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V7

# Marulan South Limestone Mine Continued Operations
# State Significant Development Application

## ENVIRONMENTAL IMPACT STATEMENT

Prepared for Boral Cement Limited | March 2019

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## Visual assessment

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richard lamb & associates

# Marulan South Limestone Mine SSD 7009

# Continued Operations

## Visual Impact Assessment

Prepared for: Boral Cement Limited

Author: Dr. Richard Lamb

September 2018

1/134 Military Road, Neutral Bay, NSW 2089 PO Box 1727 Neutral Bay NSW 2089

T 02 99530922 F 02 99538911 E info@richardlamb.com.au W www.richardlamb.com.au

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# Executive Summary

## Purpose of this report

- This report by Richard Lamb and Associates (RLA) is an assessment of the visual impacts of the State Significant Development (SSD 7009) Project for the Marulan South Limestone Mine (the mine) Continued Operations.
- The report consists of an assessment of the likely nature, extent and significance of the visual impacts of the Project, considered with regard to the range of public and private places that could be affected.
- The report specifically addresses the Secretary's Environment Assessment Requirements provided to Boral and dated 10 June, 2015, that relate to visual impacts.

## Visual context of existing mine

- The mine is situated on the edge of a dissected plateau of the Southern Tablelands of NSW, which is locally drained to the south and east by the Shoalhaven River and its tributaries, Bungonia and Barbers Creeks.
- Land use to the west and north is rural, while to the east, the landscape is dominated by the natural topography and vegetation of Morton National Park (NP) in the Barbers Creek gorge.
- The existing limestone resource has been exploited since 1869. Two separate major quarries were established at the Marulan South site by 1953 and later amalgamated under one ownership.
- Some of the consequences of long and continuous use of the site for extraction of the limestone and shale resources have been permanent and irreversible change to the visual and scenic resources of the site.
- The mine is in a secluded area and is not exposed to high intensity public domain features with large numbers of potential viewers such as main roads or urban areas.
- Rolling topography and significant areas of vegetation means that there are very few locations in the rural landscape that that are elevated and provide significant views of the Project.
- Visual exposure of the existing operations is low to the adjacent rural land to the south-west, west and north, as the current operations are predominantly below the horizons of view.
- Access to the mine is provided by Marulan South Road, which is a public but a dead-end road leading to the mine, Aglime Fertiliser plant and Peppertree Quarry.

## Visual exposure of the Project

- Overall, the Project would be of low visual exposure to the public and private domain, other than its exposure to adjacent natural landscape in part of Bungonia and Morton NPs.
- The site of the proposed Marulan Creek Dam is not visible to any publicly accessible viewing place.

- Parts of the existing operations are of high exposure to medium to distant views from the east and south (part of the McCauleys Flat track from Long Point Lookout), the Bungonia Lookdown area and parts of the Morton NP). This will initially continue to be the situation in the Project.
- Detailed analysis of the likely changes in visual exposure caused by the proposed Northern and Western Overburden Emplacements show that the overall existing low visual exposure will remain low.
- The visual exposure of the Project will be to a slightly larger area than that of the approved existing mine operations because of the proposed location and finished heights of overburden emplacements to the west, north-west and south of the Pit.
- In some views from the landscape to the south-west, west and east, the topography of the intermediate horizon will be slightly changed as the Western Overburden Emplacement is constructed, elevating newly formed topography into views.
- Part of the Western Overburden Emplacement and part of the Northern Overburden Emplacement would be exposed to views from two residences on Long Point Road to the east across Barbers Creek Gorge.
- Views into the Pit from the south in Bungonia NP will decline as the Southern Overburden Emplacement is constructed.

### Visual effects of the Project

- The height and visual exposure of the proposed Western Overburden Emplacement and Northern Overburden Emplacement will not significantly alter the composition of the views.
- The Southern Overburden Emplacement will be of no significant visibility other than in views from the Bungonia Lookdown.
- The re-aligned high voltage powerline will be of low external visibility and have localised effects on the re-aligned Marulan South Road only.
- The proposed Northern Overburden Emplacement and road sales stockpile area proposed to be shared with Peppertree Quarry would be visible at close range only from a short section of Marulan South Road which is proposed to be de-proclaimed and appear similar in character to the adjacent Western Overburden Emplacement.
- A minor change will occur in the mid-ground horizon of the view in the most exposed views, due to an increase in the height of the landscape caused by the Western Overburden Emplacement and part of the Northern Overburden Emplacement.
- In the views from the Bungonia Lookdown area, the proposed Northern Overburden Emplacement, shared with Peppertree Quarry and the majority of the Western Overburden Emplacement will be of minor visibility.
- The proposed increase in the footprint of the Pit to the west would be evident primarily in views only from The Lookdown in Bungonia NP and VP 21, McCauleys Flat track.
- The proposed Southern Overburden Emplacement would initially be prominent in views from The Lookdown, however the final landform and rehabilitation of the emplacement would also lead to reduction in visibility of the mining operations in the Pit.
- When completed and rehabilitated, the Southern Overburden Emplacement would restore a natural appearance to the majority of the view from The Lookdown.

## Field analysis of effects on viewing locations

- The scenic quality of the proposed sites of the Western and Northern Overburden Emplacement are moderate. The baseline for scenic quality has been significantly modified by the existing and long history of adjacent limestone mining.
- The moderate scenic quality baseline means that subject to other considerations, the landscape has a higher potential to absorb visual impacts than one of higher scenic quality.
- The potential for views from 17 Residential Receivers, 4 Boral-owned residences and 3 commercial receivers were analysed using 3D graphics based on a digital terrain model.
- 25 publicly accessible representative viewing places were also analysed and assessed.
- Of the 17 Residential Receivers, 10 do not have any potential views of the Project from the dwellings. Of the remaining 7, with the exception of R7, access to which could not be secured, the views were documented and compared to the views predicted by 3D modelling.
- Receiver R8 has no potential view and Receivers R5 and R7 are unlikely to have a significant view of either the Western or Northern Overburden Emplacement following rehabilitation.
- Four remaining Residential Receivers (R10, R13, R14 and R15) have potential for a view of some part of the proposed Western or Northern Overburden Emplacement, the most substantial of which were predicted to be from R14 and R15.
- The analytical photomontage for R14 and rendered photomontage for R15 show that even the worst-case visual effects of the Project on residential views would be low.

