Forest covers the north-western portion of the project area and contains introduced pine forest plantations, areas of native vegetation and several creeks that flow through deep sandstone gorges. Native vegetation within the project area is largely restricted to parts of Belanglo State Forest and riparian corridors along some watercourses.

The project area is traversed by several drainage lines including Oldbury Creek, Medway Rivulet, Wells Creek, Wells Creek Tributary, Belanglo Creek and Longacre Creek, all of which ultimately discharge to the Wingecarribee River, at least 5 km downstream of the project area. The Wingecarribee River's catchment forms part of the broader Warragamba Dam and Hawkesbury-Nepean catchments. Medway Dam is also adjacent to the northern portion of the project area.

Most of the central and eastern parts of the project area have very low rolling hills with occasional elevated ridge lines. However, there are steeper slopes and deep gorges in the west in Belanglo State Forest.

Existing built features across the project area include scattered rural residences and farm improvements such as outbuildings, dams, access tracks, fences, yards and gardens, as well as infrastructure and utilities including roads, electricity lines, communications cables and water and gas pipelines. Key roads that traverse the project area are the Hume Highway and Golden Vale Road. The Illawarra Highway borders the south-east section of the project area.

Industrial and manufacturing facilities adjacent to the project area include the Berrima Cement Works and Berrima Feed Mill on the fringe of New Berrima. Berrima Colliery's mining lease (CCL 748) also adjoins the project area's northern boundary. Berrima colliery is currently not operating with production having ceased in 2013 after almost 100 years of operation. The mine is currently undergoing closure.



Source: EMM (2016); GA (2016); MinView (2015); LPMA (2011)

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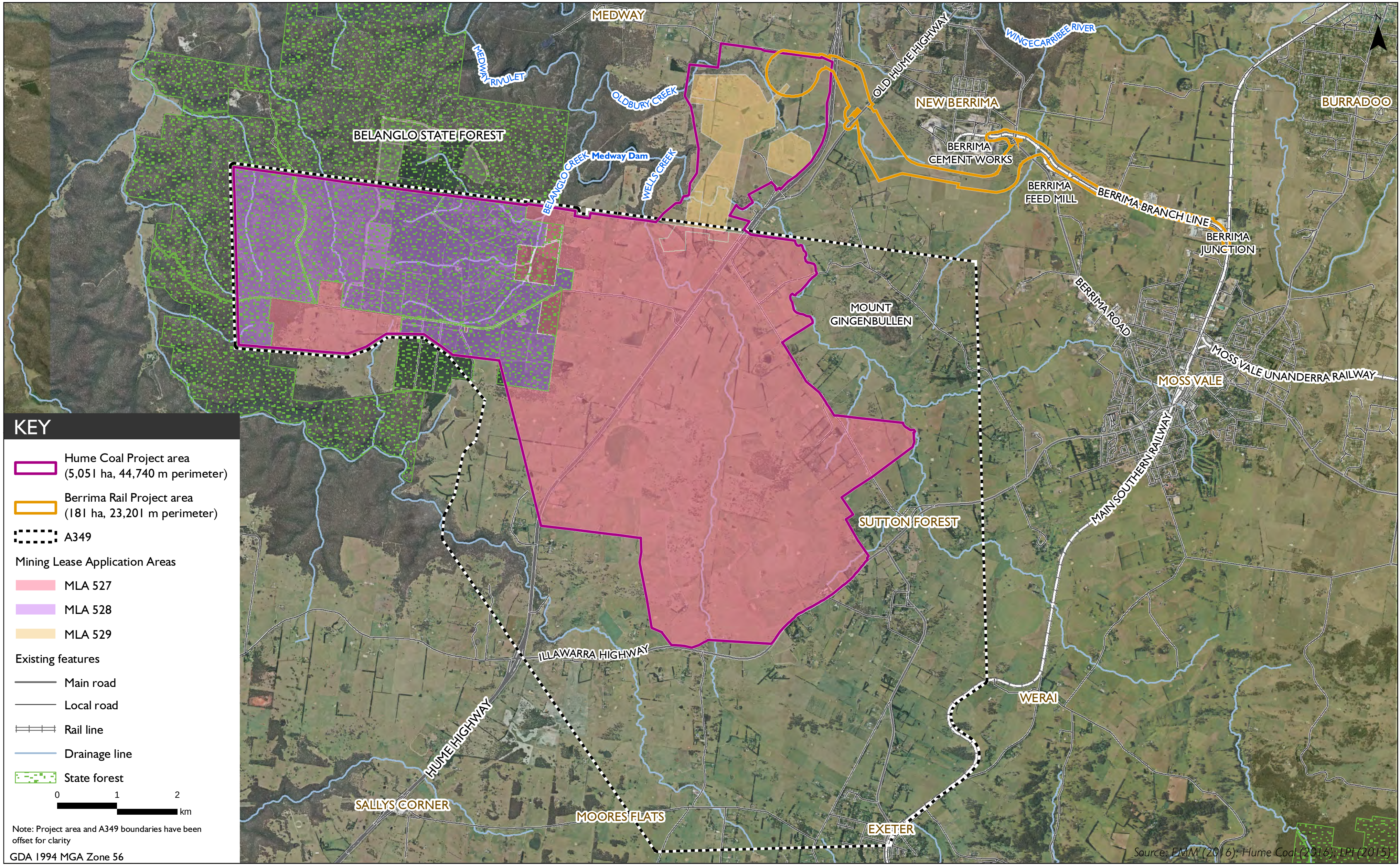
Regional context

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 1.1



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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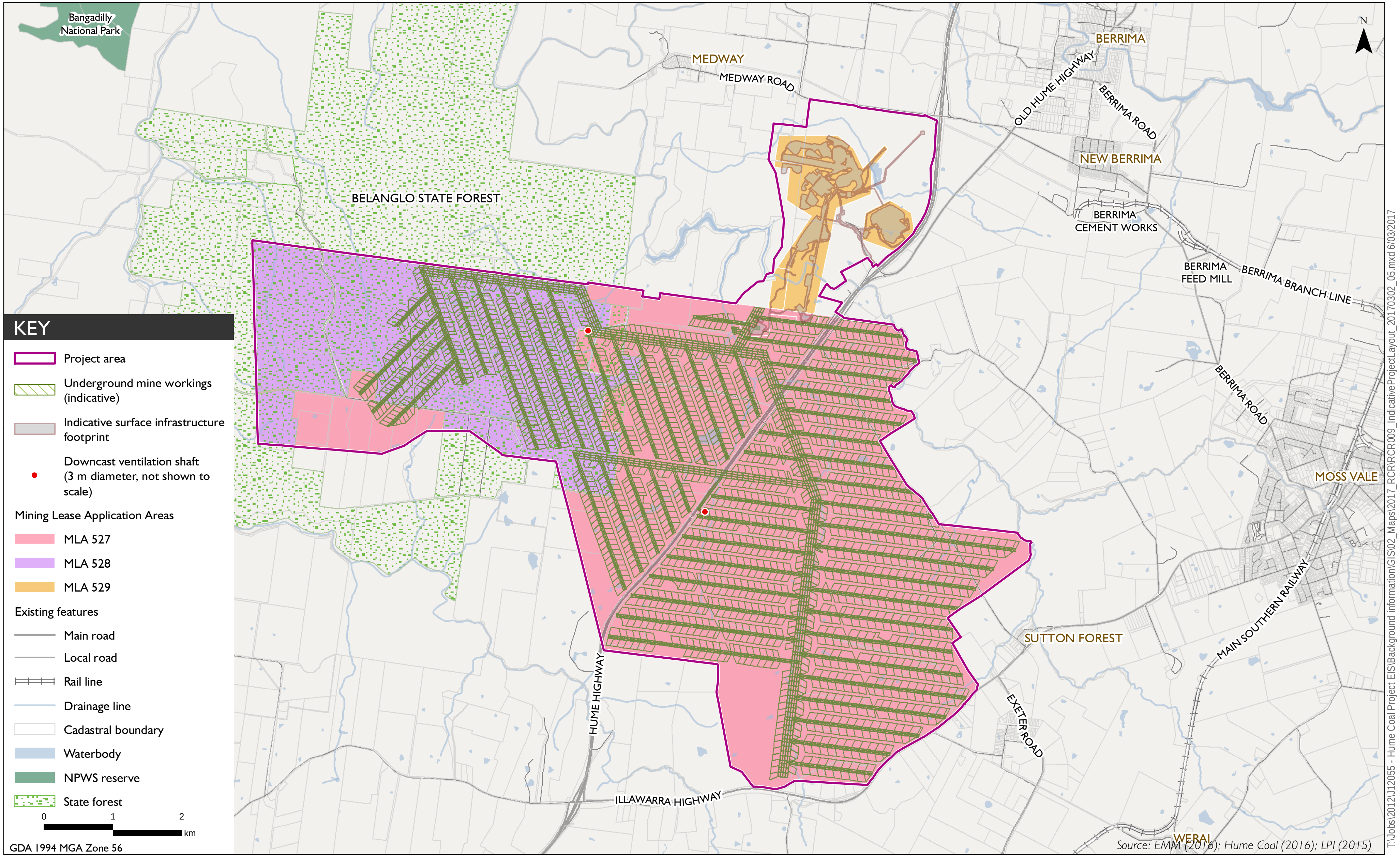
Local context

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 1.2

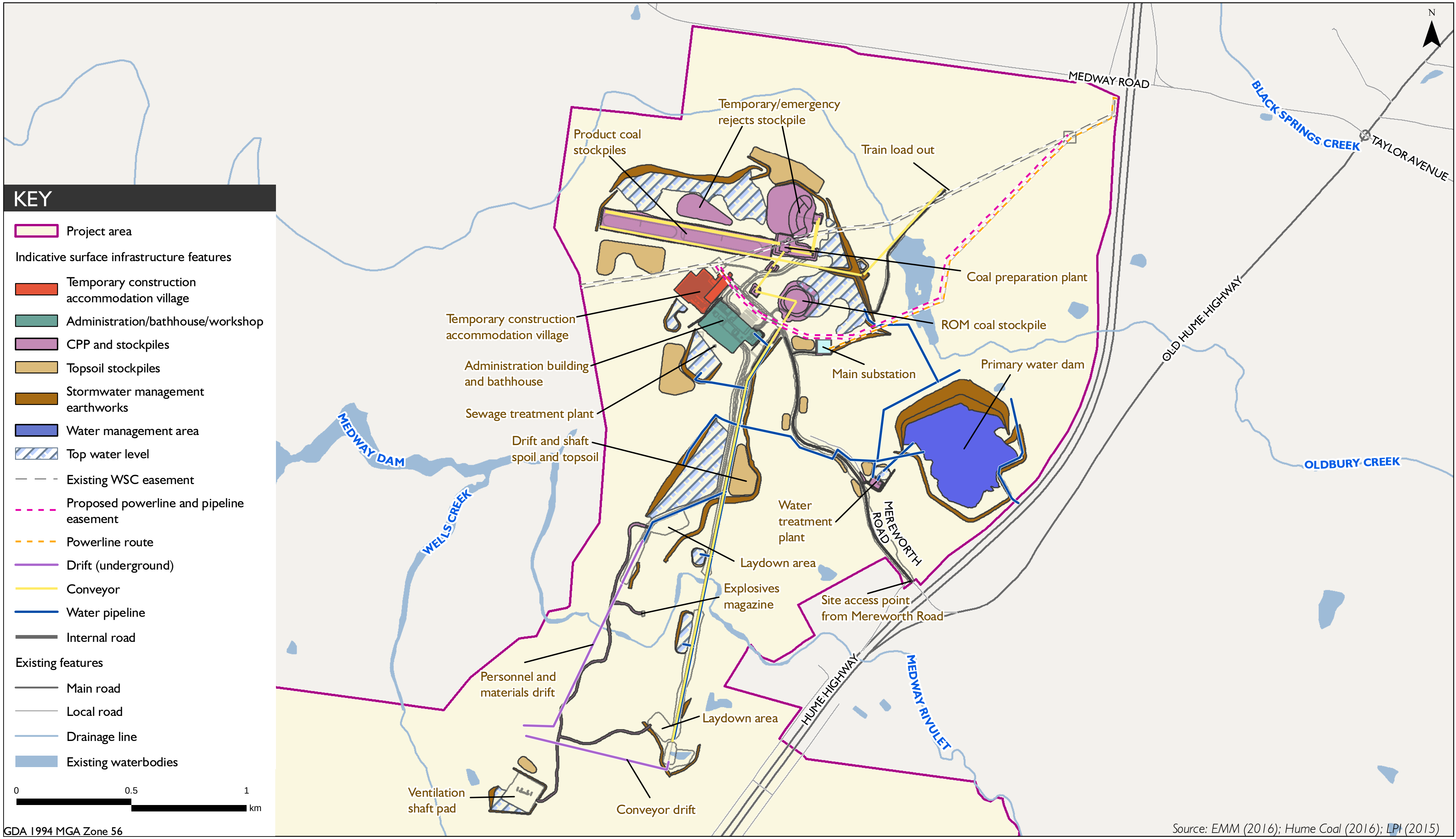


Source: EMM (2016); Hume Coal (2016); LPI (2015)

Indicative project layout

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 1.3



Source: EMM (2016); Hume Coal (2016); LPI (2015)

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Indicative surface infrastructure layout

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 1.4

1.5 Assessment requirements

This assessment has been prepared in accordance with the relevant governmental assessment requirements, guidelines and policies, and in consultation with the relevant government agencies.

This strategy has been prepared in accordance with requirements of the Commonwealth Department of the Environment and Energy (DoEE) and NSW Department of Planning and Environment (DP&E). These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for project, issued on 20 August 2015, and supplementary SEARs issued on 18 January 2016. The SEARs identify matters which must be addressed in the EIS and essentially form its terms of reference. A copy of the SEARs is attached to the EIS as Appendix B, while Table 1.1 lists the individual requirements relevant to this strategy and provides a reference to where they have been addressed.

Table 1.1 Rehabilitation and closure related Secretary's environmental assessment requirements (SEARs)

Requirement	Section addressed
The EIS must include a rehabilitation strategy, having regard to DRE's requirements (see Attachment 2)	See Table 1.2

To inform preparation of the SEARs, DP&E invited other government agencies to recommend matters for address in the EIS. These matters were taken into account by the Secretary for DP&E when preparing the SEARs. Copies of the government agencies' advice to DP&E was attached to the SEARs.

Two agencies, Department of Industry, Resources and Energy (DRE) and the Department of Primary Industries – Water (DPI Water) raised matters relevant to the rehabilitation and closure assessment. The matters raised are listed in Table 1.2 and Table 1.3 and have been taken into account in preparing this strategy, as indicated in the tables.