## Sensitivity zones

- View place sensitivity was rated as medium for places between 500-3000m from the Project, if they have clear visibility of some part of the Project. Four viewing places fall into this category: VP20, VP21 and Residential Receivers R14 and R15.
- 13 viewing places including two residences are in the low sensitivity class, having partial views to the Project from more than 3000m away. 20 viewing places are in the medium sensitivity range within 3000m, of the Project.
- Marulan South Road is proposed to be de-proclaimed and is considered to be a low sensitivity location.
- The proposed Northern Overburden Emplacement has low accessibility to the public and no significant exposure to roads with high viewer numbers, or to close views from Residential Receivers.
- The proposed Western Overburden Emplacement is an extension of the existing approved emplacement in similar topography and would be partly visible from the proposed realigned section of Marulan South Road.
- The Southern Overburden Emplacement is also inaccessible to physical access, is only visible from the immediate south in Bungonia NP and has no direct exposure to views from Residential Receivers.
- The Project is therefore generally exposed to views from locations of medium to low sensitivity to the likely visual effects.

## Viewing level

- The effect of viewing level is increased for VPs 1, 2 and 6 on Marulan South Road.
- Views from the Bungonia Lookdown lookout and McCauleys Flat track locations (VPs 20 and 21) have an increased rating for the extent of visual effects caused by viewing position.

## Viewing period

- The effect of viewing period was considered to increase sensitivity for potential views from Residential Receivers R10, R13, R14, and R15.
- Viewing period increased the sensitivity for views from only the public domain locations VP20 and VP21.

## View loss

- The planning principles in Tenacity and Rose Bay were considered. No views from residences or the public domain call for the application of the principles as no scenic features of the views would be lost.

## Night time lighting

- No change is proposed in the Project to the amount or purpose of night-time lighting.
- Existing general and security lighting will remain unchanged and will continue to have the same visual effects.
- The minor changes in visibility or topography of overburden emplacements in the Project are unlikely to cause any significant increase in visibility or effects of night time lighting.
- The proposed Marulan South Road Realignment is likely to slightly reduce or not change the exposure of adjacent receivers to light from trucks using the road at night.
- Night time lighting was not considered to be a relevant consideration to visual impacts on the public domain locations, VP20 or VP21.

## Overall visual effects ratings

- The overall visual effects of the proposed Project on its total visual catchment are assessed as medium.

## Overall visual impacts ratings

- Relevant weighting factors to determine visual impacts were physical absorption capacity (PAC), compatibility and sensitivity.
- PAC for the proposed Western Overburden Emplacement and Northern Overburden Emplacement would be high overall.
- The PAC for the Southern Overburden Emplacement would be low initially as seen from VP20 and VP21, but as rehabilitation takes over, PAC would increase to medium.
- The PAC for the proposed expansion of mining in the Pit toward the west and north-west would increase for VP20 as the Southern Overburden Emplacement successively blocks the view into the pit as it is lifted.
- PAC is considered to be a down-weight on the significance of impacts.

- The visual compatibility of the Project with mining/industrial features would be high for all viewing locations and medium with rural/natural features for most locations.
- Visual Compatibility is therefore considered to be a neutral weighting factor on impact significance.
- Impacts on different visual sensitivity zones did not significantly change the ratings for overall visual impacts.
- The medium to low sensitivity zone applies to the majority of viewing places assessed.
- It is considered that sensitivity should act as a down-weight on the significance of visual impacts.
- The overall visual impacts rating of the Project on its total visual catchment was assessed to be low, with initial higher impacts on VP20 (the Bungonia Lookdown) and VP21 (off-track site accessed from the McCauleys Flat Track), rated as medium following rehabilitation.
- Overall impacts were rated low for all Residential Receivers, including the most affected ones, R14 and R15.

### Assessment of mitigation measures

- Assessment of the proposed visual impact mitigation measures considers proposed landform, rehabilitation and lighting. Specific recommendations are made in relation to each of the mitigation measures other than lighting, which will not change.

### Conclusion

- This assessment finds that while there are some residual visual impacts, assuming compliance with the recommendations for impact mitigation, that these are minor in significance.
- There would also be a significant improvement in the view toward the mine from The Lookdown, VP20.

## 1.0 Purpose of this report

This report by Richard Lamb and Associates (RLA) is an assessment of the visual impacts of the State Significant Development (SSD 7009) Project for the Marulan South Limestone Mine Continued Operations (the Project) proposed at Marulan South Road, Marulan South, by Boral Cement Limited (Boral) for whom the report was prepared.

The purpose of this report is to assist in the assessment of the Project by the NSW Department of Planning and Environment which provided the Secretary's Environmental Assessment Requirements (SEARs) to Boral on 10 June 2015. The SEARs include Visual as a specific Key Issue to be addressed.

The report consists of an assessment of the likely nature, extent and significance of the visual impacts of the Project, considered with regard to the range of public and private places that could be affected.

The author of this report is Dr Richard Lamb, principal of RLA. A curriculum vitae for Dr Lamb is at Appendix 7. A full CV can be viewed or downloaded from the Home page tab on the RLA website at www.richardlamb.com.au.

## 1.1 Secretary Environmental Assessment Requirements in this report

The SEARs and Agency Requirements are tabulated below (Table 1.1) to indicate the location in this report or other technical reports in which matters relevant to visual impacts have been addressed.

Plate 1

*Oblique aerial image looking east with the processing area on the left and part of the North Pit visible on the right*

*Image courtesy of Boral, taken by Col Douch, 2015. Further aerial images are in Appendix 4*

Plate 2

*Oblique aerial image looking north with the South Pit in the left foreground, processing area at the centre rear and Peppertree Quarry in the background*

*Image courtesy of Boral, taken by Col Douch, 2015. Further aerial images are in Appendix 4*

*Plate 3*

*View toward the Lookdown north lookout (directly above light coloured spot on rock near the horizon in view centre, taken from the south rim of the South Pit*

*Image by RLA, June, 2014*

*Plate 4*

*View toward Bungonia NP and Morton NP from vantage point east of the Marulan Limestone Mine processing area.*

*Image by RLA, February, 2018*

Table 1.1 Response of this report to Secretary Environmental Assessment Requirements (SEARs)

| SEARS or Agency Requirements | Considered in VIA |
|---|---|
| SEARs Key Issue: Visual | (Comments) |
| The EIS must address the following specific issues:<br>- Including an assessment of the likely 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 temporary and permanent modification to the landscape during various stages of the project (overburden dumps, bunds, etc.), and minimising the lighting impact of the development. | Section 2.0: Visual Impact Assessment Methodology<br>Section 4.0: Summary of Visual Exposure<br>Section 4.1.1: Viewing Locations and Situations<br>See Figure 6, View Point Location Plan<br>See Appendix 6, individual View Points Data Sheets<br>See Appendix 1: Photographic Plates<br>Section 4.1.3: 3D Modelling to Represent Views<br>See Appendix 2: 3D model study<br>Section 4.1.4: Rendered Photomontages Method<br>See Appendix 3: Photomontages<br>Section 4.2: Visual Effects Analysis including:<br>Baseline Factors (Section 4.2.1), and:<br>Variable Factors, (Section 4.2.2), including night time lighting<br>Section 4.2.3: Overall Extent of Visual Effects<br>Section 4.3: Visual Impacts Analysis<br>Section 4.3.4: Overall Extent of Visual Impacts<br>Section 4.4: Analysis of Proposed Mitigation including specific recommendations in relation to:<br>Section 4.4.1: Proposed Landform<br>Section 4.4.2: Rehabilitation<br>Section 4.4.3: Lighting<br>Section 4.4.4: Southern Overburden Emplacement |

| SEARS or Agency Requirements | Considered in VIA |
|---|---|
| DRE Requirements | |
| All areas affected by the proposal should be shown in the context of the natural and built environments. This should be in sufficient detail to enable an understanding of the scale of impacts and gauge the effectiveness of proposed control measures.<br>The EIS should state the interaction between the proposed mining activities and the existing environment and so include a comprehensive description of the following activities and their impacts: | See above, but in particular:<br>Section 4.1: Summary of Visual Exposure<br>Section 4.1.1: Viewing Locations and Situations<br>See Appendix 1: Photographic Plates<br>Section 4.1.3: 3D Modelling to Represent Views<br>See Appendix 2: 3D model study<br>See Appendix 3: Photomontages<br>Section 4.3: Visual Impacts Analysis<br>Section 4.4: Analysis of Proposed Mitigation including specific recommendations in relation to:<br>Section 4.4.1: Proposed landform<br>Section 4.4.2: Rehabilitation<br>Section 4.4.3: Lighting<br>Section 4.4.4: Southern Overburden Emplacement |
| Mine layout and scheduling, including maximising opportunities for progressive final rehabilitation. …… The mine plan should maximise opportunities for progressive rehabilitation | See EIS<br>See RLA Visual Impact Assessment Report:<br>Section 4.4: Analysis of Proposed Mitigation<br>Section 4.4.1: Proposed Landform<br>Section 4.4.2: Rehabilitation |
| Mine closure including rehabilitation and decommissioning activities | See EIS |
| An evaluation of current rehabilitation techniques and performance against existing rehabilitation objectives and completion criteria; | See EIS |

| SEARS or Agency Requirements | Considered in VIA |
|---|---|
| Existing and surrounding landforms (showing contours and slopes) and how similar characteristics can be incorporated into the post-mining final landform design | See EIS<br>See RLA Visual Impact Assessment Report:<br>Section 4.4: Analysis of Proposed Mitigation:<br>Section 1.4.1: The Regional and Local Context<br>Section 1.4.2: Existing Scenic Resources<br>Section 4.2: Visual Effects Analysis<br>Section 4.3.1: Physical Absorption Capacity<br>Section 4.4: Analysis of proposed Mitigation |
| OEH Recommendation | |
| The existing quarrying already significantly affects views from the Bungonia Lookdown and Adams Lookout and some walking tracks in the SRA, reducing the feeling of naturalness and isolation. It is important that the southern lip of the existing south pit excavation area be maintained. This is critical to avoid risk of materials entering the gorge. The visual impact from look out and safety of users of SCA are important considerations in this regard. | Bungonia Lookdown (VP20) is considered in detail throughout the study.<br>The highest level of visual impacts assessed in this study are considered to apply to daytime views.<br>The southern lip (rim) of the South Pit will be retained.<br>The Southern Overburden Emplacement will be most profound mitigation measure that has ever been enacted for impacts on views into the mine from the Bungonia Lookdown, Adams Lookout and adjacent tracks. |

## 1.3 Documents consulted

In preparing this report, we have consulted the following documents:

- Review of Environmental Factors for Marulan South Limestone Mine, 1 December, 2010 (REF), prepared by GSS Environmental.
- Approval of extension of MOP to 30 June 2016.
- Marulan South Limestone Mine 2018-2023 Mining Operations Plan (MOP).
- Notice of Approval of 2018-2023 MOP.
- Consolidated Mining Lease No.16 including Schedule of Conditions (CML 16).
- Mining Lease 1716 (covering depth constraints) 4 September 2015.
- Marulan South Limestone Mine Continued Operations, Biodiversity Assessment Report, prepared by Niche Environment and Heritage, 2018 (Niche BAR).
- Soils, Land Resource and Rehabilitation Assessment report, LAMAC Management, 2018. (SLRRA).
- 30 year mine staging and rehabilitation plans.
- Tozer, M.G. et al. (2006). Native vegetation of South Eastern NSW: a revised classification map for the coast and eastern tablelands. Cunninghamia Vol.11(3): 1-48.

## 1.4 Context and Concept for the Development

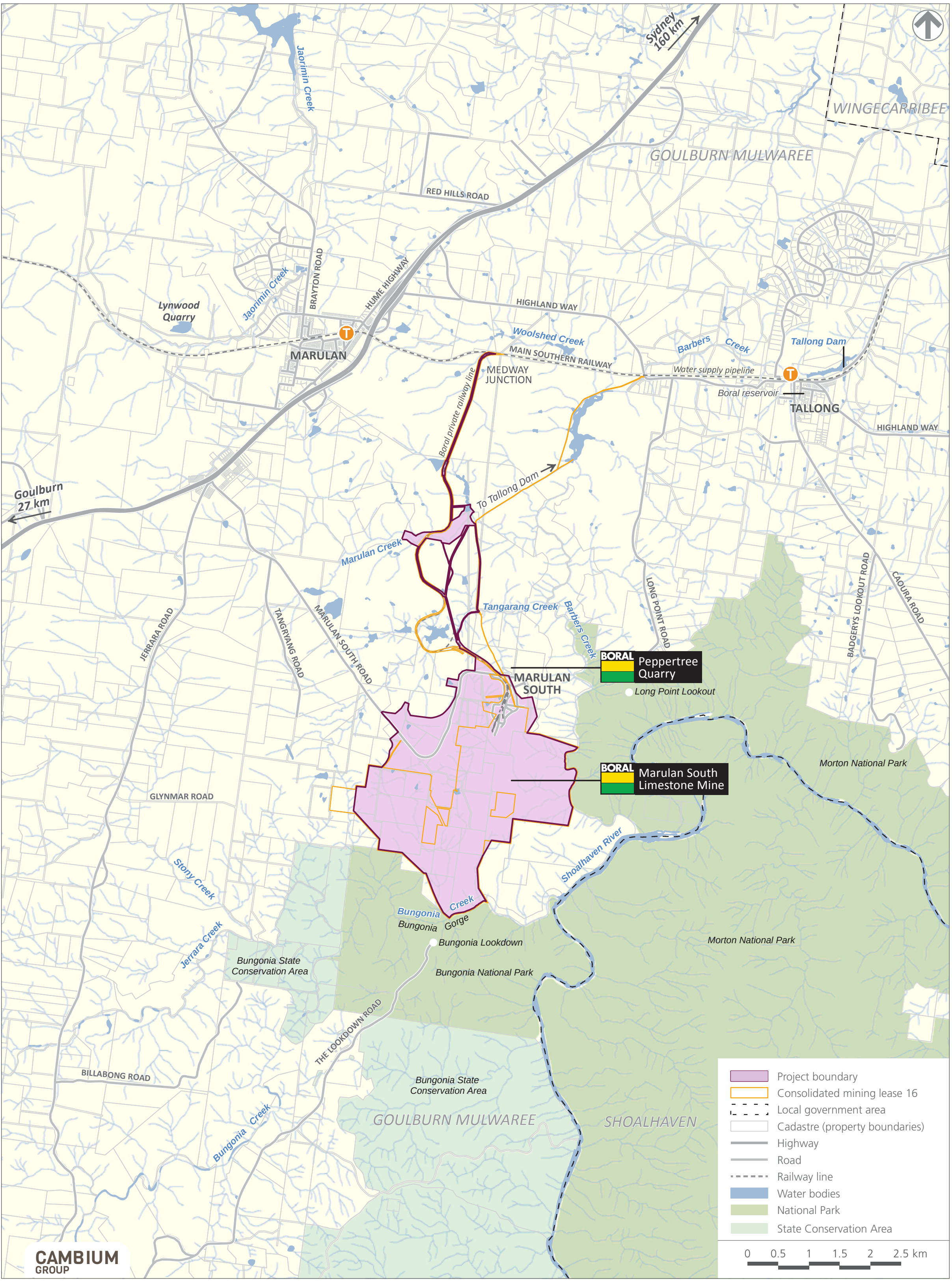
### 1.4.1 The Regional and Local Visual Context