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation	Section addressed
A statement on the interaction between the proposed mining activities and the existing environment and inclusion of a comprehensive description of the following and their impacts: - mine layout and scheduling, including maximising opportunities for progressive final rehabilitation. The final rehabilitation schedule should be mapped against key production milestones (i.e. ROM tonnes) of the mine layout sequence before being translated to indicative timeframes throughout the mine life. The mine plan should maximise opportunities for progressive rehabilitation; - mineral processing and handling, washery rejects handling and disposal management activities; - infrastructure facilities and storage requirements; and - mine closure including rehabilitation and decommissioning activities.	Section 2 Further details in Ch 2 of EIS

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation		Section addressed
Impacts associated with the operational and post closure stages of the project must also be identified in detail and control management measures outlined. The identification and description of impacts must draw out those aspects of the site that may present barriers or limitations to effective rehabilitation and which may limit the mine closure potential of the land. The following are the key issues to be addressed in the EIS that are likely to have a bearing on rehabilitation and mine closure:		
-	An evaluation of current rehabilitation techniques and performance against meeting existing rehabilitation objectives and completion criteria.	Widely accepted rehabilitation techniques are proposed, as described in Section 17.7. A literature review of successful mine site rehabilitation for a grazing land use was also conducted as part of the AIS (refer to Section 7.6.5 of Appendix G)
-	An assessment and life of mine management strategy of the potential for geochemical constraints to rehabilitation, particularly associated with the management of overburden/interburden and reject material. Based on this assessment, the EIS is to document the processes that will be implemented throughout the mine life to identify and appropriately manage geochemical risks that may affect the ability to achieve sustainable rehabilitation outcomes.	Section 3.2.1 *See Water Assessment Report (Appendix E of the EIS)*
-	A life of mine tailings management strategy which is to detail measures to be implemented to avoid the exposure of potentially environmentally sensitive tailings material as well as promote geotechnical stability of the rehabilitated landform.	Section 2.2.3.iii for management of coal rejects (ie tailings) *See Ch 2.8 of EIS (Coal washing and processing)*
-	Existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design. This should include an evaluation of how the key geomorphological characteristics evident in stable landforms within the natural landscape can be adapted to the materials and other constraints associated with the site.	Section 4.4 and Figure 4.1
-	Groundwater assessment to determine the likelihood and associated impacts of groundwater accumulating and subsequently discharging (eg acid or neutral mine drainage) from the workings post cessation of mining. This is to include a consideration of the likely controls required to prevent or mitigate against these risks as part of the closure plan for the site.	*See Ch 7 EIS, and Appendix E of EIS*
-	An assessment of the biological resources associated with the proposed disturbance area and how they can be practically salvaged for utilisation in rehabilitation (ie topsoil, seedbanks, tree hollows and logs, native seed etc.), including an evaluation of how topsoil/subsoil of suitable quality can be direct-returned for use in rehabilitation.	Section 5.2 – 5.4 (topsoil management) *See Ch 8 EIS, and Soils and Land Assessment Report (Appendix F of EIS)* See Ch 10 EIS, and Biodiversity Report (Appendix H of EIS)
-	The flora, fauna and ecological attributes of the disturbed area should be recorded and placed in a regional context.	See Ch 10 EIS, and Biodiversity Report (Appendix H of EIS)

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation	Section addressed
- An evaluation of current land capability class and associated condition. The EIS should characterise soils across the proposed area of surface disturbance and assess their value and identify opportunities and constraints for use in rehabilitation.	Section 4.6 *See Ch 8 EIS, and Soils and Land Assessment Report (Appendix F of EIS)*
- Where an agricultural land use is proposed, the EIS should: ▪ demonstrate how Agricultural Suitability Class in the rehabilitated landscape would be returned to the existing Class/es or better. ▪ where the intended land use is likely to be grazing, the existing capacity in terms of Dry Sheep Equivalent or similar must be calculated and a timeframe from vegetation establishment be given for the return to agricultural production to at least the existing stock capacity. ▪ provide information on how soil would be developed in order to achieve the proposed stock capacity.	*See Ch 9 EIS, and Agricultural Impact Statement (Appendix of G EIS)*
- Where an ecological land use is proposed, the EIS should demonstrate that the revegetation strategy (eg seed mix, habitat features, corridor width etc.) has been developed in consideration of the target vegetation community(s).	An ecological land use is not proposed – therefore not applicable See Ch 10 EIS, and Biodiversity Report (Appendix H of EIS)
REHABILITATION AND MINE CLOSURE DRE's role focuses on ensuring that land mined in NSW is effectively rehabilitated and returned to beneficial post mining land uses. This is undertaken by requiring mine operators to have strategies in place to ensure the rehabilitation of all mined land, and strategies in place to ensure the rehabilitation of all mined land, and strategies for an orderly transition from a mining land use to an agreed stable and beneficial post mining use. At the EIS stage, the strategies may be conceptual in nature. Each of the following aspects of rehabilitation planning should be addressed in the strategy:	
- Post Mining Land Use – the proponent must identify and assess post-mining land use options and provide a statement of the preferred post-mining land use outcome in the EIS, including a discussion of how the final land use(s) are aligned with relevant local and regional strategic land use objectives as well as the benefits of the post-mining land to the surrounding environment, a subsequent landowner, the local community and the state of NSW.	Section 4
- Rehabilitation Objectives and Domains - a set of project rehabilitation objectives and completion criteria that define the environmental outcomes required to achieve the final land use for each domain. The criteria must be specific, measurable, achievable, realistic and time-bound. - If necessary, objective criteria may be presented as ranges rather than finite indicator levels. Subjective criteria may also apply where a gap in technical knowledge is experienced. Further refinement of these criteria will be undertaken and included in the Rehabilitation Management Plan (RMP).	Section 4 and 6
- Final Landform Design - a drawing at an appropriate scale with final landform contours should be provided which identifies vegetation types, habitat features, contaminated areas, drainage infrastructure, access and internal roads, fencing design and other remaining infrastructure such as sheds, dams, bores and pipelines.	Figure 4.1

Table 1.2 DRE comments: standard and project-specific assessment recommendations

Recommendation	Section addressed
- Scope of Rehabilitation and Decommissioning Activities – The EIS is to include a detailed description of the scope of decommissioning and rehabilitation activities required to meet the nominated closure objectives and completion criteria for each domain. The scope of these activities must be developed in consideration of the existing environment, identification of impacts and constraints as listed above.	Section 4.5
- Monitoring and Research - Outline the proposed monitoring programs that will be implemented to assess how rehabilitation is trending towards the nominated land use objectives and completion criteria. This should include details of the process for triggering intervention and adaptive management measures to address potential adverse results as well as continuously improve rehabilitation practices.	Section 6.3
- In addition, an outline of proposed rehabilitation research programs and trial, including objectives. This should include details of how the outcomes of research are considered as part of the ongoing review and improvement of rehabilitation practices.	
- Post-closure maintenance - Describe how post-rehabilitation areas will be actively managed and maintained in accordance with the intended land ues(s) in order to demonstrate progress towards meeting the closure objectives and completion criteria in a timely manner.	Section 5.7

Table 1.3 DPI - Water comments: standard and project-specific assessment recommendations

Recommendation	Section addressed
Landform rehabilitation (including final void management) Where significant modification to landform is proposed, the EIS must include:	
• Justification of the proposed final landform with regard to its impact on local and regional surface and groundwater systems.	Section 4 *See Ch 7 EIS, and Water Assessment Report (Appendix E of EIS)*
• A detailed description of how the site would be progressively rehabilitated and integrated into the surrounding landscape.	Section 4
• Outline of proposed construction and restoration of topography and surface drainage features if affected by the project.	Section 4.4, 4.5
• The measures to be put in place to ensure that sufficient resources are available to implement the proposed rehabilitation.	Section 5.7.5
• The measures that would be established for the long-term protection of local and regional aquifer systems and for the ongoing management of the site following the cessation of the project.	*See Ch 7 EIS, and Water Assessment Report (Appendix E of EIS)*

1.6 Other legislation, guidelines and leading practice

There is no clear directive provided within NSW legislation describing the engineered controls that underground mines must use during closure and rehabilitation. The following sections describe sections of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*, the *Mining Act 1992* and the *Protection of the Environment Operations Act 1997* (POEO Act) that are relevant to the closure and rehabilitation of the project and how they have been addressed within this strategy.

1.6.1 Legislation and environmental planning instruments

i Work Health and Safety (Mines and Petroleum Sites) Regulation 2014

The *Work Health and Safety (Mines and Petroleum Sites) Act* 2013 and Work *Health and Safety (Mines and Petroleum Sites) Regulation 2014* (WHS (Mines Petroleum Sites) Regulation) regulate the process of permanently sealing surface entries into underground mines. Specifically, closure and rehabilitation is addressed in the WHS (Mines Petroleum Sites) Regulation in Clause 35:

> 35 Closure, suspension or abandonment of mine or petroleum site:
>
> (1) If the operator of a mine or petroleum site closes the mine or petroleum site, the operator must, at the time of the closure, ensure so far as is reasonably practicable that the mine or petroleum site is safe, including by being secure against unauthorised entry by any person.
>
> (2) If mining activities or petroleum activities at a mine or petroleum site are suspended, the operator must ensure so far as is reasonably practicable that the mine or petroleum site is safe, including by being secure against unauthorised entry by any person during the period of suspension.
>
> (3) For the purposes of subclause (1) or (2), a mine is not secure against unauthorised entry by a person unless every shaft or outlet to the mine:
>
> > (a) is permanently sealed or filled, or
> >
> > (b) is provided with a barrier that is properly maintained....”

The relevant provisions of the WHS (Mines Petroleum Sites) Regulation have been considered during the preparation of this strategy. As discussed further in Section 4.5.1 ii, Hume Coal will undertake the following steps prior to closing all surface entries to the underground mine:

- A risk assessment will be undertaken and used to inform the design of the seal; and
- a detailed design and installation procedure will be developed and approved by the relevant Authority, prior to it being applied.

ii Mining Act 1992

Rehabilitation and environmental performance conditions are attached to all mining leases issued under the Mining Act. The Mining Act defines rehabilitation as the “treatment or management of disturbed land or water for the purpose of establishing a safe and stable environment”.

Titleholders are required to develop a Mining Operations Plan (MOP) which includes objectives and criteria for rehabilitation, rehabilitation plans, risks that need to be addressed, rehabilitation controls and methodologies, and monitoring programs. The MOP is not required at this stage of the approval (discussed in greater detail in Section 1.4.2iii), but the requirements of the MOP have been addressed in this Closure and Rehabilitation Strategy. Accordingly, rehabilitation of the project area will be carried out generally in accordance with this strategy.

iii Protection of the Environment Operations Act 1997

The POEO Act establishes the State’s environmental regulatory framework and includes licensing requirements for certain activities. The objectives of the POEO Act that relate to decommissioning and rehabilitation include *...to protect, restore and enhance the environment, to reduce risks to human health and prevent degradation of the environment*.

The POEO Act objectives have been used in the preparation of this strategy, and are principally reflected in one of the overarching goals of the strategy; to minimise the risk of offsite pollution occurring from the site during and following closure, decommissioning and rehabilitation.

iv Wingecarribee Local Environmental Plan 2010

The *Wingecarribee Local Environmental Plan 2010* has outlined objectives for each land use zone in the shire. The disturbance footprint of the project, is within land zoned E3 – Environmental Management. The objectives for this zone are:

- To protect, manage and restore areas with special ecological, scientific, cultural or aesthetic values.
- To provide for a limited range of development that does not have an adverse effect on those values.
- To encourage the retention of the remaining evidence of significant historic and social values expressed in existing landscape and land use patterns.
- To minimise the proliferation of buildings and other structures in these sensitive landscape areas.
- To provide for a restricted range of development and land use activities that provide for rural settlement, sustainable agriculture, other types of economic and employment development, recreation and community amenity in identified drinking water catchment areas.
- To protect significant agricultural resources (soil, water and vegetation) in recognition of their value to Wingecarribee’s longer term economic sustainability.

The objectives for the zone have been considered when identifying final land use options. Returning the land back to the pre-mining agricultural land use is consistent with the second and fifth objective of retaining a restricted range of development that provides for sustainable agriculture. Removal of all infrastructure at decommissioning is consistent with the fourth objective of minimising the proliferation of buildings.

1.6.2 Guidelines

This strategy has been prepared generally in accordance with the appropriate guidelines, policies and industry requirements, where appropriate. Guidelines and policies referenced are as follows:

- *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (NSW Department of Industry, Skills and Regional Development - Division of Resources and Energy, March 2016);
- *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012* (NSW Department of Trade and Investment – Division of Mine Safety, 2012);
- *ESG3 – Mining Operations Plan (MOP) Guidelines , September 2013* (NSW Department of Trade and Investment – Division of Resources and Energy, 2013);
- The *Strategic Framework for Mine Closure* (ANZMEC and MCA, 2000);
- *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth of Australia, 2006); and
- *Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry* (Commonwealth of Australia, 2006).

The relevance of each of the guidelines is discussed briefly in the following sections.

i Borehole Sealing Requirements on Land

The guideline *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells* (the drilling guideline) provides an overview of the process for rehabilitation of boreholes not licensed under the *Water Management Act 2000*.

In the event that any boreholes remain open at completion of the operational phase, Hume Coal will appropriately rehabilitate any remaining boreholes, having regard to the borehole sealing requirements in the drilling guideline.

ii Permanent Filling and Capping of Surface Entries Guidelines

The *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams* (the guideline) (NSW Department of Trade and Investment – Division of Mine Safety, 2012) provides an overview of the process for design and approval of permanent caps and seals for surface entries into underground mines. The guideline *"is designed to be used to describe the minimum requirements to safely perform the task of sealing entries to the point where they can be considered permanently sealed."*

This strategy sets out the proposed approach to permanently cap and/or seal drifts and ventilation shafts.

iii Mining Operations Plan Guidelines

The *ESG3 – Mining Operations Plan (MOP) Guidelines, September 2013* (the MOP guidelines) (NSW Department of Trade and Investment – Division of Resources and Energy 2013) provide an overview of the approval process for mining developments in NSW and provides content and formatting requirements for MOPs and Annual Reviews. The purpose of these documents is to *"ensure that all mining operations are safe, the resources are efficiently extracted, the environment is protected and rehabilitation achieves a stable and satisfactory outcome."* Specifically, the MOP must meet the content and format as set out in the MOP guidelines as well as:

- be consistent with any development consent requirements;
- be consistent with safety management plans;
- be based on objectives and outcomes developed with stakeholder involvement;
- provide sufficient detail, supported by scientific and engineering assessment and/or peer review where appropriate, to clearly demonstrate that the objectives and outcomes defined in the MOP will be met; and
- where necessary, contain an environmental assessment of any impacts associated with the implementation of the MOP, where the activities have not been previously assessed under the EP&A Act.

This strategy has been prepared to address the various requirements of the closure and rehabilitation aspects of the MOP guidelines. A MOP will be prepared and submitted to the DRE for approval following the grant of development consent for the project. An approved MOP must be in place prior to commencing any significant disturbance activities.

As noted in the MOP guidelines, a MOP is designed to fulfil the function of both a rehabilitation plan and a mine closure plan. It will document the long-term mine closure principles and outcomes whilst outlining the proposed rehabilitation activities (if any) during the MOP term (typically five years).

A MOP also forms the basis for the estimation of the security deposit imposed to ensure compliance with conditions of authorisation granted under the Mining Act. An estimate of rehabilitation cost has been prepared, and will be updated and presented in the MOP, prior to commencing operations.

iv Strategic Framework for Mine Closure

The *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia, 2000) (SFMC) was developed to promote nationally consistent mine closure management. The SFMC provides guidelines for the development of a mine closure plan to make sure that all stages of mine closure are conducted appropriately, including stakeholder engagement, development of mine closure methodology, financial planning, and implementation of mine closure. The SFMC also describes the expected standards for mine closure and relinquishment of the mine to a responsible authority. Whilst the objectives generally relate to mine closure, there are key elements that are relevant to rehabilitation of the project, in particular the allocation of appropriate resources and the establishment of rehabilitation criteria which have been included in this strategy. The main objectives of the SFMC are:

> "To enable all stakeholders to have their interests considered during the mine closure process;
>
> To ensure the process of closure occurs in an orderly, cost-effective and timely manner;
>
> To ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability;
>
> To ensure there is clear accountability, and adequate resources, for the implementation of the closure plan;
>
> To establish a set of indicators which will demonstrate the successful completion of the closure process; and
>
> To reach a point where the company has met agreed rehabilitation criteria to the satisfaction of the Responsible Authority."

v Mine Rehabilitation - Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Rehabilitation – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MR Handbook) is to provide guidelines to promote 'leading practice' sustainable mine plan and rehabilitation design, considering environmental, economic, and social aspects to support on-going sustainability of a mining development. The MR Handbook recommends procedures and mitigation measures that should be considered during mine plan and rehabilitation design, including stakeholder consultation, material and handling, water balance, final landform design, soil (topsoil and subsoil) management, vegetation and fauna habitat re-establishment and rehabilitation, and agriculture / commercial forestry suitability. The MR Handbook also provides relevant mine development case studies supporting the recommended procedures and mitigation measures. Where relevant to the project, the above principals have been addressed in this strategy.

vi Mine Closure and Completion - Leading Practice Sustainable Development Program for the Mining Industry

The aim of *Mine Closure and Completion – Leading Practice Sustainable Development Program for the Mining Industry* (NSW Department of Industry, Tourism and Resources, 2006) (MCC Handbook) is to provide guidelines to promote 'leading practice' sustainable mine closure and completion, minimising any long-term environmental, economic, and social impacts and resulting in a suitable final land form for an agreed land use. Specifically, the MCC Handbook provides that a progressive rehabilitation plan, which is a key principle of this strategy, should be developed for mine closure.