The regional and local visual context of the mine is described in detail in the EIS (See also Figure 1, Regional Context and Figure 2, Local Context). The mine is situated on the edge of a dissected plateau of the Southern Tablelands of NSW, which is locally drained to the south and east by the Shoalhaven River and its tributaries, Bungonia and Barbers Creeks.). Land use to the west and north is rural, while to the east and south, the landscape is dominated by the natural topography and vegetation of Morton National Park (NP), the Bungonia NP and the Bungonia State Conservation Areas (SCA), respectively.

The Project's proposed disturbance footprint is shown on Figure 8 and the inundation area of the proposed Marulan Creek Dam is shown on Figure 18. The mine is in a secluded area and not exposed to high intensity public domain features with large numbers of potential viewers such as main roads or urban areas. It is a significant distance (greater than six kilometres) from the nearest highway (Hume Highway) and the nearest urban settlement (Marulan) and is not significantly exposed to either. The inundation area of the proposed Marulan Creek Dam is not visible from publicly accessible places.

Access to the mine is provided by Marulan South Road, which is a public but a dead-end road leading to the mine, the Peppertree Quarry and Aglime Fertilisers' Manufacturing plant. It is a minor rural road that provides access to a small number of private properties and commercial enterprises before entering what is predominantly Boral-owned land. There is no other public access to the immediate environment of the mine.

Figure 1
**Regional context**



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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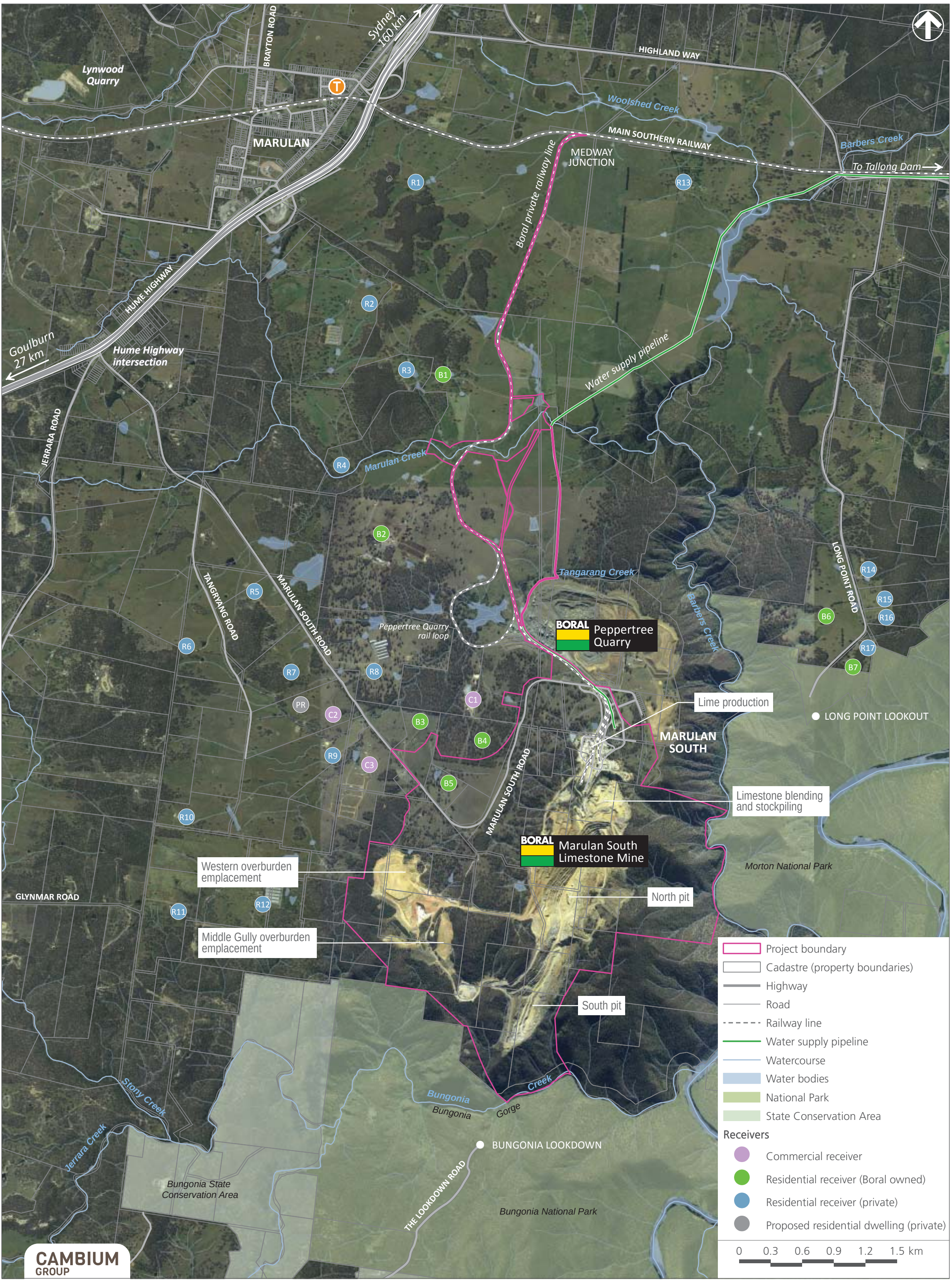
Figure 2
## Local context