1.7 Adoption of leading practices

Hume Coal is committed to adopting leading practices in the planning, construction, operation, closure and rehabilitation of the project. This includes leading practice measures to avoid, minimise and/or mitigate potential environmental and social impacts. In particular, in relation to rehabilitation the leading practices adopted are:

- All coal reject material will be returned underground to partially backfill the mined-out void, rather than keeping it at the surface in a large above ground emplacement or trucking it off-site for emplacement elsewhere. This minimises the surface disturbance footprint, thereby reducing the land to be rehabilitated at closure.

- To eliminate and/or minimise impacts on surface features and water resources, Hume Coal will use an innovative non-caving coal extraction method, leaving coal pillars in place throughout the mine that are designed to provide indefinite long-term support to the overlying rock. Given this mining system is first workings only, there will be no associated subsidence impacts, and therefore the structure of the overlying groundwater system will remain intact and surface features will be protected.

1.8 Purpose and scope of this strategy

The purpose of this report is to prepare a strategy that addresses applicable regulatory requirements, standards and guidelines for the closure and rehabilitation of the project.

This strategy has been prepared recognising that, once conditions of consent are available for the project to proceed, a complete MOP will then be prepared and submitted to the DRE for approval. The MOP will be generally consistent with the commitments relating to rehabilitation and closure outlined in this strategy.

The objectives of this strategy are:

- to describe the proposed post-mining land use;

- identify potential risks and impacts which will impact on rehabilitation and closure success;

- to describe the methods for establishing stable post-mining landforms; and

- to set rehabilitation criteria and outlining the monitoring requirements that assess whether or not these criteria are being accomplished.

The rehabilitation concepts presented in this strategy should be regarded as provisional to allow for consideration of the outcomes from future rehabilitation trials and research, and other unforeseeable changes that may come about, for example via the mine closure consultation phase. Final rehabilitation and project closure requirements will ultimately be formulated in consultation with key government agencies and other relevant stakeholders.

1.9 Strategy structure

This strategy has been structured as follows:

- proposed activities (Section 2);
- rehabilitation and closure risks, and appropriate mitigation methods (Section 3);
- post-mining land use, rehabilitation goals, and rehabilitation objectives (Section 4);
- rehabilitation methods (Section 5); and
- performance indicators and completion/relinquishment criteria (refer Section 6).

2 Proposed activities

2.1 Project schedule

The project will be undertaken in three phases over approximately 23 years, as follows:

- Construction and commissioning phase – building of surface infrastructure, development of underground access and associated infrastructure (approximately 2 years);

- operational phase – coal extraction from the underground mine and associated coal product processing (approximately 19 years); and

- decommissioning and rehabilitation phase - closure and rehabilitation activities of nominally two years.

2.2 Primary domains

Primary domains (as defined in the MOP guidelines) are based on land management units within the project area, usually with a unique operational and functional purpose during operation and therefore have similar characteristics for managing environmental issues. The primary domains form the basis of conceptual rehabilitation and project closure planning for this strategy. The primary domains that have been identified for the project are:

- infrastructure area;

- water management area;

- stockpiled material; and

- underground mining area.

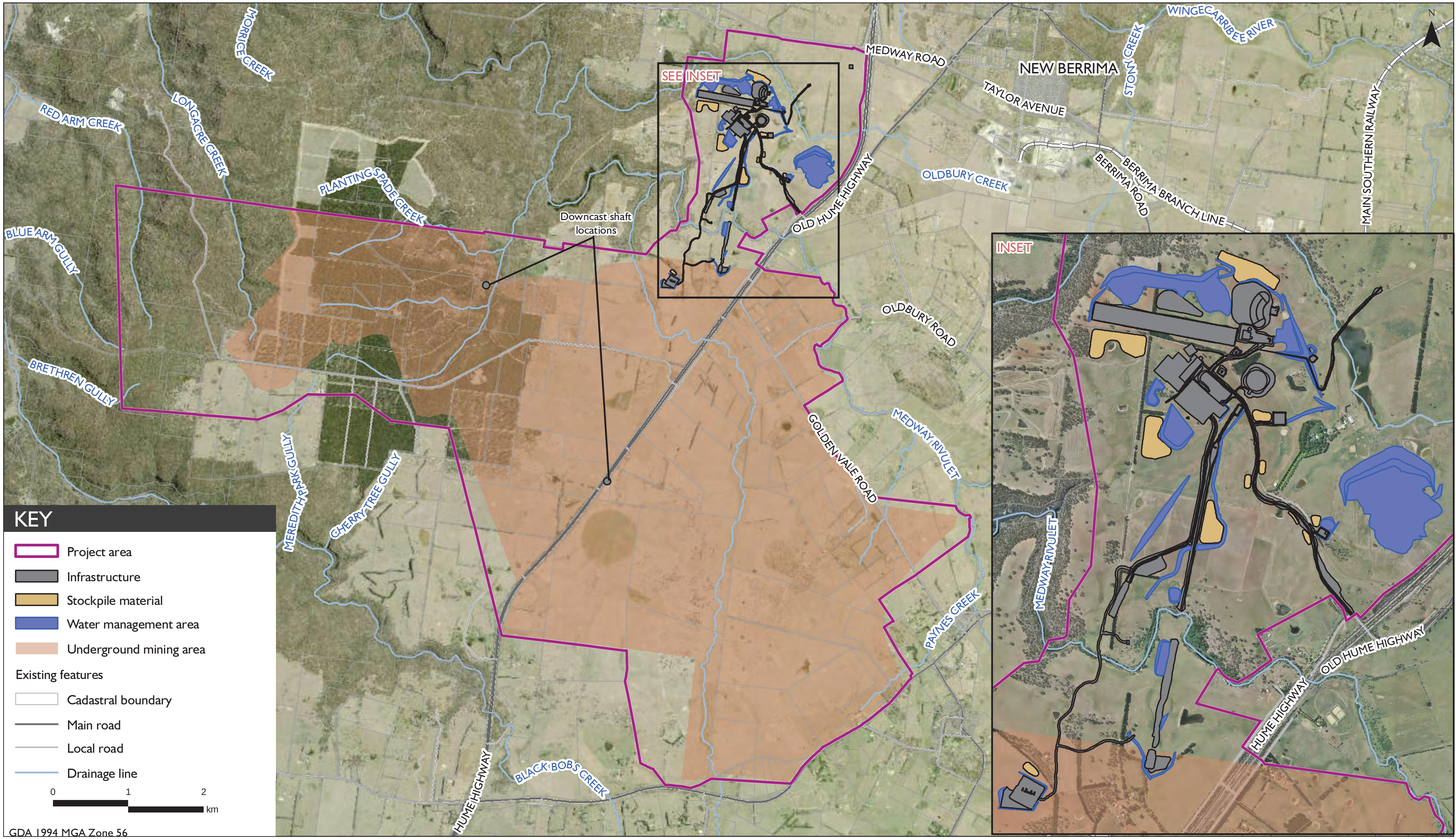
The extent of disturbance per primary domain is presented in Table 2.1 and the location is shown in Figure 2.1.

A description of the activities to be carried out in each primary domain is presented in the following sections. The decommissioning of each project element is described in Section 4.

Table 2.1 Surface Infrastructure disturbance by primary domain

Primary domain	Project element	Area (ha)
Infrastructure area	• Mining infrastructure o drifts o upcast ventilation shaft o downcast ventilation shafts o service supply holes (power, water, gravel supply) • Coal handling infrastructure o ROM overland conveyor system o product overland conveyor system o coal preparation plant o coal loading facility • General infrastructure o access roads o offices, bathhouse, carpark, workshop o temporary accommodation o temporary construction facilities o utilities (power line, water pipeline)	64
Water management area	• Primary water dam; • Stormwater basins • Sediment control dams	44
Stockpiled material	• ROM stockpile • product stockpiles • temporary coal reject stockpile • Drift spoil stockpile • topsoil stockpiles	9
Underground mining area (SMP[1])	• Minor access tracks to exploration sites and environmental monitoring equipment etc.	3,423

Notes: *1. SMP – Subsidence Management Plan as per coding for primary (operational) domains in the MOP guidelines.*



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Primary domains

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 2.1

2.2.1 Infrastructure area

i Mine surface infrastructure

a. Drift portals

The primary access to the underground mine will be via two drifts aligned west-northwest to east-southeast in the northern part of the project area. Underground mine access includes one drift for personnel and materials, and one conveyor drift.

b. Upcast ventilation shafts

Ventilation of the underground mine will be provided by exhaust fans. A main upcast ventilation shaft and associated fans will be installed close to the bottom of the drifts. The main ventilation shaft will be around 110 m deep and nominally 5.5 m in diameter.

c. Downcast ventilation shafts

Up to two additional downcast shafts will be installed later in the mine life if needed, pending ventilation requirements at the time. The two downcast shafts will be nominally 90 m and 140 m deep and nominally 3m in diameter. The design of the shafts may incorporate above-ground structures designed to prevent unauthorised access. The construction and access pad at the site of the downcast fans will be nominally 50 m by 50 m in size.

d. Infrastructure area

The mine surface infrastructure will be located north of the drift portals and includes the administration buildings, bathhouse, staff car park, warehouse, and laydown areas, vehicle washdown, fuel depot and lubricant storage facilities. For safety, the explosives magazine will be over 1,100 m from the fuel and other hydrocarbon storage areas of the mine infrastructure area.

ii Coal handling infrastructure

a. ROM overland conveyor system

The ROM coal will be transported from the underground mining faces along the panel conveyors and onto a trunk conveyor which will transfer the coal up the drift. Coal that has been transported up the drift will then be transferred via a covered overland conveyor system that runs from the drift portal to a ROM stockpile adjacent to the coal preparation plant (CPP).

b. CPP

The ROM coal will be taken from the ROM stockpile and processed through the CPP. The product handling area will consist of a series of conveyors and two stackers transferring coking and thermal product coal from the CPP onto the product coal stockpiles. Each product coal stream will be transferred onto a slewing and luffing stacker and stockpiled. Coal from the stockpile will be reclaimed by a portal reclaimer prior to train loadout (TLO).

c. Product coal overland conveyor system

The product coal will be transferred from the coal stockpiles at the CPP to the TLO via an overland conveyor system. Product coal is will be transported by rail to port for shipment to international markets and/or transported by rail to domestic markets.

iii General infrastructure

a. Access roads

A sealed main access road will be built from the Mereworth Road to the MIA and CPP. Other smaller roads will also be built or re-shaped.

b. Accommodation facility

The accommodation facility will be temporary for the duration of construction. The facility will contain around 400 rooms, a kitchen and dining area, laundries, gym, recreation room, first aid room, and car park. It will also have a water treatment, storage and pumping station and a sewerage treatment plant.

c. Temporary construction facilities

Temporary construction facilities will be located adjacent to the MIA and the CPP.

d. Powerline and pipeline easement

The existing Wingecarribee Shire Council (WSC) easement, containing a water supply pipeline, traverses the proposed surface infrastructure area; therefore it is to be re-aligned. The new easement will contain the re-aligned water pipeline, and the Hume Coal electricity transmission line.

2.2.2 Water management

The water management system will reuse as much mine water as possible, with it being used first to meet all demands except for potable water. If demand cannot be fully met from rainfall-runoff and the mine sump in the underground workings, supplies will be supplemented by groundwater from the sealed voids.

The overarching water management philosophy involves:

- one primary water dam (PWD) with a minimal catchment area that is used for storage and reuse of water for mine operations;

- water runoff from undisturbed catchments being diverted around the mine surface infrastructure and into natural drainage lines via diversion drains;

- water runoff from the disturbed area within the mine surface infrastructure footprint being directed to one of four stormwater basins (SB01-SB04) or four mine water dams (MWD05-MWD08) and then pumped to the PWD for use in mine operations; and

- clean water runoff into SB03 and SB04 (it has not come into contact with coal) being discharged to a local creek if rainfall meets the adopted first flush and water quality criteria. If rainfall does not exceed the adopted first flush criteria it will be transferred to the primary water dam.

2.2.3 Stockpiled material

i Drift spoil stockpile

Spoil excavated during the installation of the drift portals and shaft will be stockpiled on the surface, near to the drift portals. The stockpile will contain approximately 27,000 m^3 of drift spoil. Some of the drift spoil may be used throughout the project for building infrastructure such as roads and dam walls as required, with the remainder to be stored in the drift spoil stockpile. Upon decommissioning it will be used to fill the drifts and shafts.

ii ROM and product stockpiles

The ROM stockpile will have a capacity of around 60,000 tonnes (t). There will be two product stockpiles, one for thermal coal and one for coking coal. Product coal will be stockpiled prior to transport via overland conveyor to the rail load out bin.

iii Temporary coal reject stockpile

During the initial 12-18 months, as the project is developed, the coal reject will be stored in a temporary coal reject stockpile adjacent to the CPP until sufficient void space is available underground, and the plant is commissioned to commence underground emplacement. During this initial period, the fines will be dewatered via belt press filters prior to being combined with the course reject for “co-disposal” on the temporary coal reject stockpile. At the end of the operational phase of the project the reject on the temporary coal reject stockpile will be put back through the reject plant and pumped underground prior to sealing the surface entries to the underground mine.

iv Soil stockpiles

Soil stockpiles will be created as soil is conserved during the construction phase. The soil will be used in the decommissioning phase for rehabilitation.

2.2.4 Underground mining area

i Above ground level

The area of land overlying the underground mining area is approximately 3,500 ha. No surface disturbance will occur over this area in the commissioning or operating phases. Any infrastructure that is within this area (ie downcast fans) is addressed in the infrastructure domain. Therefore, no surface rehabilitation will be required at decommissioning with the exception of a limited number of exploration boreholes and their access tracks. This area is not predicted to be subject to subsidence (see Section 3.4).

ii Below ground level

The project strategy is to develop a mining system which effectively eliminates subsidence and hence eliminates the impact of the project on surface and subsurface water flows. It accomplishes this by using a high productivity non-caving, first workings system with a layout that utilises elements from traditional underground development layouts and long narrow plunges similar to those used in highwall mining. These panels are called plunge panels. Remaining coal pillars are designed to provide long-term stability resulting in negligible surface subsidence impacts and preservation of the hydraulic properties of the overlying groundwater systems.

a. Panel sealing

The mine design compartmentalises the underground operations into individual panels utilising the plunge panel system. This will allow progressive sealing of completed panels (compartments) and assist with groundwater management. The length of the plunge panels have been limited to minimise the time the panels are open to the ingress of ground water and hence minimise the time for the panels to re-charge from natural ground water.

When mining is completed in a panel, the panel will be sealed to allow water injection as well as natural recharge to occur. Bulkhead seals will be installed in every panel of the underground mine. Seals will be designed generally in accordance to relevant industry standards, including the UK Health and Safety Executive guideline “The design and construction of water impounding plugs in working mines”.

b. Underground reject emplacement

To minimise the environmental impact of coal reject, it is proposed to return the coal reject underground to panels which will subsequently be sealed off. The coal reject will be mixed with water to a consistency which can be pumped underground in a continuous process using commercially appropriate pumping equipment.

The total volume of coal reject slurry over the life of the project represents only around 30% of the void created, depending on assumed moisture content of the mix.

Individual panels have been designed so that they are down apparent dip where possible to minimise the risk of reject material moving towards the main headings once it is emplaced. The nature of the mine design as a series of long, narrow blind headings also minimises the risk of any bulk movement of material.

2.3 Decommissioning and Rehabilitation

Decommissioning of the project will involve the following activities:

- decommissioning of the infrastructure area;
- decommissioning of services and infrastructure;
- removal of infrastructure, materials and rubbish;
- soil testing of potentially contaminated areas (ie coal stockpile areas, hydrocarbon storage areas);
- remediation or removal of any coal or AMD contaminated soil to the underground mine;
- remediation or removal of any soil contaminated with hydrocarbon or industrial chemicals at a licensed facility or on-site bioremediation; and
- soil and groundwater testing to validate benign material is present before rehabilitation programs commence.

Rehabilitation of the project will involve the following activities:

- contouring earthworks, deep ripping compacted areas, and blend disturbed surfaces into surrounding topography; and
- application of the stockpiled soil to promote establishment of improved pasture suited to agreed future land use.

Table 2.2 summarise the key aspects related to the decommissioning and closure of the primary domains. It assumes that all buildings and other infrastructure are demolished and removed despite the potential for them being used after mining (subject to the landholder's requirements and consultation with relevant stakeholders such as government agencies closer to the time of closure). It is considered likely that at least some aspects of the existing infrastructure will be used post-mining (eg roads). These options will be considered in greater detail during stakeholder engagement and development of the detailed closure plan.

Table 2.2 Decommissioning strategy by primary domain

Primary domain	Decommissioning strategy
Infrastructure area	• all surface infrastructure removed; • drifts and ventilation shafts partially backfilled and sealed to prevent access. Drift portals will be removed to below ground level; and • rehabilitated land is contoured to match the surrounding landforms.
Water management area	• water in storages to be tested to determine if water quality criteria are met, and if not, then put through treatment plant to remove any potential contamination before being returned to underground or released from the project area; • water management structures removed and area re-shaped to match surrounding topography; and • re-shaped area is ripped, soiled and seeded.
Stockpiled material	• all stockpiled coal or drift spoil materials removed and buried in underground workings; • no hazardous material or sources of contamination left within the project area; and • disturbed land is re-shaped to match the surrounding landforms, and area is ripped, soiled and seeded.
Underground mining area (SMP)	• Exploration tracks and drill holes rehabilitated.

3 Environmental and socio-economic risk management

3.1 Overview

Identifying environmental, social and economic (socio-economic) risks associated with rehabilitation and closure is essential for effective closure planning. A preliminary risk assessment has been conducted to identify and assess risks associated with closure and rehabilitation of the project. The risk assessment has had regard for *AS/NZS ISO 31000:2009 Risk Management - Principles and Guidelines. S*pecific objectives of the assessment were to identify:

- risks from closure and associated rehabilitation activities;
- risks which have the potential to adversely affect the environment;
- community and other stakeholder risks, eg economic, health and safety, etc; and
- controls required to mitigate the identified risks.

A number of potential risks were identified by the risk assessment process, which are presented in Appendix A, and discussed in the sub-sections below. Management practices have been identified and presented in this strategy to manage any residual risks after rehabilitation.

3.2 Environmental risk

3.2.1 Geochemistry

The management of the coal product stockpiles and the temporary coal rejects stockpiles will need to manage the potential for AMD during operation due to the presence of normal levels of sulphur in the coal. At closure after all coal has been sold, any residual coal materials and coal reject stored on the surface will be removed and emplaced in the underground mine.

The specific management of coal and coal reject materials is further detailed in Section 3.2.4iib below. Additional detail can be found in the report *Hydrogeochemistry assessment* (Geosyntec 2016) which is appended to the Water Assessment Report of the Hume Coal Project EIS (EMM 2017c).

i Geochemistry risk management

Coal and coal reject will be located at a number of locations within the project area during operation and at closure including:

- coal in the coal product stockpiles and coal remaining insitu in the underground mine in the barrier pillars etc; and
- coal rejects in temporary reject stockpiles and then permanently stored in the underground mine.

Drifts will be constructed to access the underground mine. Spoil from the drifts will be temporarily stockpiled nearby the drifts during operation.

The following sections describe how the potential for AMD is mitigated at the project for coal stockpiles, coal reject stockpiles and drift spoil.

a. Coal stockpiles

During operations the coal stockpiles will have been subject to standard water management and monitoring practices which should have identified if any AMD is present in water. If elevated levels are found, then alkaline materials (eg agricultural limestone) will be added to the water management infrastructure as required as required.

During construction, 300mm of soil and subsoil will be stripped from the stockpile pad areas and set aside for rehabilitation. At closure, the ground under the stockpiles will be selectively assessed for potential contamination issues against background criteria for:

- pH, electrical conductivity (EC), total dissolved solids (TDS), acidity and alkalinity;
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (such as aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the contaminated area will be appropriately remediated so that it is made suitable for the agreed future land use prior to reinstating the topsoil and subsoil that was set aside during construction.

b. Coal reject stockpiles

The majority of the coal reject will have been returned to the underground workings during operations. However, the temporary coal reject stockpiles emplaced on the surface at the start of mine life will be recovered and relocated to the underground parts of the mine during operations or during decommissioning.

To provide for the safe and efficient emplacement of coal reject underground during operations, a coal reject management plan will be developed and implemented.

During operations temporary coal reject stockpiles will be subject to standard water management and monitoring practices which will have identified if any AMD is present in runoff. If required alkaline materials (eg agricultural limestone) will be added to temporary coal reject stockpiles to maintain pH levels in the neutral pH range and to avoid any potential environmental impacts from AMD in surface runoff and/or seepage.

As per the coal stockpiles, after the coal rejects from the temporary stockpile have been removed the ground under the stockpiles will be selectively assessed against background criteria for:

- pH, EC, TDS, acidity and alkalinity;
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium); and
- analysis of soluble metals (aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the project element will be appropriately remediated so that it is suitable for the agreed future land use prior to the replacement of stockpiled topsoil and subsoil.

c. Underground workings

During pumping of the coal reject to the underground mine workings, up to 1% limestone may be added to create excess alkalinity in backfilled coal reject. This will reduce any residual risk of impacting groundwater quality to as low as reasonably possible.

Following sealing of each panel, any remaining void will become anoxic and/or fill with water, removing the risk of oxidation of any reactive sulphide content of the coal or reject materials.

d. Drift spoil

There will be a drift spoil stockpile at the time of closure; although some drift spoil may have been used as fill material during the construction phase. This material will be used in the rehabilitation and closure phase for sealing and backfilling the drifts and ventilation shafts.

Samples that represented the proposed drift spoil materials were tested (RGS Environmental 2016) and determined that they have excess acid buffering capacity and a high factor of safety with respect to producing AMD. The excess buffering capacity is several times greater than the maximum potential acidity and has low reactive sulfide content. Therefore, the drift spoil is considered to be non-acid forming and is not expected to generate AMD; that is, surface runoff and seepage from drift spoil is likely to be pH neutral.

Static and kinetic leach tests of the proposed drift spoil indicate that trace metals and major ions are sparingly soluble in surface runoff and seepage. Dissolved concentrations of metals in surface water and seepage are therefore expected to be low and unlikely to present any significant environmental risks in the project area or for the receiving environment. Dilution effects from rainfall and natural attenuation are also likely to occur and further reduce the concentrations of soluble metals in surface runoff and seepage.

The concentrations of metals/metalloids in drift spoil samples will be low and within relevant background criteria for soils (RGS Environmental 2016), and therefore unlikely to present any environmental issues associated with revegetation and rehabilitation. Drift spoil is likely to have a low level of sodicity and therefore have a relatively low risk of being susceptible to significant dispersion and erosion (RGS Environmental 2016). Further, salinity will be low due to low levels of dissolved solids.

Based on the benign nature of the drift spoil, no special management measures are required for their handling and storage.

3.2.2 Spontaneous combustion

Spontaneous combustion is not expected to be a risk during operation or at closure. Studies have shown that there is a low risk of spontaneous combustion occurring in the targeted Wongawilli seam (Beamish 2012). Annual reporting for other mines in the area which target the same target seam, such as Dendrobium Mine and Illawarra Metallurgical Coal, also confirms no recorded spontaneous combustion events. Historically the Wongawilli seam is not known as being prone to spontaneous combustion as identified in the following coal mines in the region; Kemira, Nebo, Wongawilli, Avon, Huntley, Avondale, Yellow Rock, Meryla, Southern and Erith mines.

3.2.3 Subsidence

There is a negligible risk of subsidence-related impacts occurring above the underground mine, due to the proposed mining method which retains pillars of coal to support the overlying strata. Mine Advice (2016) has assessed the predicted maximum subsidence associated with the proposed mine method and layout and predicts that it is “imperceptible” or “negligible”. No rehabilitation activities as a result of mine subsidence impacts are expected to be required.

3.2.4 Soil

Accurate estimates of the available depths of soil, and of the required volume of soil, are needed for effective rehabilitation. The recommended stripping depths of 0.15m topsoil and 0.15m subsoil are based on results from the soil survey (EMM 2017b), which assessed soil depths found across the project area.

To successfully rehabilitate surface disturbance within the project area soil will be replaced at a general depth of approximately 0.3 m over disturbed surfaces. The area of direct disturbance is 117 ha. Therefore, around 351,000 m^3 of soil will need to be stripped. The actual volumes of soil available will only become definitely known when detailed stripping plans are being prepared. If any topsoil shortages emerge, due to factors like unanticipated shallowness or waterlogging, additional subsoil will be stripped in an adjacent area.

i Soil risk management

The following sections describe how Hume Coal will manage the potential risks of soil loss in the project area either from inefficient handling or from erosion.

a. Soil losses

To mitigate the risks of insufficient soil being available, soil requirements will be accurately determined before construction works commence. An inventory of stripped and stockpiled soil will be prepared, and any additional soil requirements identified. Hume Coal will preferentially strip topsoil however subsoil will be stripped and used for rehabilitation if a short fall in the available inventory is identified. These requirements are further addressed in the proposed rehabilitation management strategy (Section 4).

b. Erosion and sediment control

Erosion results in loss of soil from the landscape and a subsequent deterioration in the productive capacity of the land and in the capacity of the land to perform ecosystem functions. The potential for soils to erode determines the applicability of management measures and whether the soils are appropriate for use in rehabilitation activities. Erosion of soil may take place after the soil has been spread on rehabilitated areas. The design of the re-shaped landforms will need to take into account soil erosion and sediment control to prevent impacts to waterways, as well as impacts to the rehabilitation itself.

The rehabilitated land contours will be designed to minimise receiving environment impacts from erosion and sediment runoff. The re-shaped land will be spread with soil and seeded to quickly establish a vegetation cover which will minimise erosion and runoff. Wherever possible the rehabilitated land will be close to the original landform characteristics, which were generally gentle slopes and rolling hills. An erosion and sediment control plan will be implemented during operations and will be maintained during rehabilitation.

3.2.5 Noise and dust

Air quality and noise management plans will be implemented during operations and will be updated to include the rehabilitation phase of the project prior to rehabilitation activities commencing. These management plans will be designed to achieve compliance with licence limits during decommissioning and rehabilitation activities.

3.2.6 Weeds

The presence of weed species has the potential to have an impact on revegetation outcomes. Additionally, weed species within the surrounding land has the potential to impact on the success of rehabilitated areas. Weed management will therefore be a critical component of rehabilitation activities.

Weeds will be managed through a series of control measures, including:

- if machinery to be used for rehabilitation is brought to the site from another project, and if there is a risk of weed seeds having been transported on the machinery, it will be hosed down in an approved wash down area before entry to the project area;
- herbicide spraying or scalping weeds from soil stockpiles prior to re-spreading;
- rehabilitation inspections to identify potential weed infestations; and
- identifying and spraying existing weed populations together with ongoing weed spraying over the life of the project.

Weed control programs will be implemented according to industry best management practice for the weed species present, if required.

3.2.7 Hydrocarbons, chemicals and wastes

Despite designs that prevent or contain spills, there is a low residual risk that land within the surface infrastructure area could be contaminated during de-commissioning (eg from hydrocarbon spills, storage of fuel and chemicals, refuelling activities, sewage, etc).

To manage any potential contamination sources, waste management practices in accordance with the site Environmental Management System will continue to be implemented during rehabilitation. For example:

- hydrocarbons at the project will be stored in bunded areas designed in accordance with the relevant Australian Standards;
- waste products that are removed from the project will be appropriately disposed of at licensed facilities; and
- sewage generated post-decommissioning will be minimal (ie after the on-site sewerage treatment facility is removed). Any such waste (eg portable toilets) will be transported off site for appropriate disposal at a licensed facility by a licensed waste contractor.

There is a low risk that hydrocarbon spills may also occur during soil spreading associated with rehabilitation (eg a burst hydraulic hose), but the impact would be isolated and spill-clean-up procedures would mitigate any potential impacts.

3.2.8 Bushfire

To prevent or manage bushfire risks, the site bushfire management plan will continue to be implemented. A hot work permit system will be used during rehabilitation works which will take into account the risk factors for bush fires.

3.3 Socio-economic impacts

Community consultation has been, and will continue to be, key to project planning and understanding the project's potential impacts on the local community. Relevant stakeholders will be engaged in the closure planning and implementation process, including in the development of a detailed closure plan as the project progresses towards completion. The closure plan will address socio-economic impacts at closure.

4 Post-mining land use and rehabilitation objectives

4.1 Land use options following closure

Land uses on properties surrounding the project area primarily comprise agricultural, native vegetation and/or conservation. Other land uses on land near the project area include the Berrima Cement Works, Berrima Colliery (which is closing), Berrima Feedmill, residential development at New Berrima and Medway, water infrastructure (Medway Dam and water filtration plant), forestry, and transport infrastructure (Hume Highway and Illawarra Highway). Considerations for final land uses have taken into account the current land uses in and surrounding the project area, infrastructure to be developed by the project, and the proximity of the project to existing agricultural industry, residences and general local infrastructure. The surrounding land use on the properties will continue to be farming, during the construction and operational phases of the project.

Final land uses considered include:

1. **Industrial development:** Given the proposed status as a mining operation, some form of industrial development could be developed; however, the infrastructure area is currently used for agricultural purposes and it is considered best practice to return the land to a similar land use and capability to that pre-mining. The demand for industrial land would also have to be considered in light of the availability of other land in the region already zoned for industrial purposes. This industrial development use has thus been removed from further consideration.

2. **Conservation:** Regionally, with the exception of the Belanglo State Forest, much of the land is cleared for agricultural purposes. The area to be disturbed (around 117 ha for surface infrastructure) is a relatively small area, and developing a conservation area isolated from the Belanglo State Forest is likely to be of little conservation value. Further, an objective of the rehabilitation strategy is to return the land to a similar land use and capability to that which existed pre-mining. This conservation use has thus been removed from further consideration.

3. **Tourism:** On the closure of the mine, it is unlikely to be of any interest to tourists travelling in the general region and the availability of other examples of mining in the region preclude this tourism option from further consideration.

Based on the above assessment, it is considered that establishment of conditions that have grazing value (on improved pastures) is the preferred land use option.

As noted above, a detailed closure plan will be developed within five years of closure, which will confirm the most appropriate land use option in consideration of input from all relevant stakeholders at the time.

4.2 Rehabilitation goals

The overriding goal for this strategy is to return disturbed land to a condition that is stable, and supports the proposed post-mining land use which is grazing with improved pasture. The surface disturbance area is within existing farmland, and it is proposed that the rehabilitated land will be incorporated back into the operating farm. Specifically, the rehabilitation goals are:

- restoration of a safe and stable landform;

- reinstate soil profile and function and create landforms that are compatible with surrounding topography; and

- the re-shaped landform permits land uses of grazing with improved pasture.

4.3 Rehabilitation objectives

Rehabilitation objectives have been further defined. Each primary domain requires specific management objectives to achieve the final land use outcome due to distinct features associated with the operational land use.

- All infrastructure that is not to be used as part of the future intended land use, is removed so that the site is safe, free from hazardous materials, and will not pose a threat of environmental harm.

- There is no residual contamination of soil or water on site that is incompatible with the intended land use or that poses a threat of environmental harm.

- Underground workings are sealed and present no safety risks for humans and animals now and in the long-term.

- The rehabilitated land is suitable for the planned land use and is compatible with the surrounding landscape.

- The rehabilitated land is stable, and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna.

- Returned soil on the rehabilitated land is able to support the planned land use.