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2018), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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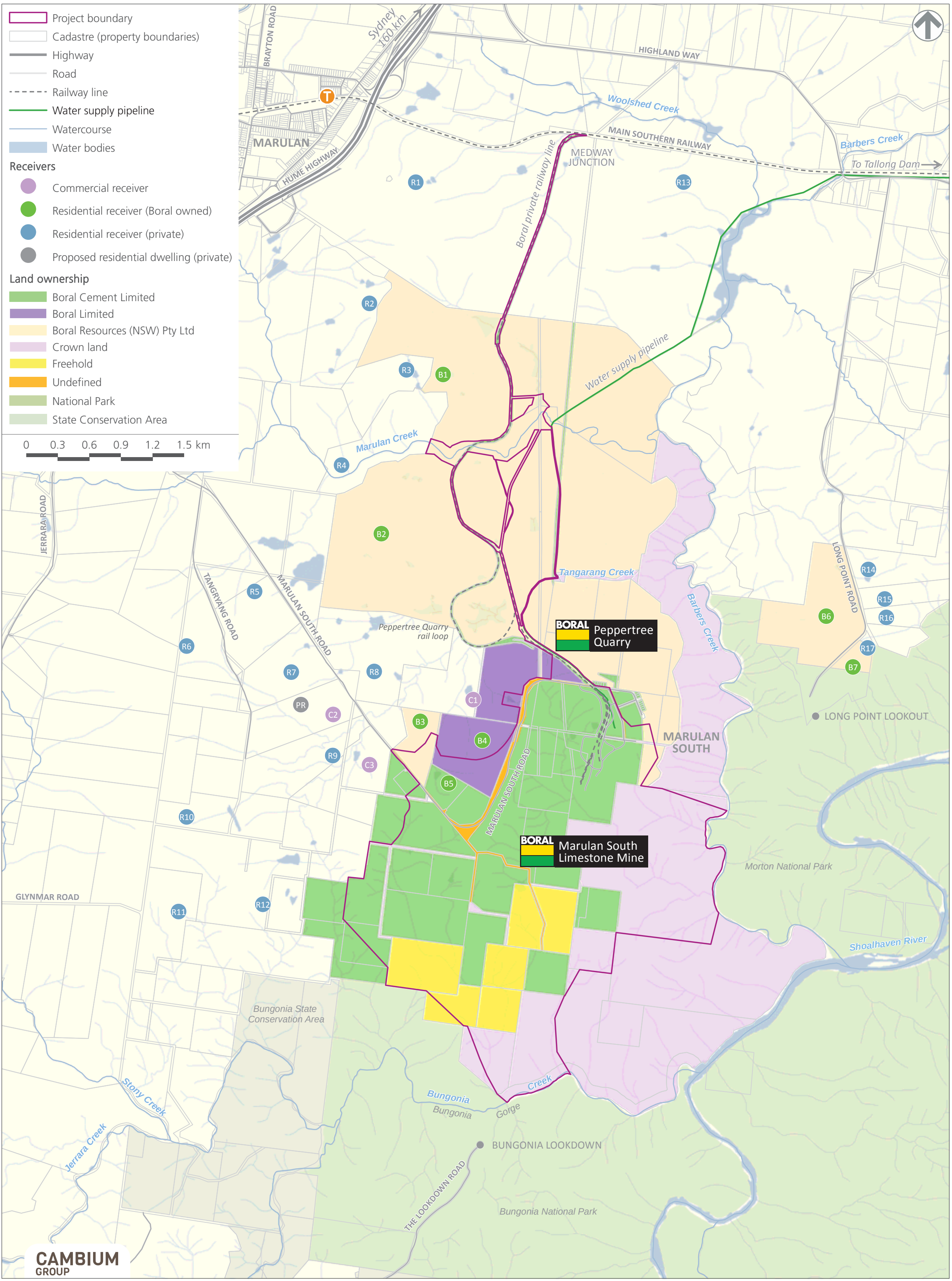
Figure 3

## Land ownership

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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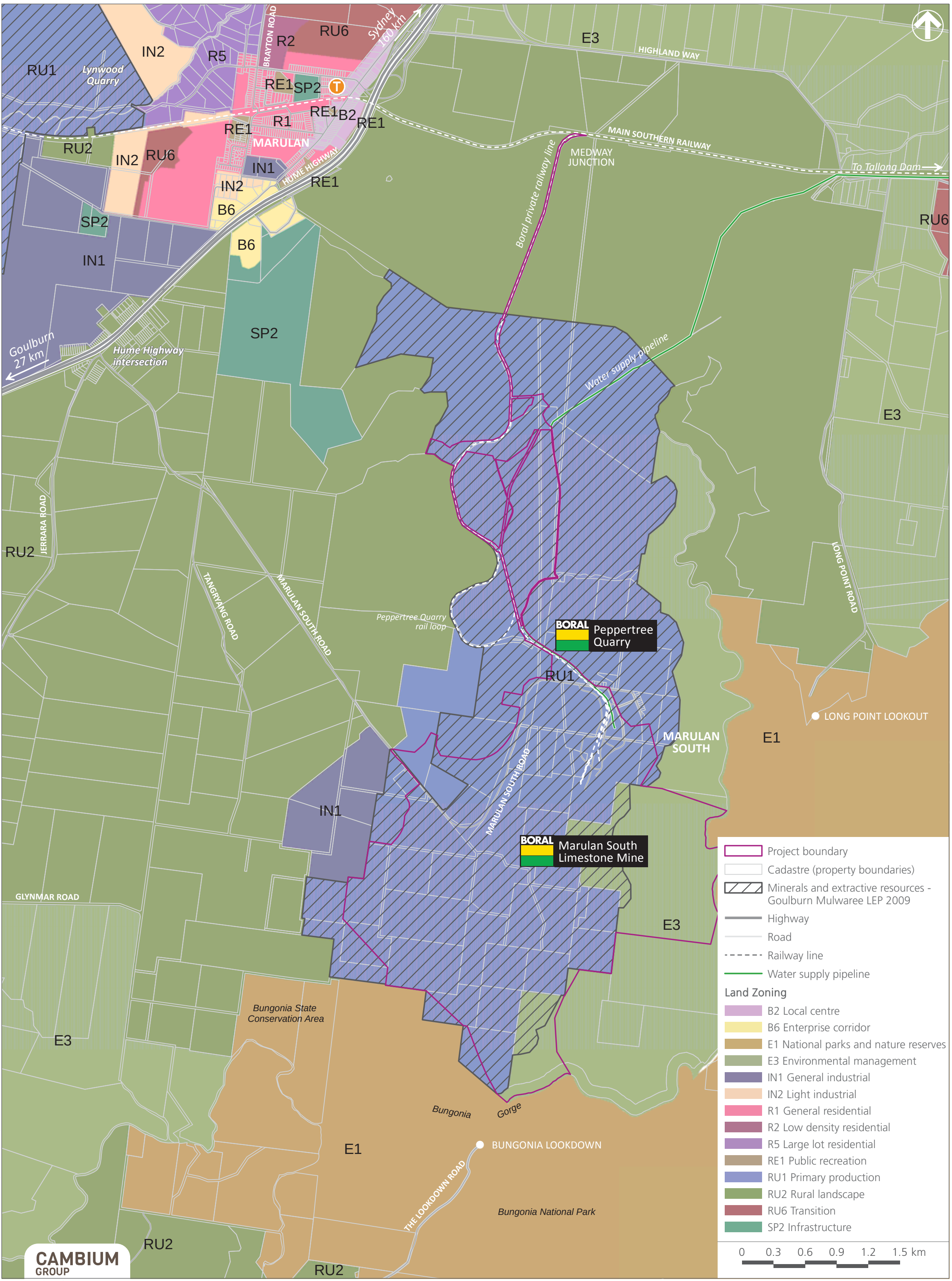
Figure 4
## Land zoning