- Vegetation establishment is adequate and able to support the desired land use. The rehabilitated land is sustainable for the long term and only requires maintenance that is consistent with the final land use.

- Runoff water quality is similar to, or better than, the pre-disturbance runoff water quality.

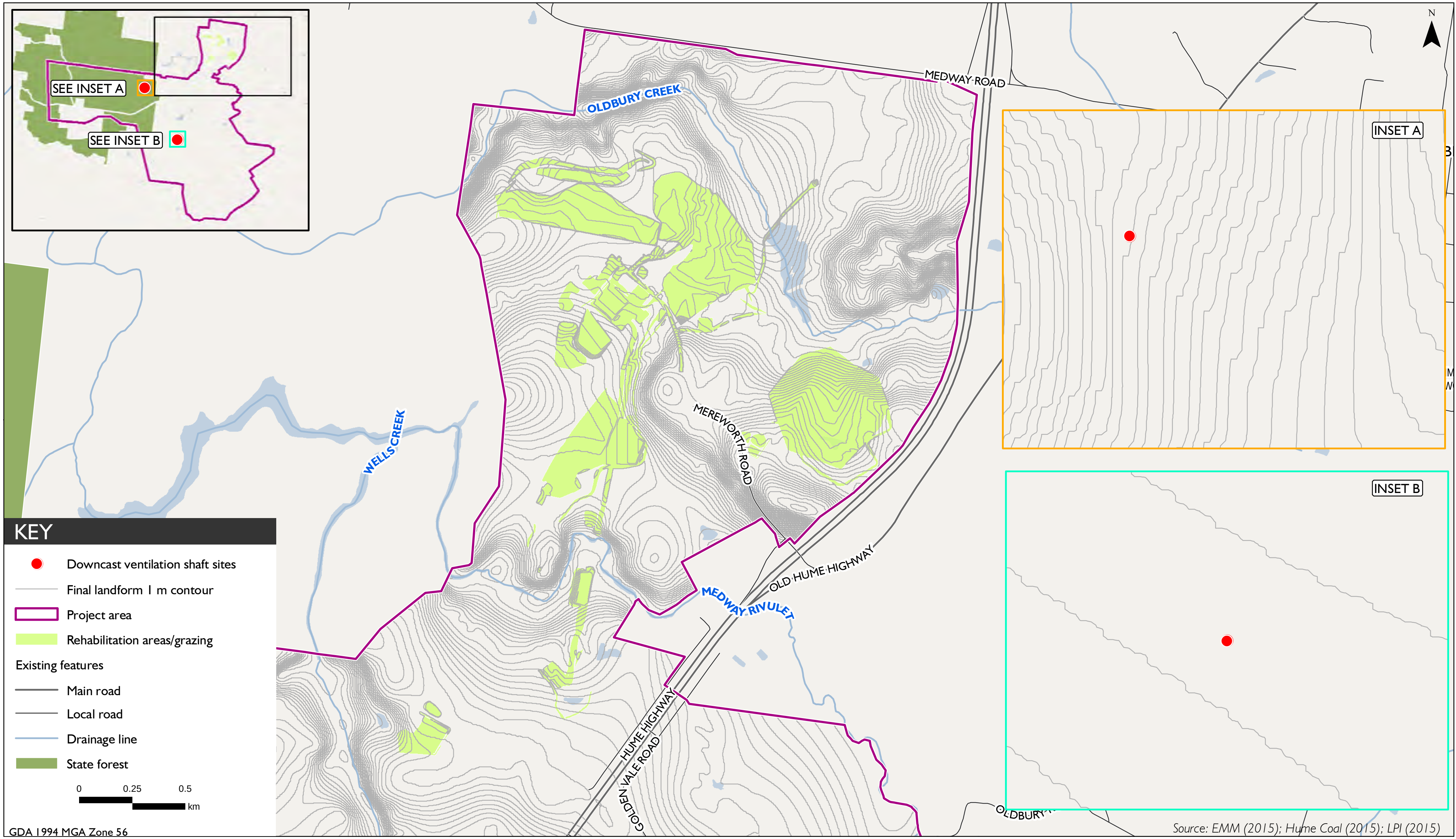
- Ground level and surface stability is not impacted by the presence of the underground workings.

4.4 Conceptual post-mining landform design

Areas disturbed for the construction of the infrastructure area and other ground disturbances including soil stockpiles footprints and access roads will generally be the subject of superficial disturbance. Consequently, the objective for these primary domains will be to reinstate the pre-mining contours and drainage. Figure 4.1 shows the conceptual rehabilitated landform.

The water management structures and drainage diversion bunds and embankments will be re-shaped so that they do not permanently hold water, and wherever possible the topography of the land will be re-instated.

The other most significant variation in the post-mining landform compared to pre-mining conditions will be the areas that have been cut and filled to create flat areas (ie coal stockpiles). However, as addressed below, these landforms will be re-shaped to be compatible with the surrounding landscape.



Source: EMM (2015); Hume Coal (2015); LPI (2015)

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Conceptual final landform

Hume Coal Project
Closure and Rehabilitation Strategy

Figure 4.1

4.5 Primary domain rehabilitation intent

The following sub-sections describe the rehabilitation concepts relevant to each primary domain. The concepts presented may be refined in the MOP and subsequently over the life of the project in consultation with relevant government agencies and key stakeholders. The MOP will provide a more detailed description of the proposed measures for each primary domain provided below.

4.5.1 Infrastructure area

i General

The following description of the rehabilitated landform and rehabilitation concepts apply to the project elements as follows:

- surface infrastructure area including buildings, access roads, accommodation facility, powerline and pipeline easement;
- coal handling infrastructure; and
- ROM overland conveyor system.

Following decommissioning, dismantling and/or demolishing of infrastructure (including the removal of all concrete footings and services to 1 m below ground level), the disturbed areas will be cleared of any remaining coal. After any remaining coal is removed, the ground surface will be selectively assessed against background criteria for:

- pH, EC, TDS, acidity and alkalinity;
- major anions (sulfate, chloride) and major cations (calcium, magnesium, sodium and potassium; and
- analysis of soluble metals (aluminium, arsenic, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, molybdenum, nickel, selenium and zinc).

If any contamination is found then the area will be appropriately remediated so that it is suitable for the agreed future land use.

Once disturbed areas are deemed to be free of construction materials and/or contaminants, they will be deep ripped (where required) to ameliorate the effects of compaction as a result of operational activities. The area will then be sp read with approximately 0.1-0.3 m of soil and treated with ameliorants, if necessary. Revegetation will be primarily by direct seeding of improved pasture species.

General overland flow management for each disturbed area will require a coordinated response in terms of final landforms and flow direction. A rehabilitation objective is to maintain overland flow to minimise disturbance. This will be achieved by:

- re-shaping the area as required to return it to its pre-mining topography, where practicable;
- deep ripping any compacted surfaces to minimise the effects of compaction and maximise infiltration following rainfall; and
- installing diversion banks/channels (where necessary) to safely convey overland flow.

ii Drifts

The following strategy has been developed with consideration of relevant parts of the WHS (Mines and petroleum sites) Regulation and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012*. A final strategy will be developed prior to closure of the project in consultation with all relevant stakeholders.

At closure the following activities will be undertaken to backfill and seal the drifts:

- Any structures or plant and equipment within the drift containing oils or greases will be removed or drained.
- Pipes and conveyor structure will be removed from the part of the drift to be filled with material, if it is safe to do so.
- A substantial bulk head that has been designed and certified by a suitably qualified engineer will be constructed in a location that is deeper than at least 30m of cover, and located within the part of the drift that is excavated in rock, with a septum of solid rock above the drift of at least 15 m.
- The remainder of the drift, including the cut and cover section will be filled with material either excavated from the drift originally, or otherwise determined to be geochemically benign and suitable as fill.
- The concrete floor and arch sections will be removed to a depth of at least 1m below final ground level.
- The remaining fill material will be placed and compacted and covered with top soil at least 300mm deep.

The potential for environmental harm will be limited as follows:

- the geochemistry of the drift spoil has been assessed and it is NAF and therefore there will not be an on-going potential for AMD;
- there is a very low likelihood of gas building up due to the fact the coal seam has very low measured gas contents. Nonetheless, if gas is assessed to be a potential risk prior to sealing the underground mine, the bulkhead will be designed accordingly; and
- the drift spoil will be placed and shaped in a way that limits the potential for rainfall infiltration and the accumulation of water in the backfilled drifts.

After sealing and backfilling the top sections of the drifts, landforms will be re-shaped to a similar angle to pre-mining. Once the area has been re-shaped, soil will be applied approximately 0.3 m thick, and will be seeded with improved pasture species.

The location of the drifts may be durably marked with a plaque or similar device, subject to the outcomes of a risk assessment as part of preparation of the detailed closure plan within five years of closure.

iii Ventilation shafts

The following strategy has been developed with due regard for the WHS (Mines and petroleum sites) Regulation and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012*. A detailed strategy will be developed prior to closure of the project in consultation with all relevant stakeholders.

The ventilation shafts will require rehabilitation at closure to limit the potential for access. At closure infrastructure associated with the ventilation shafts and their services such as electricity lines will be removed. In the case of buried services they will be excavated to a depth of 1 m below ground level where they will be cut and the excavation backfilled.

A retaining structure (such as a seal or solid plug) will be designed and constructed in the connecting roadways at the base of each ventilation shaft to prevent backfill from flowing into any unfilled voids. Once the retaining structures have been built the ventilation shafts will be filled with drift spoil or other suitable borrow material.

At the ground surface a suitably designed and engineer certified concrete plug will be used to permanently seal the top of the ventilation shafts. The concrete plug will be keyed into the ventilation shaft collar, which will be designed and constructed so that it is founded on hard rock, and is of appropriate geometry to allow the final plug to be permanently keyed in place by the use of pockets, wedge shape or other mechanical system.

Where practicable the shaft collars/plugs will remain uncovered, and the location of the shafts durably marked with a plaque or similar device displaying sealing details.

4.5.2 Water management

i Panel sealing for groundwater management

The underground mine will be compartmentalised to allow progressive sealing of completed panels and assist with groundwater management.

When mining is completed in a panel, the panel will be sealed with bulkheads to allow groundwater recharge to begin to occur.

ii Surface water management structures

Water management structures (primary water dam, stormwater dams, sediment dams) and associated infrastructure (pipes, pumps, discharge points, sediment control dams and diversion drains) will be rehabilitated once no longer required. Decommissioning and rehabilitation will include:

- any remaining water in storages will be tested to determine if water quality criteria are met, and if not, then treated to remove any contaminants before discharging, or pumped into the underground voids;

- pushing down the dam walls and re-shaping the area generally consistent with the surface of the surrounding land as practicable;

- deep ripping the compacted base of the dams to facilitate infiltration and minimise the potential effects of compaction; and

- spreading soil and seeding.

4.5.3 Stockpiled material

No stockpiled material (drift spoil, soil, coal or coal reject) will remain on the ground surface after rehabilitation is completed. The following sections described how these stockpile areas will be rehabilitated.

i Drift and shaft spoil stockpile

Stockpiled drift and shaft spoil will be returned to the underground mine during closure of the project to seal the drifts and ventilation shafts. Once the spoil is removed the ground surface will be deep ripped to remove compaction. Stockpiled soil will be returned and the area will be seeded with improved pasture species.

The drift spoil has been assessed and has been found to be NAF with sparingly soluble constituents (RGS Environmental 2016). To make sure that no contamination remains, the land under the stockpiles will be selectively assessed for potential contaminants.

If any contamination is found then the area will be appropriately remediated so that it is suitable for the agreed future land use. Once the area is deemed to be free of contaminants, it will be rehabilitated as described above.

ii ROM and coal product stockpile

At decommissioning any residual coal will be removed from the ROM coal pad and coal product stockpile, and if there is no commercial value it will be returned to the underground workings. The risk of AMD is considered very low from these stockpiles (RGS Environmental 2016). The area will be selectively tested for potential contaminants.

Once the area is free of contaminants, it will be deep ripped to remove compaction, soil will be applied 0.1-0.3 m thick, and the area will be seeded with improved pasture species.

iii Coal reject stockpiles

The temporary coal reject stockpile will be removed during rehabilitation of the project. The addition of an alkaline material (eg agricultural limestone) will be added to control/neutralise any acidity that could potentially be generated from these materials if required.

Rehabilitation will be as per the coal stockpiles.

iv Soil stockpiles

Soil stockpiles will be used for rehabilitating the rest of the site. After stockpiled soil removal, the compacted subsoil will be ripped (if needed) and topsoil replaced (if needed) and seeded.

4.5.4 Underground mining area

The underground mine will remain predominately as voids after rehabilitation with the exception of about 30% which will be backfilled with coal rejects. Groundwater will be managed progressively through the mine life by the installation of bulkheads and upon closure, entry to the underground mine will be managed by sealing and partial backfilling the drifts and shafts, as described in Section 4.4.1.

As there will be negligible subsidence, no rehabilitation will need to be carried out to manage subsidence impacts.

Piezometer sites will be rehabilitated once they are no longer required for groundwater monitoring.

If drill pads from exploration remain at the time of closure then they will be rehabilitated with regard for *Guideline for mineral exploration drilling; drilling and integrity of petroleum exploration and production wells*.

4.6 Post-mining land and soil capability

An assessment of the LSC classes for the project was conducted (EMM 2017).

Soil depth will be shallower in the rehabilitated post-mining land because not all soil is suitable for use in rehabilitation. Therefore there will be less soil available resulting in shallower soil depths by comparion to the pre-mining land. Table 4.1 is taken from the LSC assessment scheme guideline, and shows how the depth of soil is translated into a LSC.

Table 4.1 Shallow soils and rockiness LSC class assessment table[1] (OEH 2012)

Rocky outcrop (% coverage)	Soil depth (m)	LSC class
<30 (localised)	>1	2
	0.75 -<1	3
	0.5 - <0.75	4
	0.25 - <0.5	6
	0 - <0.25	7

Notes: 1.only relevant portion of table shown.

2. depths presented in m – modified from original.

Table 4.2 describes the type of disturbance and rehabilitation required for each of the surface infrastructure types. The table also describes the reason for the change in land class.

It should be noted that in Table 4.2 that fill will be sourced mostly from the excavation of the initial drift workings and will therefore be a mixture of soil and rock.

From the *Australian Soil Classification* and SALIS there are three factors that may come into effect regarding the definition of soil depth in the LSC assessment scheme guideline:

- depth to a hardpan in the mining landscape (ie land which has been compacted by heavy machinery, noting that the impact of compaction can be overcome by deep ripping);
- depth to rock (ie vegetation cannot grow in rock because of low plant available water capacity and inherent fertility); and
- most importantly the presence of a C horizon (ie the layer of soil above bedrock, which is defined as weathered rock or a mixture of weathered rock and newly developed soil in the *Australian Soil Classification*).

In the rehabilitated land, areas that are likely to be underlain by rocky fill are equivalent to having a C horizon of weathered rock, so only the returned topsoil is counted as the overall soil depth.

Some surface infrastructure may be underlain by subsoil however, the depth of soil may also be constrained by chemical inhibition such as high salinity. Salt is highly water soluble and mobile and there is some potential that it may become concentrated overtime creating a chemical inhibition layer. The assessment shown in Table 4.2 conservatively assumes that salt has been built up under infrastructure. If it is found after rehabilitation that subsoil is not constrained by chemical inhibition then the overall soil depth may increase from the conservative assumptions given in Table 4.2 resulting in a higher capability LSC class.

Table 4.2 Reasons for LSC changes in the post mining land

Surface infrastructure	**Disturbance and rehabilitation type**	**Justification for post-mining LSC**
Drift portals, ventilation shafts	Portal and shafts excavated into rock deep underground – rehabilitation involves replacing fill materials and overlaying with 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m (fill material is not equivalent to natural soil profile).
Dam walls	Dam walls constructed with fill material – rehabilitation involves re-profiling of fill material to match surrounding contours and overlaying 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m (fill material is not equivalent to natural soil profile).
Excavated sediment dams	Dams constructed by excavating material – rehabilitation involves filling with excavated material or fill removed from dam walls or roadways, and overlaying 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m (fill material is not equivalent to natural soil profile).
Waterbody areas	Dam areas of natural contours which held water for extended periods of time – rehabilitation involves return of topsoil.	LSC class 6, based on the assumption that the subsoil which has been saturated for extended periods has effectively become a Hydrosol soil.
Soil stockpiles	Topsoil stockpiles placed on natural land contours, only topsoil disturbed – rehabilitation involves spreading of topsoil over underlying subsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.
Temporary accommodation and construction facilities	Buildings placed on natural land contours, only topsoil disturbed – rehabilitation involves spreading of topsoil over underlying subsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.

Table 4.2 Reasons for LSC changes in the post mining land

Surface infrastructure	Disturbance and rehabilitation type	Justification for post-mining LSC
Overland conveyor system	Conveyor footings placed on natural land contours, only topsoil disturbed – rehabilitation involves spreading of topsoil over underlying subsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.
Minor tracks and roads (no cut and fill)	Roads or tracks built on existing land surface, topsoil removed, road base materials placed over the top. Rehabilitation involves the removal of road base and return of topsoil.	LSC class the same as the pre-mining LSC, as the soil profile depth is now the same, and all other factors are still the same.
Constructed roadways and infrastructure areas	Roads and infrastructure areas created by cut and fill of existing land surface. Rehabilitation involves re-profiling the fill material to match surrounding contours and overlaying 0.3m topsoil.	LSC class 6, based on replaced soil depth of 0.3m.
Underground mine area	No surface disturbance, negligible subsidence – no rehabilitation.	No change to LSC class.

Class 6 land will still be suitable for grazing and improved pasture. The LSC guideline says in relation to Class 6 land:

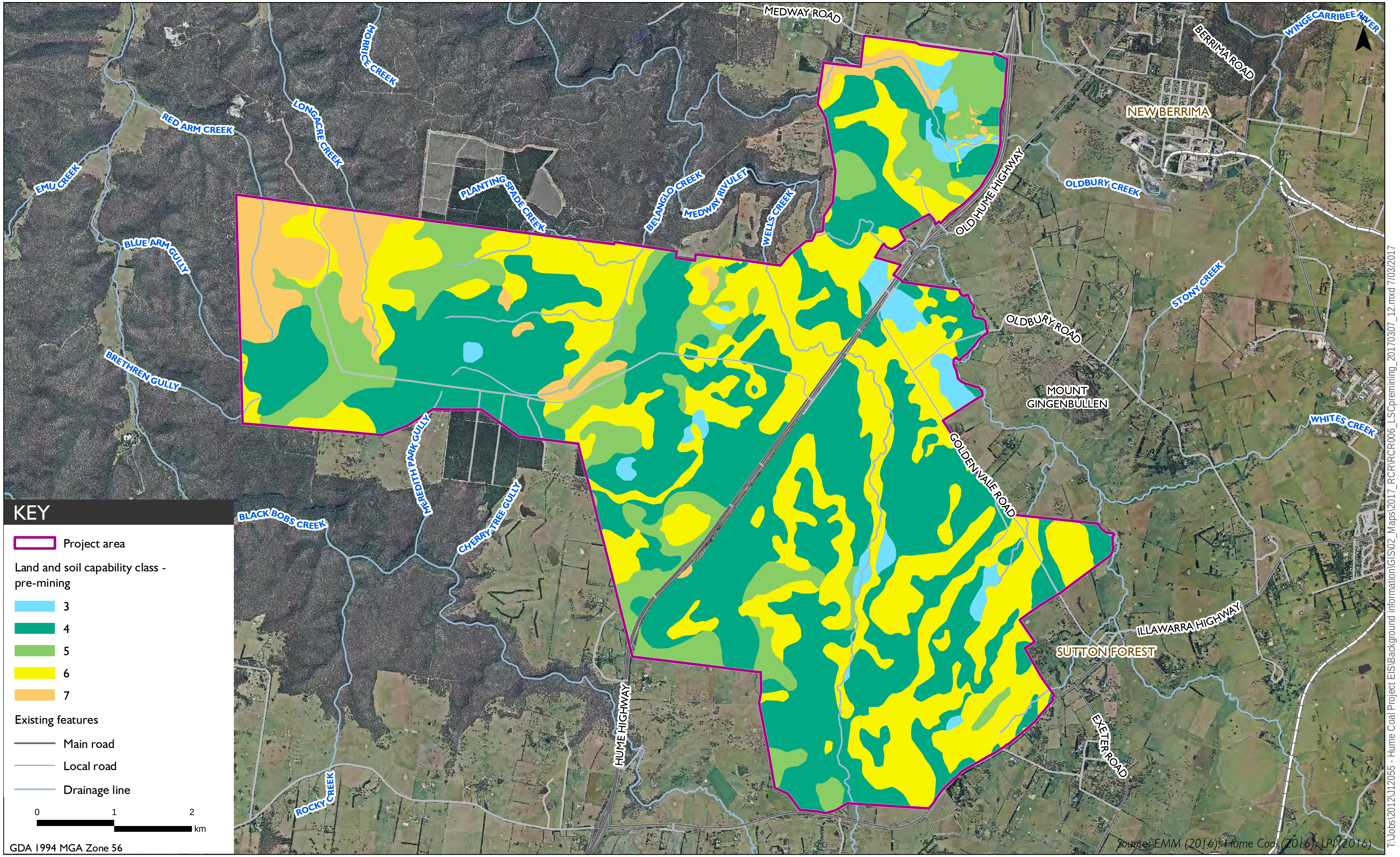
> "...This land requires careful management to maintain good ground cover (maintaining grass or cover taller than 8 cm is a guide). Grazing pressures need to be lower than those used on Class 4 and 5 land. Rotational grazing systems with adequate recovery time for plant regrowth are essential. It is important to minimise soil disturbance, retain perennial ground cover and maintain high organic matter levels...."

Therefore grazing will still be an option for land beneath the infrastructure area and water management areas, even with a lower LSC class compared to pre-mining.

Table 4.3 shows the pre- and post-mining area changes for each LSC class found on land that makes up the project. Figure 4.2 show the pre- mining LSC and Figure 4.3 show the post- mining LSC classes. Of the 117 ha to be disturbed, 59 ha will be rehabilitated back to the original land and soil capability, as the soil profile will not be significantly altered. There will be a change to the land and soil capability class over 58 ha of land disturbed by the surface infrastructure area and water management areas. The original land class of these areas (3 ha of Class 3, 37 ha of Class 4 and 18 ha of Class 5) will change to Class 6 because the soil depth will be 0.3 m as the replaced topsoil will overlie re-profiled fill materials. However, Class 6 land will still be suitable for grazing and improved pasture, allowing the continuation of an agricultural land-use post-mining, as it is now.

Table 4.3 LSC class pre- and post-mining

LSC Class	Capability	Pre-mining LSC (ha)	Post-mining LSC (ha)	Amount lost or gained (+/- ha)	% change
LSC of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)					
1	Extremely high	-	-		
2	Very high	-	-		
3	High	144	141	-3	-2%
LSC of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)					
4	Moderate	2221	2184	-37	-2%
5	Moderate-low	704	686	-18	-3%
LSC for a limited set of land uses (grazing, forestry and nature conservation)					
6	Low	1641	1699	+58	+4%
LSC generally incapable of agricultural land use (selective forestry and nature conservation)					
7	Very low	300	300		
8	Extremely low	-	-		
None	Waterbodies, Hume Highway, etc	41	41		



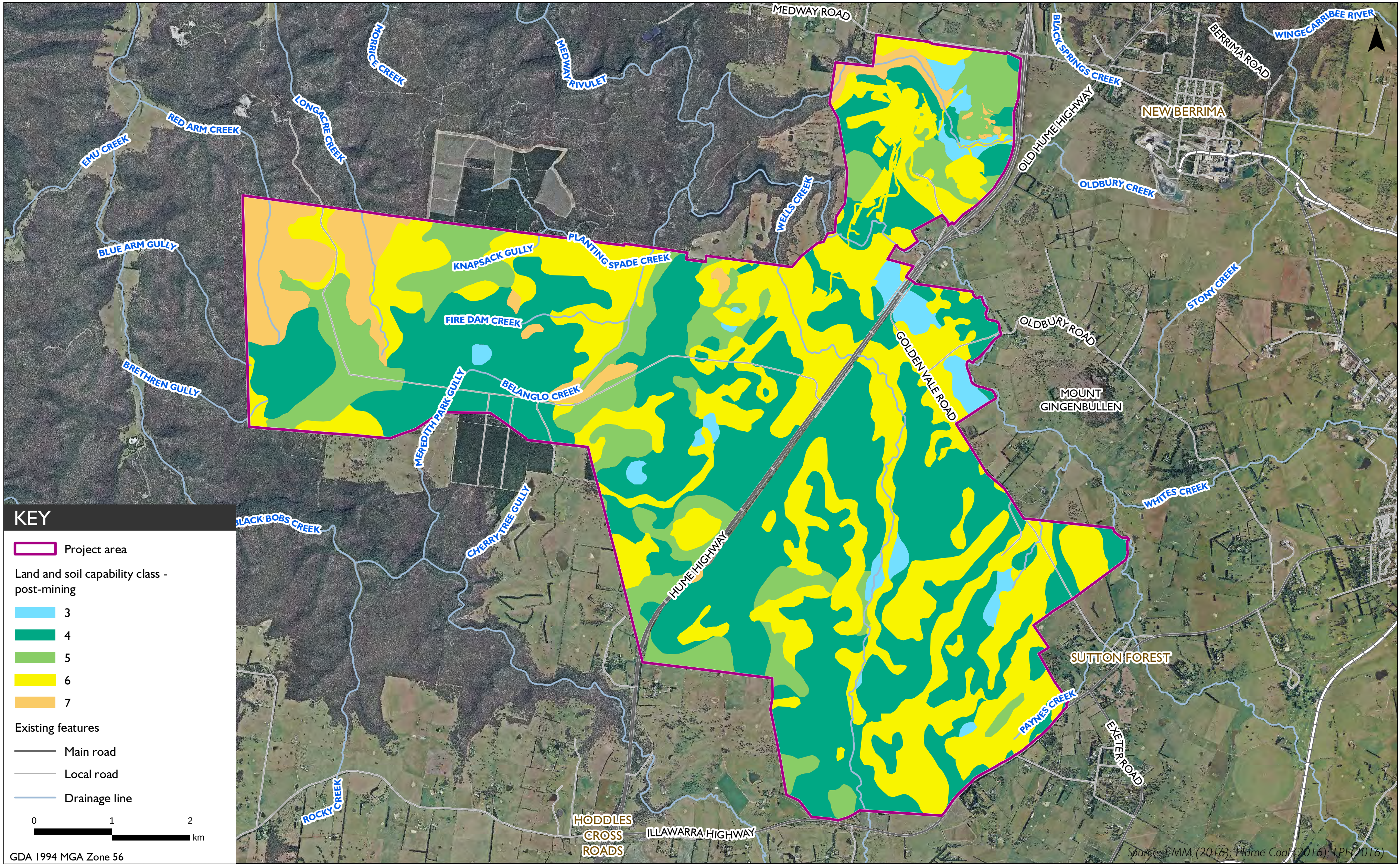
Source: EMM (2016); Hume Coal (2016); LPI (2016)

Land and soil capability classes- pre-mining

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 4.2



Source: EMM (2016); Hume Coal (2016); LPI (2016)

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Land and soil capability classes – post-mining

Hume Coal Project

Closure and Rehabilitation Strategy

Figure 4.3

5 Rehabilitation methods for closure

5.1 Progressive rehabilitation

Rehabilitation of areas containing early and temporary works or facilities will occur progressively. In particular, once the construction accommodation village is vacated and pipeline and powerlines relocated, the affected areas will be rehabilitated.

There is limited opportunity for any other progressive rehabilitation as almost the entire surface infrastructure will remain for the duration of the project.

Areas that can be rehabilitated progressively are:

- temporary construction facilities;
- accommodation facility;
- powerline and pipeline easement; and
- exploration drill pads and access tracks.

5.2 Soil stripping procedure

The topsoil stripping procedure will be designed to maximise the salvage of suitable topsoils and subsoils. These measures will be consistent with leading practice and incorporate the full range of reasonable and feasible mitigation methods for soil stripping.

The procedure for topsoil stripping will include the following soil handling measures that will minimise soil degradation (in terms of nutrients and micro-organisms present) and compaction, thus retaining its value for plant growth.

- The area to be stripped will be clearly defined on the ground, avoiding any waterlogged or similarly constrained areas. The target depths of topsoil and subsoil to be stripped for each location will be clearly communicated to machinery operators and supervisors.

- A combination of suitable earthworks equipment will be used for stripping and placing soils in stockpiles. Machinery circuits will be located to minimise compaction of the stockpiled soil.

- All machinery brought onto the site for soil stripping will have to comply with any weed management and biosecurity protocols established for the site.

- Where the soil surface of the soil stockpile footprint is to be disturbed by the creation of topsoil stockpiles (ie vegetation removal, tracks, turning circles, etc), a nominal 0.1m topsoil only (not subsoil) will be stripped before stockpiles are developed.

- The surface infrastructure area does not contain significant areas of native vegetation or trees, but any trees present will be cleared and grubbed prior to topsoil salvage.

- Topsoil and subsoil will be stripped to the required depths as nominated in this assessment and then stockpiled. Subsoil will be stripped and stockpiled separately where identified as suitable. Depending on compaction and recovery rates, deep ripping may be required to maximise topsoil recovery. Where soils are shallower, topsoil and subsoils will be stripped and stockpiled together.

- Handling and rehandling of stripped topsoil will be minimised as far as practicable by progressively stripping vegetation and soil only as needed for development activities.

- Soil stripping in very wet conditions will be avoided if practicable, because of the risk of compaction, nutrient deterioration and less volume of suitable materials being available. However, when possible, soils will be stripped when they are slightly moisture conditioned and this will assist in their removal and retain their structure.

- To avoid dust hazards, stripping of soil during particularly dry conditions will be avoided where possible.

5.3 Soil stockpile management

Soil stockpile management procedures will be designed to minimise degradation of soil characteristics that are favourable for plant growth. These measures are consistent with leading practices and incorporate all reasonable and feasible mitigation methods.

The following management practices will generally be adopted:

- Stockpiles will be located at an appropriate distance from water courses and dams (so they are not washed away).

- Where practical, topsoil and subsoil will be stockpiled separately. Where this is not possible, combined topsoil and subsoil stockpiles will still be built to the specifications for topsoil stockpiles.

- Topsoil stockpiles will be designed and constructed to a height generally no greater than 3 m in order to limit anaerobic conditions being generated within the stockpile and to minimise deterioration of nutrients, soil biota and seed banks.

- Soil stockpiles will have a slope grade of 1V:4H or less to limit erosion potential.

- Subsoil stockpiles can be designed over 3 m in height; however the slope grade needs to be considered for erosion control and should still be 1V:4H or less.

- The surface of the soil stockpiles should be left in a 'rough' condition to help promote water infiltration and minimise erosion via runoff. If required, sediment controls will be installed downstream of stockpile areas to collect any runoff.

- Overland water flow onto or across stockpile sites will be kept to a practical minimum and will not be concentrated to the extent that it causes visible soil erosion.

- Stockpiles will be seeded with an appropriate pasture grass mixture to stabilise the surface, restrict dust generation, minimise erosion and weed growth.

- The location will be marked on site maps to identify the stockpiles so that they are protected from future disturbance.

- The stockpile locations will be surveyed and data recorded about the soil types and volumes present.

- The establishment of weeds on the stockpiles will be monitored and control programs implemented as required.

- Short-term stockpiles created during construction will be managed under the Construction Environmental Management Plan.

5.4 Soil reinstatement

Upon decommissioning of the infrastructure area and other hardstand areas at closure, compacted areas will be ripped to break up hard layers and provide a favourable root zone. Soil will be applied to landforms once they are re-shaped and drainage works are complete. This may include contour or diversion banks with stable discharge points if required to manage runoff.