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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East of the mine and across the Barbers Creek valley is Long Point Road, a minor dead-end rural road that terminates in the carpark of the Long Point Lookout, from which a track (McCauleys Flat Track) enters Morton NP east of the mine. Long Point Road provides access to a small number of rural properties. Other rural roads that provide potential viewing places of the Project site from isolated locations are Jerrara Road, which leads to Bungonia to the south-west and Glynmar Road/Government Road, a dead-end rural road south-west of the mine.

To the south and east the landscape is undeveloped and in a natural state in the Bungonia NP and SCA and Morton NP. In Bungonia NP directly south of the existing South Pit and a minimum of approximately 900m away, is the Bungonia Lookdown area and lookouts, from some of which the mine is visible (Plates 1/21 and 1/22 in Appendix 1).

Overall, the mine is of very low visual exposure to the public domain, other than its exposure to adjacent natural landscape in part of Bungonia NP.

### 1.4.2 Existing Scenic Resources

The existing limestone resource has been exploited since 1869. Major mining projects occurred in the 1920s to supply limestone for the cement manufacturing and steel making industries. Two separate major quarries were established at the Marulan South site by 1953 and diversified into providing materials for cement, steel-making, agriculture, glass making and the production of lime, quicklime and hydrated lime. The two mines were later amalgamated under one ownership.

The vegetation of the Project site has been validated in the Niche BAR and six native vegetation types identified. In visual terms, the areas south-east and east of the existing Pit are open to closed woodland above a sparse understorey on steep slopes of largely natural character. By contrast, the areas of native vegetation generally west of the existing Pit are highly varied in appearance. They range in appearance from grassland with some emergent trees, to open woodland or open forest, above a shrubby, or grassy understorey. Pockets of land with a relatively natural appearance are interspersed among larger, disturbed or regenerating areas of vegetation. The commonest vegetation form other than pasture in this area is grassy woodland, but with little visual consistency.

As a result of the long history of utilisation of the resource, its shape and the constraints on expanding operations to the south and east, significant changes have occurred to the topography, form, line, colour and textures of the landscape that includes the Project site.

Some of the consequences of long and continuous use of the site for extraction of the limestone and shale resources have been permanent and irreversible change to the visual and scenic resources of the site. The following visual effects have occurred:

- Removal of vegetation, soil and overburden
- Lowering of the original topographic surface
- Emplacement of overburden outside the original pits, now amalgamated into a single elongated Pit
- Filling of former gullies with overburden and rock

- Changes to the original topography, both raising and lowering it in different locations
- Exposure of the underlying weathered and unweathered rock, which although mixed in colour, has an overall light grey or, ochre to yellowish colour
- Creation of forms, lines and textures that are not found in the original either agricultural or natural environment, such as vertical rock walls, benches, batters, bunds, roads and overburden emplacements
- Landform structures, such as bunds, compacted walls, retaining and containment lines, rock lined drains and other drainage structures, contour banks, gabion walls, etc.
- Construction and use of infrastructure such as crushers, kilns, railway sidings
- Continual construction and demolition of benches, batters and roads
- Visibility of use and movement of vehicles on and off the mine/s and in construction and maintenance of earth works of various kinds, such as banks, bunds and overburden emplacement areas

Not only does the overall area of current disturbance bear little resemblance to its underlying character, other than along part of the western side of the amalgamated Pit, but even that area appears to have been disturbed in the past.

The Project site is therefore not only of very mixed visual character, but also contains little that is of original character. The adjacent rural land has also been significantly modified by historical processes of occupation, clearing, grazing and other land management practices.

*Plate 5*

*Typical appearance of the line, form, colour and texture of mined walls and benches and of the appearance of machinery in the North Pit*

*Image by RLA, June, 2014*

*Plate 6*

*Appearance of rehabilitation trial area adjacent to the Western Overburden Emplacement area*

*Image by RLA, June, 2014*

## 2.0 Assessment Methodology

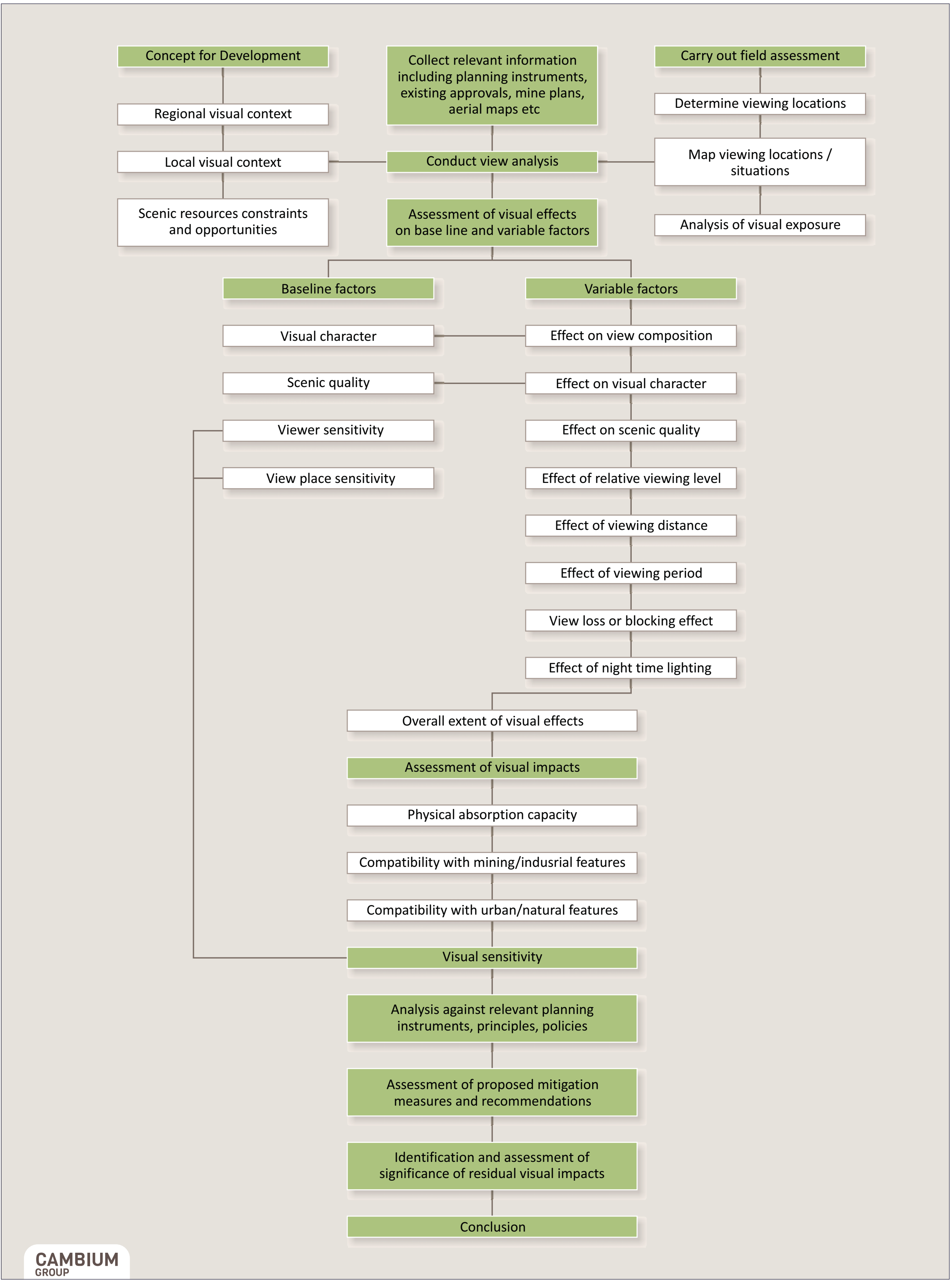
The assessment of visual impacts is a field that requires a degree of subjective judgement and cannot be made fully objective. It is therefore necessary to limit the subjectivity of the work by adopting a systematic, explicit and comprehensive approach. This has the aim of separating aspects that can be more objective, for example the physical setting, visual character, visibility and visual qualities of a Project, from more subjective elements, such as visual absorption capacity and the compatibility of the Project with the setting.

The methodology used in this assessment has been developed over several years and uses relevant aspects of methods accepted in landscape assessment, extended and modified to adapt to mining and rural environments. The modifications introduced are informed by visual perception research that has been carried out by RLA and others in both natural and mining contexts.

## 2.1 Assessment Methodology Flow Chart

The flow chart at Figure 5 below indicates the relationships among the components of the visual impact assessment methodology and the logic of the process of analysis and assessment.

Figure 5
**Methodology flow chart**



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## 2.2 Components of the Methodology

Overall, the major components of the visual impact assessment are determining the concept for the Project and general strategic planning principles, view analysis, visual effects analysis, visual impact evaluation and assessment of significance of residual visual impacts.

### 2.2.1 The Components of the View Analysis

#### The Project and detailed field assessment

This component of the view analysis includes gaining a thorough understanding of the proposed Project including its location and extent to understand its scale and spatial arrangement. The next step is to carry out a detailed field assessment by identifying the potential viewing locations (see Photographic Plates in Appendix 1), visiting the representative locations, documenting the Project's approximate location on a base map, photographing representative locations and filling out an evaluation sheet for each, which contains separate and overall assessment of the visual effects and relative visual impact factors.

The photographic analysis also utilises objective aids to visualising the likely visual effects of the proposed Project such as 3D modelling of the terrain of the site and its surroundings and the simulation of views from a series of representative viewing locations, including sensitive Residential Receivers (refer to analytical 3D graphics in Appendix 2). The 3D model's simulated views were cross-checked by observations on site to confirm or modify the models. Photorealistic photomontages were prepared for selected viewing places, based on 3D modelling (refer to Photomontages in Appendix 3).

To assist in understanding the overall visual context of the existing mine, a series of oblique aerial photographs taken for Boral in 2015 were examined (refer Plates 1 and 2 and to some further examples in Appendix 4) and the changes in the disturbance footprint were also interpreted in relation to historical aerial images (refer to Appendix 5).

At each documented viewing location or situation, an analysis sheet is prepared on which observations are recorded along with a log of photograph locations, image numbers, GPS coordinates and the altitude computed by the camera-mounted GPS. Representative images are presented in the Photographic Plates (see Appendix 1) and within this report.

Examples of the analysis sheets are in Appendix 6. The assessment factors are explained in Sections 2.2.2 and 2.2.3. The analysis sheet that was filled out for each viewing location rated the assessment on each factor in three qualitative ranges; Low, Medium or High.

#### Identification of the potential visual catchment

Visibility means the extent to which the Project would be physically visible to the extent that it could be identified, for example as a new, novel, contrasting or alternatively a familiar, recognisable but compatible feature. Features such as vegetation, buildings and intervening topography can affect the degree of visibility. We first identify the area within which the Project would be identifiable and where it could cause visual impacts by assessing its visibility within its visual catchment.

The potential visual catchment means the physical area within which the Project would be visible and identifiable.

## Identifying viewing locations and viewing situations

A viewing location is the term given to a fixed place from which a view can be experienced. The period of view (how long that view is likely to be sustained) is also a criterion of assessment that gives greater or lesser weight to the effect of the Project on the view. A viewing situation is the circumstance in which the view can be experienced. For example, a view from a road may be of single, or many different aspects of what is a view, may also be fleeting, but be repeated regularly by local users. A view from a National Park may be part of a relatively sustained view over a longer period, but not be regularly repeated. Different viewing situations have different view and viewer sensitivities.

To represent all of the kinds of viewing locations which could be affected by each of these factors and variations among them, a view point analysis is conducted. This is carried out as part of the ground truthing exercise associated with mapping the visual exposure of the site and operations. Viewing places are chosen to represent the full range of possible view experiences, situations, distances and intervening land uses in the effective visual catchment, as required by good visual impact assessment practice.

The effective visual catchment is the area within which there is sufficient detail including view of the surrounding visual context, for the proposed changes to the environment to be perceived as either positive or negative impacts.

The viewing locations fall into two categories, a) Public domain locations and b) Private domain locations. Public domain locations are major and minor roads, public reserves and recreation areas. The private domain viewing locations are predominantly residences and their settings.

It was possible for views to be assessed from most of the relatively few residences that would have views containing visual effects of the Project. It was also possible to interpret the likely effects of the Project based on views taken toward the Project from roads and reserves in the vicinity of residences that could not be visited and assessed, and also by observing the locations of windows and outdoor areas which would or may provide views.

The viewing places visited and analysed therefore represent views from both the public and the private domain. Significant vantage points from which the site can be viewed and from which views are publicly available were also assessed. A sample of the large number of general viewing places assessed, which represents examples of each relevant kind of viewing place, was abstracted from the total number of places assessed, for detailed analysis (see Figure 6).