The topsoil application procedure will essentially be the reverse of the stripping procedure. It will be designed to minimise any degradation of soil physical and chemical characteristics. Generally, all soils will be applied with a thickness of approximately 0.3 m to provide sufficient depth for ripping and plant growth. If subsoil is stripped separately to the topsoil, the subsoil will need to be spread at approximately 0.15 m depth and then topsoil spread over the top at approximately 0.15m depth to create an overall depth of approximately 0.3 m.

The following measures are designed to minimise the loss of soil during respread on rehabilitated areas and promote successful vegetation establishment:

- A soil balance plan will be prepared before the topsoil is spread, which shows the depths and volume of soils to be reapplied in particular areas. The plan will take account of the relative erodibility of the soils, with more erodible material being placed on flatter areas to minimise the potential for erosion.

- After the area to be rehabilitated has been re-profiled and/or deep ripped, the subsoil will be spread onto the site, followed by the topsoil (or all at once if not stripped and stored separately).

- Soil will be respread in even layers at a thickness appropriate for the land capability of the area to be rehabilitated.

- Soils will be lightly scarified on the contour to encourage rainfall infiltration and minimise run-off.

- As soon as practicable after respreading, pasture grasses will be seeded.

5.5 Drainage and erosion control

Re-shaped surfaces will be stabilised as soon as practicable to reduce potential wind erosion and subsequent dust.

All rehabilitation areas will require stabilisation to protect them against the risk of erosion from wind or water. Measures include:

- ripping of ground to increase surface roughness and slow wind speed at ground level; and

- establish a cover crop. Improved pasture species are considered the most likely to be suitable as their seed is readily germinated.

Drainage zones will not receive special erosion control treatments. Sediment movement associated with stream flow is a natural phenomenon in the region, however if excessive sediment movement occurs then supplementary earthworks will be undertaken to return the drainage channels to design levels.

5.6 Revegetation

Disturbed areas will be revegetated with improved pasture seed.

Fertiliser may be applied at an appropriate rate with seed-mixes to increase the likelihood of initial revegetation success. The pasture grass species will be chosen to suit the proposed grazing strategy, as well as species that are suitable for fast establishment of an initial cover crop. The timing of the seeding operation will take into account the seasonal growing season for the grass species, but should not be delayed after the soil has been returned to prevent soil erosion.

5.7 Post-closure maintenance

5.7.1 Rehabilitation monitoring

Maintenance will encompass post-rehabilitation monitoring to identify areas requiring maintenance, and identify and address deviations from the expected outcomes. Rehabilitated areas will be assessed against performance indicators (refer Section 6) and regularly (at least on an annual basis) inspected for the following aspects:

- evidence of any erosion or sedimentation;
- success of initial establishment cover;
- natural regeneration of improved pasture;
- weed infestation (primarily noxious weeds, but also where rehabilitation areas are dominated by other weeds);
- integrity of graded banks, diversion drains, waterways and sediment control structures; and
- general stability of the rehabilitation areas.

Where rehabilitation criteria have not been met, maintenance works will be undertaken. This may include the following:

- re-seeding and, where necessary, re-soiling and/or the application of specialised treatments;
- use of materials such as composted mulch to areas with poor vegetation establishment;
- replacement of drainage controls if they are found to be inadequate for their intended purpose, or compromised by vegetation or wildlife; and
- de-silting or repair of sediment control structures.

5.7.2 Weed management

The presence of weed species has the potential to have a major impact on revegetation outcomes. Additionally, any significant weed species within the surrounding land has the potential to impact on the success of the rehabilitated areas. Weed management will be an important component of rehabilitation activities.

The spread of declared noxious weeds (and other invasive weeds that could impact revegetation success and/or plants that are undesirable to grazing stock) will be managed across the project area through a series of control measures, including:

- herbicide spraying or scalping weeds;
- post-mining use of rehabilitated areas as a working farm, with associated management practices; and
- rehabilitation inspections to identify potential weed infestations.

5.7.3 Access

Access tracks may be required to facilitate the revegetation and ongoing maintenance of the project. These tracks will be kept to a practical minimum and will be designated prior to the completion of the project.

5.7.4 Public safety

Controls will be implemented to minimise the potential for impacts on public safety, and may include maintenance of fencing and warning signs around areas that have the potential to cause harm and are that are accessible to the public. Public safety measures will be implemented following consideration of the Work Health and Safety (Mines) Regulation and *MDG 6001 – Guideline for the Permanent Filling and Capping of Surface Entries to Coal Seams, February, 2012*.

5.7.5 Rehabilitation resources

Environmental personnel will implement specific management requirements arising from this strategy.

Earth moving operations will be performed by machinery operators with experience and skill in the operation of the relevant machinery (scrapers, loaders, excavators etc). Project Supervisors will be responsible for compliance with the requirements of this strategy and its future revisions.

The Mine Manager will be responsible for achieving the rehabilitation criteria.

6 Performance indicators and completion/relinquishment criteria

6.1 Secondary domains

Secondary domains (as defined in the MOP Guidelines) (DRE 2013) are defined as land management units characterised by a similar post-mining land use objective (ie following mining). The secondary domains form the basis of performance criteria used for measuring rehabilitation and closure success.

All of the project primary domains have a secondary domain (post-mining land use) of "D – Rehabilitation Area – Pasture." The secondary domain is shown in Figure 4.1.

6.2 Rehabilitation criteria and reporting

Rehabilitation completion criteria will be used as the basis for assessing when rehabilitation of the project is complete. Indicators will be measured against the criteria, and are set for the 6 phases of rehabilitation, as follows:

- Phase 1 – Decommissioning (ie removal of equipment and infrastructure);
- Phase 2 – Landform Establishment (ie earthworks);
- Phase 3 – Growth Medium Development (ie topsoil spreading);
- Phase 4 – Ecosystem and Land Use Establishment (ie vegetation establishment);
- Phase 5 – Ecosystem and Land Use Sustainability (ie established vegetation is able to support post-mining land use); and
- Phase 6 – Land Relinquishment.

Interim rehabilitation criteria for the project have been developed with the current knowledge of rehabilitation practices and success in similar project environments. They have been based largely on experience elsewhere in Australia. They consist of a set of objectives; rehabilitation criteria and evidence that criteria have been met.

Whether rehabilitation criteria have been met depends on the trending of measurements over time compared to pre-mining or reference site conditions. The criteria will be refined and confirmed in the MOP and in the detailed closure plan as the project progresses towards closure.

The rehabilitation criteria need to demonstrate that the rehabilitation objective has been achieved. Consequently, interim rehabilitation criteria are presented in Table 6.1 that address the following outcomes:

- restoration of a safe and stable landform that is non-polluting; and
- reinstate soil profiles and function and create landforms that are compatible with surrounding topography; and reestablishment of landforms that permit grazing and improved pasture.

Reporting on rehabilitation activities, monitoring and progress towards achieving agreed rehabilitation criteria will occur via an annual environmental management report.

Table 6.1 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	Primary Domain	Completion criteria	Indicator
Phase 1 – Decommissioning (ie removal of equipment and infrastructure)			
All infrastructure that is not to be used as part of the future intended land use will be removed so that the site is safe, free from hazardous materials, and will not pose a threat of environmental harm.	Infrastructure	Removal of all above ground services (power, water, communications) that have been connected on site as part of the project and that will have no future use. Decommissioning and removal of all plant, equipment and associated surface infrastructure. All access roads and tracks not required for the future intended land are removed and rehabilitated.	Certification by a suitably qualified person
	Water management area	Removal of all water management infrastructure (including pumps, pipes and power).	Certification by a suitably qualified person
	Underground management area	All exploration drill holes undertaken on the mining lease have been rehabilitated or converted to water bores.	Certification by a suitably qualified person
There is no residual contamination of soil or water on site that is incompatible with the intended land use or that poses a threat of environmental harm.	Infrastructure	No stockpiled materials of coal product or coal reject to remain on the surface of the project area. Any hazardous material or potential sources of contamination have been isolated, remediated or removed.	Certification by a suitably qualified person
Underground workings are sealed and present no safety risks for humans and animals now and in the long-term.	Underground management area	Sealing and backfilling of drifts and vent shafts in accordance with approved design and relevant guidelines.	Certification by a suitably qualified person
	Infrastructure	Where risk mitigation measures include bunds, safety fences and warning signs, these have been erected in accordance with relevant guidelines and Australian Standards.	Certification by a suitably qualified person
Phase 2 – Landform Establishment (ie earthworks)			
The rehabilitated land is suitable for the planned land use and is compatible with surrounding landscape.	Infrastructure, Water management area, Stockpiles	Rehabilitated land is contoured in similar form to the existing and/or surrounding topography.	Rehabilitated land surveyed for extent, height and slope

Table 6.1 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	**Primary Domain**	**Completion criteria**	**Indicator**
The rehabilitated land is stable and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna.	Infrastructure, Water management area, Stockpiles	If engineered structures to control water flow are required (eg contour banks, channel linings, surface armour, engineered drop structures and other required measures), they are installed and functioning.	Certification by a suitably qualified person
		Rehabilitated land does not exhibit any signs of continued erosion greater than that exhibited at a comparable reference site (with similar chemical and physical characteristics including slope to the rehabilitated site).	Certification by a suitably qualified person
		Dimensions and frequency of occurrence of erosion of rills and gullies are no greater than that in comparable reference site(s).	Rate of soil loss; certification by a suitably qualified person
Phase 3 – Growth Medium Development (ie topsoil spreading)			
Returned soil on the rehabilitated land is able to support the planned land use.	Infrastructure, Water management area, Stockpiles	Soil thickness is adequate to support growth of pasture species suitable for desired land-use.	Soil depths
		Site soil characteristics (eg pH, salinity, nutrient content , sodium content, rockiness, depth of soil, wetness and plant available water capacity) are able to support growth of pasture species suitable for desired land-use.	Soil testing of relevant soil physical properties
Phase 4 – Ecosystem and Land Use Establishment (ie vegetation establishment)			
Vegetation establishment is adequate and able to support the desired land use.	Infrastructure, Water management area, Stockpiles	Vegetation growth parameters are no less than that exhibited at a comparable reference site.	Biomass, percent cover, height and vigour of plant species
		The abundance of declared plants (weeds) identified in rehabilitated areas in no greater than comparable reference sites.	Percentage weed cover
Phase 5 – Ecosystem and Land Use Sustainability (ie established vegetation is able to support post-mining land use)			
The rehabilitated land is stable and does not present a risk of environmental harm downstream of the site or a safety risk to the public/ stock/ native fauna	Infrastructure, Water management area, Stockpiles	Rehabilitated land does not exhibit signs of continued erosion greater than that exhibited at a comparable reference site (with similar chemical and physical characteristics including slope to the rehabilitated site).	Rate of soil loss; certification by a suitably qualified person
		Dimensions and frequency of occurrence of erosion of rills and gullies are no greater than that in comparable reference site(s).	Certification by a suitably qualified person

Table 6.1 Interim completion criteria at each phase of decommissioning and rehabilitation

Objective	Primary Domain	Completion criteria	Indicator
Phase 6 – Land Relinquishment			
The rehabilitated land is sustainable for the long-term and only requires maintenance that is consistent with the final land use.	Infrastructure, Water management area, stockpiles	The re-established topsoil/subsoil is capable of supporting the targeted pasture regime on a sustained basis.	Physical and chemical soil properties.
		Pasture establishment is consistent with the range of species suitable for the targeted pasture regime.	Pasture species present
		Pasture establishment is in good health and provides adequate cover.	Ground cover, biomass, etc
Runoff water quality is similar to, or better than, the pre-disturbance runoff water quality.	Infrastructure, Water management area, stockpiles	Downstream surface water quality at monitoring locations is not negatively impacted when trends indicated by results from baseline monitoring and the five years previous to closure are compared to monitoring results for the rehabilitated landform.	Surface water quality
Ground level and surface stability not impacted by the presence of the underground workings.	Underground management area	Mining has been undertaken generally in accordance with designs and tolerances that provide for long-term geotechnical stability. Where land access can reasonably be obtained, no evidence of perceptible surface impacts are evident in the area above underground operations.	Mine survey plans are developed by a registered mine surveyor as mining progresses and provided to DRE annually and following completion of mining.

6.3 Rehabilitation monitoring and research

6.3.1 Sampling intensity

The sampling intensity for rehabilitation monitoring will take into account:

- practical and cost effective monitoring techniques;
- standard rehabilitation monitoring practice; and
- the need for broadscale monitoring, ensuring that overall project rehabilitation performance is obtained.

6.3.2 Frequency of monitoring

Regular monitoring of the rehabilitated areas will be required during the initial vegetation establishment period and beyond to demonstrate whether the objectives of the strategy (as amended for the MOP) are being achieved and whether a sustainable and stable landform has been provided. Monitoring will be conducted periodically by suitably skilled and qualified persons at locations which will be representative of the range of conditions on the rehabilitating areas. Regular reviews of monitoring data will be undertaken to assess trends and monitoring program effectiveness.

6.3.3 Reference/analogue sites

In addition to the rehabilitated areas, reference/analogue sites will be established and monitored to allow a comparison of the development and success of the rehabilitation against a target control site. Reference sites will indicate the condition of surrounding undisturbed areas for land currently utilised for agriculture.

6.3.4 Rehabilitation monitoring

Rehabilitation methods will be improved as additional knowledge develops from monitoring data collected through these programs. The specific monitoring program will be outlined in the detailed closure plan, to be prepared within five years of closure. Monitoring will include:

- surface water and groundwater monitoring;
- erosion monitoring;
- soil profile; and
- vegetation condition.

Key aspects are described further below.

i Soil profile assessment

In the first year of rehabilitation, preliminary soil pits may be excavated to allow early confirmation of the soil profile and identification of any limiting factors such as compaction. Early identification of such factors will allow remedial activities such as ripping to be performed in a timely manner.

The final post-mining assessment of the rehabilitated soil profile will be performed by a suitably experienced soil scientist. This assessment will not be performed until several years after establishment of the improved pasture. This timing is so that plant root distribution through the profile may be assessed.

Assessment of the post-mining soil profile will utilise similar methods to the pre-mining soil survey. Pits or auger holes will be excavated. The soil profile will be recorded, with all soil horizons described and their location within the profile measured. Similar physical and chemical parameters assessed in the pre-mining survey will be reassessed within each soil horizon.

The results of the soils assessment will be presented to the regulatory authorities in a rehabilitation report.

ii Vegetation

Rehabilitated vegetation will be monitored annually in the first three years following rehabilitation, subject to review of observed vegetation growth rates. Subsequent monitoring is likely to be decreased to lower intervals. These intervals will be determined in consultation with rehabilitation specialists.

Control sites will be established to allow comparison of rehabilitation with undisturbed sites under the same seasonal conditions.

The number and location of vegetation monitoring plots for rehabilitated and control sites will be determined in consultation with rehabilitation specialists, as will the most appropriate survey method. As the rehabilitated land will be used as grazing pasture, the vegetation assessment will include pasture quantity and quality.

The following techniques may be used:

- **Quadrats:** The quadrat (eg. 1m x 1m) surveys will be carried out using standard vegetation survey methods. Samples of pasture will be cut from a selected number of quadrats and dried and weighed to estimate kg of pasture dry matter per hectare. Other observations from the quadrats may include the percent cover, species composition including weeds (ie undesirable to grazing stock), proportion of legume, growth phase of the plants, and proportion of leaf to stem (leaf is more edible).

- **Photographic Monitoring Points (Photopoints):** Photograph frames will be aligned at set monitoring points, so that comparisons can be made between sampling intervals.

6.3.5 Research and continual improvement

Knowledge of appropriate rehabilitation practices required to achieve the rehabilitation objectives is continually growing. Hume Coal will consult with various experts during preparing of the detailed closure plan to investigate key aspects of the rehabilitation process, such as benchmarking against industry rehabilitation best practice, and review of mechanical process which are relied upon in the rehabilitation process against new available technologies at the time.

Abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council
ANZMEC	Australian and New Zealand Minerals and Energy Council
AMD	Acid mine drainage
CEMP	Construction Environmental Management Plan
CPP	Coal processing plant
DoEE	Commonwealth Department of the Environment and Energy
DP&E	NSW Department of Planning and Environment
DPI Water	NSW Office of Water
DRE	NSW Division of Resources and Energy
EC	Electrical conductivity
EIS	Environmental impact statement
EMM	EMM Consulting Pty Limited
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
ha	hectares
LGA	Local government area
Local Government Act	*Local Government Act 1993*
LSC	Land and soil capability
m	metres
MCA	Minerals Council Australia
MIA	Mine infrastructure area
MOP	Mining operations plan
Mt	Million tonnes
Mtpa	Million tonnes per annum
NAF	Non-acid forming
NMD	Neutral mine drainage
NSW	New South Wales
PAF	Potentially acid forming
ROM	Run of mine
SEARs	Secretary’s environmental assessment requirements
SFMC	*Strategic Framework for Mine Closure*
TLO	Train load Out
TDS	Total dissolved salts
WHS	Workplace health and safety
WLEP	Wingecarribee Local Environmental Plan
WM Act	NSW *Water Management Act 2000*
WSC	Wingecarribee Shire Council

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Appendix A

Closure Risk Assessment

Rehabilitation and Closure Risk Workshop

Date: 30th November 2015

Attendees: Greig Duncan (Project Director); Luke Edminson (Manager – Environmental Planning, Hume Coal Project); Alex Pauza (Manager, Mine Planning - Hume Coal Project); Nicole Armit (Associate Environmental Scientist – EMM Consulting); Kylie Drapala (Senior Soil Scientist – EMM Consulting)

Risk assessment boundaries:

- Hume Coal project area
- Infrastructure areas vs areas above mine layout
- Timeline: Construction to operational to decommissioning and rehab works to monitoring

Key considerations for risk assessment:

- Decommissioning activities and regulatory requirements (eg MDG 6001)
- Coal treatment activities - washing, tailings?
- Rehabilitation criteria for on-going monitoring link to chosen controls
- Transitions from operational controls to rehabilitation controls

Not considered in risk assessment:

- Groundwater impacts – this is assessed in the Water Assessment process

Risk assessment matrix:

- Table A1 shows the matrix used for risk ranking. Risk ranking was assessed as a residual risk, after control measures were put in place.

Table A.1 Risk assessment matrix tool

Potential consequence				Probability				
Score	**People**	**Environment**	**Community**	**A Almost certain to happen**	**B Likely to happen at some point**	**C Moderate: possible, heard of**	**D Unlikely: not likely to happen**	**E Rare: practically impossible**
5 **Catastrophic impact**	Fatality	Disastrous environmental impact, where there is long term effects, requiring remediation, regulatory intervention or premature closure of the operation	Public international condemnation .Major breakdown of social order in affected communities	**1**	**2**	**4**	**7**	**11**
4 **Severe negative impact**	Major injuries or health effects to multiple people Permanent total disability	Serious environmental impact, with medium term effect, requiring significant remediation or resulting in prosecution	Loss of community's economic viability. Significant damage to reputation of the operations	**3**	**5**	**8**	**12**	**16**
3 **Major negative impact**	Minor injury or health effects to multiple people Major injury or health effects (eg LTIs or permanent disabilities)	Moderate reversible environmental impact with short term effect, requiring moderate remediation, such as reportable incident	Significant public criticism eg community complaints. NGO or media "taking up the issue". Major negative impact on economic viability	**6**	**9**	**13**	**17**	**20**
2 **Negative impact**	Minor injury or short-term health effects requiring restricted work	Minor reversible environmental impact, requiring minor remediation such as non reportable environmental incident	Flare up of issue in affected communities Media criticism	**10**	**14**	**18**	**21**	**23**
1 **Minor negative impact**	Minor injury or short-term health effect (eg requiring first aid)	Negligible reversible environmental impact, requiring very minor or no remediation	Slight negative impact on individuals in local community	**15**	**19**	**22**	**24**	**25**

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Air quality	Community complaints about dust nuisance during rehabilitation.	Mine will operate a complaints phone number and register for recording and actioning complaints. All complaints will be investigated with appropriate actions being completed as required to mitigate against future risk.	1	C	22
Air quality	Impact of exceeding dust limits in approval - low impact.	Air quality/dust management plan - closure construction phase, ongoing phases, consultation for closure. Management plan to deal with specifics, eg monitoring requirements of approval. Mine closure plan to consider dust impacts and management of rehabilitation timing - (including progressive rehab) Incident reporting procedures will be in place.	1	D	24
Air quality	Community complaints about nuisance dust after rehabilitation is complete ie landform has been created and seed has been spread.	Location of infrastructure is planned to avoid trees/forest and the proposed final land use of cropping and grazing provides control. Monitoring during rehabilitation phase expected to identify dust generation from farming activities not in excess of surrounding land users.	1	D	24
Air quality	Gas emissions from underground workings after closure.	Very low gas content of coal - analysis shows a very low risk of ongoing emissions. Individual panels will be sealed and flooded as mine progresses shafts and drifts will be backfilled and capped as part of rehab works.	2	E	23
Strategic risk	In the future local weather patterns may change (ie rainfall, ambient temperature, bushfire) resulting in weather patterns that are not compatible with a future land use of cropping and light grazing causing completion criteria to not be achieved and relinquishment delayed.	The micro-climate is created by elevated topography and orographic rainfall. Seasonal variability is already a feature of this landscape, and the grazing/cropping cycles are adjusted accordingly. Any significant changes to the climate would affect the entire region, not just the small area of surface disturbance that has been created by the mine. The closure management plan includes landforms and vegetation that is compatible to a future land use of cropping and light grazing and is compatible with current weather patterns and existing seasonal variations; completion criteria will take seasonal variation into consideration.	2	C	18

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Strategic risk	Mine owner cannot deliver closure due to bankruptcy; site left unrehabilitated.	Rehabilitation security deposit calculated as per regulatory requirements on an ongoing basis. Ensure that latest costings and guidelines are referenced as part of rehabilitation costings.	2	E	23
Strategic risk	Failure to identify all stakeholders and all stakeholder concerns. Stakeholder groups perceive insufficient stakeholder engagement and become vocal with opposition.	Undertake a detailed closure planning process as required by ESG3 (DRE 2013) for the Mine Operations Plan - include Stakeholder consultation at the time.CCC - update over time.	1	E	25
Strategic risk	Risk - loss of jobs, impacts to service providers, flow on economic effects on local businesses	Detailed closure plan address socio-economic impacts of closure Mine approved for known period of time, ongoing stakeholder engagement throughout mine life.	3	B	9
Finance	Unable to relinquish the mine because of changed regulator expectations leading to increased post closure costs. Modifications provide opportunity to change approvals.	Mine Closure Plan to be reviewed and updated as required. Completion criteria to be proposed within the Mine Closure Plan and agreed with regulators as soon as practicable; investigate opportunities for progressive certification of rehabilitation. Security deposit updated with annual submission. Current mine design for long term stability (underground).	3	C	13
Finance	Poor staff retention leading to delayed rehabilitation works and loss of historical knowledge. Impacts on costs of rehabilitation planning and works.	Knowledge sharing, documentation and document control; the level of impact is dependent on the level of the person leaving. Undertake a detailed closure planning process as required by ESG3 (DRE 2013) for the Mine Operations Plan at closure.	1	C	22
Water resources	Subsidence creates permanent impact. New drainage points in the landscape and affects natural surface water flow. Subsidence may cause activity areas to become drainage depressions.	Underground pillars designed for long-term geotechnical stability is the main control. Predicted surface settlement will be within the traditionally accepted survey value of “zero” ie <20mm, and immeasurable using traditional surveying techniques as it is less than survey error which is 20mm. Ongoing monitoring to detect subsidence will be carried out.	3	E	20

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Water resources	High rainfall events cause excessive runoff of from rehabilitated landforms, releasing sediment to surface water. Triggers reporting level.	Mine has been designed with a small surface disturbance area Works will be sequenced to ensure minimal disturbance at any one time, areas will be progressively rehabilitated. Erosion and sediment controls will be used and monitored during onsite landforming works. PIRM - pollution incident response management in place.	3	D	17
Water quality	Risk that water quality stored in dams is not compatible with a future land use of light grazing If agreements in place to handover dams.	Rehabilitation schedule will remove operational dams in final landform designs. Remove any sources of contaminants through rehabilitation of infrastructure areas. Water treatment on site to initially treat water to acceptable quality to suit land use. Water quality testing at regular intervals during monitoring phase.	2	D	21
Water quality	Dam decommissioning - quality of water and sediment makes it difficult to dispose (limited options) with significant financial implications for disposal.	Treat water same way as during operations until dams are decommissioned. Options to reinject the water.Water and sediments tested and develop plans to dispose of as appropriate based on resultsDevelop a detailed closure plan prior to closure and rehabilitation to identify suitable disposal options.	2	C	18
Soil/Landform	Non-reportable fuel and machinery spills (eg hydraulic fluids) affects soils during decommissioning and rehabilitation works.	All vehicles scheduled to take part in the field rehab programs will be inspected prior to accessing site and daily pre-starts to ensure no hydrocarbon leaks or other defects. Management of spills to ground - contain and manage any effected volume of soil material. PIRM - pollution incident response. Spill kits provided on site during rehabilitation activities.	1	C	22

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Soil/Landform	Reportable fuel and machinery spills (eg hydraulic fluids) affects soils during decommissioning and rehabilitation works.	Incident management and reporting procedures will be developed and updated over time (PIRM - Pollution incident response). All vehicles scheduled to take part in the field rehab programs will be inspected prior to accessing site and daily pre-starts to check for hydrocarbon leaks or other defects. Spill management to contain and manage any effected volume of soil material. Spill kits provided on site during rehabilitation activities.	3	C	13
Soil/Landform	Closure contamination assessment identifies hydrocarbon contamination of soils/materials in storage areas or along buried pipe lines.	Design controls to minimise potential for hydrocarbon spills Bunded storage areas, use of suitable piping materials. Minimise pipe length through infrastructure design. Consideration for not burying diesel pipes.	2	B	14
Soil/Landform	Perceived quantities of soil inaccurate and not enough subsoil and topsoil available to stabilise and rehabilitate disturbed areas.	Identify appropriate stripping depths for top and subsoil based on mapped soil types in proposed infrastructure areas. Stockpile topsoil and subsoil separately and stabilise to prevent erosion and dust generation. Investigate alternative storage or treatment options for long term storage of topsoil (eg storing subsoil stockpiles as bunds).	2	D	21
Soil/Landform	Rates of soil amendments (eg fertiliser and seed) required is cost prohibitive.	Identify appropriate stripping depths for top and subsoil based on mapped soil types in proposed infrastructure areas. Stockpile topsoil and subsoil separately and stabilise to prevent erosion and dust generation.At rehabilitation identify appropriate ameliorants based on soil typesFactor in costs for rehabilitation associated with machinery to amend and ameliorate should more material be required.	2	D	21
Soil/Landform	Amendment of soil (topsoil and subsoil) is ineffective resulting in poor vegetation cover and increased erosion rates or potential.	Rehabilitation monitoring program to determine success of selected option. Planning and management for topsoil. Potential land management plan - for future land use - link to land use policy.	2	D	21

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Soil/Landform	Subsidence - risk of potholing or sinkholes in final landform.	Mine design control - designed everything to be >80m or deeper to avoid sink hole effects.	3	E	20
Waste	Volume of waste generated is greater than budgeted for (HDPE liners (if used), other decommissioned infrastructure) and transport of waste off site is cost prohibitive.	Develop a waste disposal management plan specific to the project methodology and infrastructure requirements to capture what will be re-used and what is required for removal from site and ensure cost implications are understood. Identify all hazardous waste, demolition waste and municipal waste streams. Ongoing MOP amendment and rehabilitation security deposit calculations (incorporate waste management realistically).	2	C	18
Waste	Temporary accommodation village - potential contaminated soils from sewerage disposal site.	Design of amenities in accordance with AS/NZS 3500.2:2003 - Plumbing and drainage - Sanitary plumbing and drainage, location of amenities away from sensitive receivers where practical, appropriate containment structures ie bunding, good onsite drainage design, appropriate maintenance of amenities, safe work methods, use of licensed contractors (Australian Standards and NSW legislation), emergency management and response plans/training/equipment, environmental management plan, operator training. Undertake a contaminated land assessment of any irrigation disposal areas prior to rehabilitation.	2	C	18
Noise	Noise perceived by local land holders and complaints received.	Maintain a complaints register and response system during the rehabilitation and monitoring phase. Stakeholder engagement program. Closure and rehabilitation plan to cover noise management (monitoring as per existing etc).	2	B	14
Noise	Exceedance of noise limits during decommissioning (construction noise goals) - reportable	Closure and rehabilitation plan to cover noise management (monitoring as per existing etc). Incident management and reporting procedures implemented.	3	D	17

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Fire	Non-Hume caused fire (eg bushfire) - effect rehabilitation, increase cost.	Fire fighting facilities provided on site – eg water cart or extinguishers; Install a fire break around specified landforming work areas and rehabilitation areas Land use of farmland suitable to area (cropping and pasture).	2	D	21
Fire	Risk of bushfire effects on biodiversity offset area.	Implement a bushfire management plan and monitoring program where required to allow measurement of rehabilitation resilience from pressures such as fire.	3	D	17
Fire	Fire risk to from spontaneous combustion.	Fire fighting system, sufficient buffer between vegetated areas/flammable materials storages and coal stockpiles, coal relatively non-combustible in a non-pulverised form. Studies show targeted coal seams are low risk for spontaneous combustion - and seam has had no combustion events.	2	E	21
Fire	Fire risk from hotwork or other rehab activities.	Hot works permit system used during rehabilitation works Daily Pre-Start Meetings to consider weather and fire conditions to inform activities or work plans. Contractor SME fire fighting facilities systems.	2	D	21
HSE	Increased potential for mine based environmental personnel to be injured completing a task that is a non standard (monitoring phase only).	Activity in accordance with WHS legislation and Hume requirements (Safety management plans etc). Use of suitably trained and/or qualified employees/contractors.	2	D	21
HSE, Impact on reputation	Death or injury to people and cattle during rehabilitation of shafts.	Clear marking of site boundaries and delineation of entry point. Controlled entry point. Site access is managed and a comprehensive risk assessment is completed regarding site security. Comprehensive risk assessment and system of work developed to rehabilitate shafts. Decommissioning of shafts will be in accordance with regulatory requirements (eg MDG6001 or equivalent). Communication procedure for persons with right of entry, traffic controls and barricades, warning signs.	5	D	7

Table A.2 Rehabilitation and closure risk assessment (residual risk)

Consequence Category	**Impact (Description based on Maximum Probable Outcome)**	**Overview of Proposed Controls, Measures & Actions** *Readiness / Effectiveness of Controls: Consider all engineering, administrative & mitigating controls*	**Maximum Probable Outcome (With Proposed Control Measures)**		
			CONSEQUENCE	**LIKELIHOOD**	**RISK**
Flora and fauna	Vegetation cover on the rehabilitated landform is dominated by weeds; and is not compatible with a future land use of light grazing because it is not palatable and/or nutritious for cattle.	Develop a pest and weed management plan and a rehabilitation monitoring program identifies weeds that require attention. Monitoring and completion criteria; demonstration cattle grazing trials; and weed control as required. Source local seed to ensure site suitability and higher germination rates for native and improved pasture species and native vegetation rehab areas.	1	D	24
Fauna and Flora	Rehabilitation of offset area fails resulting in being unable to relinquish lease.	Implement monitoring program for biodiversity offset areas to flag development problems during the rehabilitation and monitoring phase.	3	D	17
Fauna and Flora	Threatened native fauna injured during rehabilitation works.	Regular fence inspections by environmental team, gate etiquette included in employee inductions. Inspections prior to landforming works and stockpile deconstruction.	1	C	22
Aboriginal Heritage	Reputation Impact to Hume if aboriginal heritage sites are impacted by future land owner.	Heritage sites will be listed on register for potential land owners to search during conveyance. High significance sites will be clearly marked and delineated.	2	D	21

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