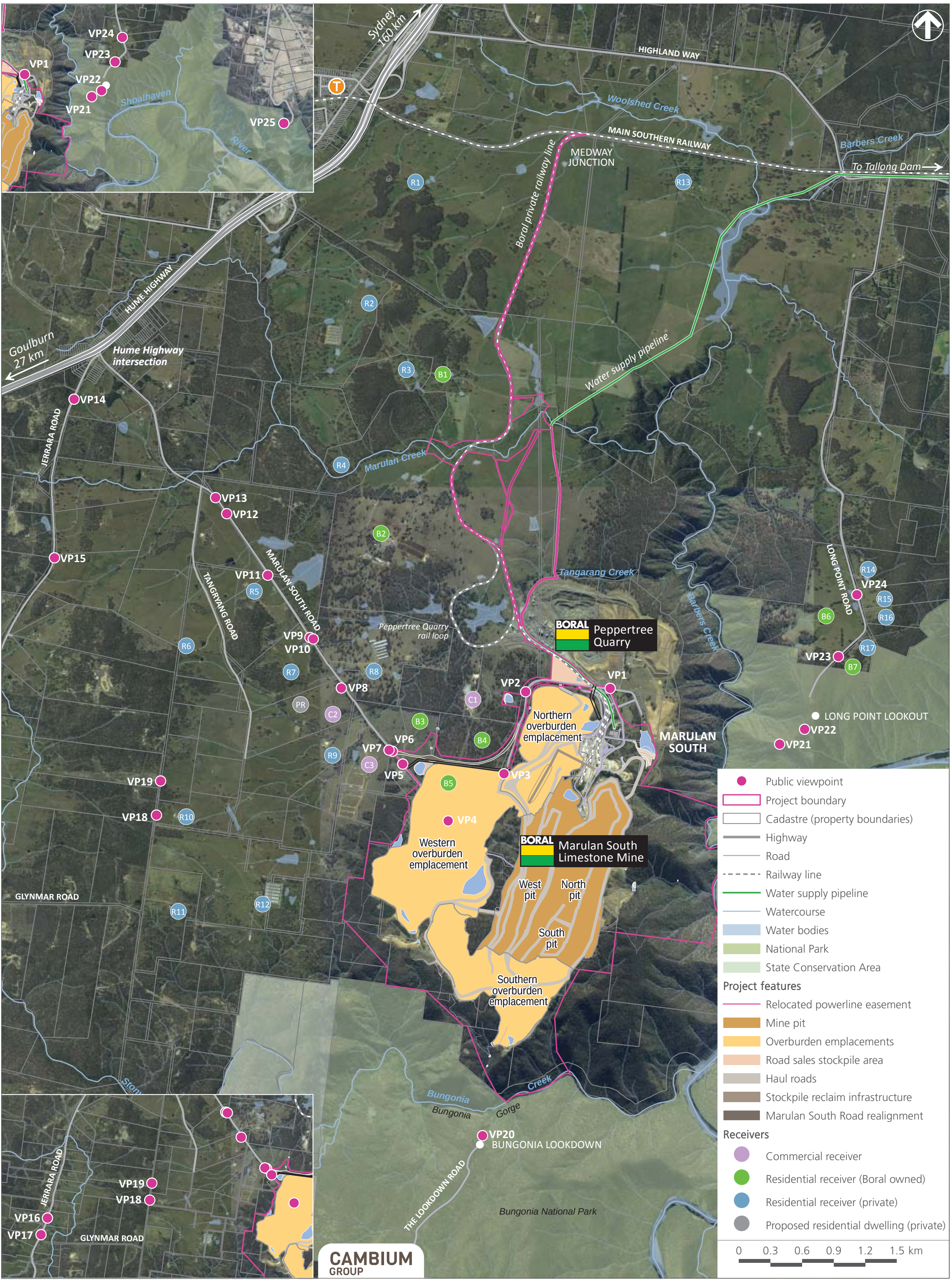
There are a large number of potential viewing locations in areas such as the national parks and reserves, from which views of some kind may be possible, from informally accessible locations. However, increasing the number of such viewing places assessed does not lead to greater accuracy of the assessment process. This is because increasing the sampling frequency of low usage or largely inaccessible places would skew the results in favour of low sensitivity places and situations, which would tend to minimise the overall level of visual effects and impacts.

### Mapping viewing locations and situations

The representative viewing locations and situations analysed during the field assessment are mapped including the ones for which photomontages have been prepared to represent the future appearance of the proposed Project in the existing context.

Figure 6
## View point location plan

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2018), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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## 2.2.2 The Components of the Visual Effect Analysis

### 2.2.2.1 Baseline Factors

The criteria that remain predominantly constant and independent of the nature of viewing locations and factors which condition the viewing situation are known as baseline factors.

**Visual character**

The visual character of the locality is the setting in which the Project would be seen and is identified. It consists of identification of the physical and biological components of the area and the setting of the Project that contribute to its visual character. The character elements include topography, vegetation, natural systems, land use, settlement pattern, urban form, industrial and infrastructure elements.

Visual character is a baseline factor against which the level of change caused by the Project is assessed. The future character of the locality and the effect that the Project is intended to make to the setting, is also relevant to assessing the extent of acceptable change to character.

**Scenic quality**

Scenic quality is a measure of the ranking which the setting of the Project would be predicted to have, on the basis of empirical research carried out on scenic beauty, attractiveness, preference, or other criteria of landscape perception. Scenic quality is another baseline factor against which the visual impacts caused by the Project are assessed.

**View place sensitivity**

View place sensitivity is the term given to a measure of the public interest in the view. The public interest is considered to be reflected in the relative number of viewers likely to experience the view, their expectations for the viewing experience and the public significance of the viewing location.

The public significance of viewing places is considered to increase from low to high in the following order: roads, general lookouts, reserves. Places from which there would be close or middle distance views available to large numbers of viewers from public places such as roads, or to either large or smaller numbers of viewers over a sustained period of viewing time in places such as lookouts and reserves, are considered to be more sensitive viewing locations.

**Viewer sensitivity**

Viewer sensitivity is the term given to a measure of the private interests in the effects of the Project on views. The private interest is considered to be reflected in the extent to which viewers, predominantly viewing from private residences, would perceive the effects of the Project. Residences from which there would be close or medium distance range views affected, particularly those which are available over extended periods from places such as living rooms and outdoor recreational spaces, are considered to be places of medium and high viewer sensitivity, respectively.

Viewing places that are of low sensitivity that are not individually assessed include commercial receivers, receivers owned by the proponent and roads that carry predominantly industrial traffic, such as the section of Marulan South Road beyond (east of) the entry to the Aglime Fertiliser Manufacturers, which is proposed to be de-proclaimed as a public road.

### 2.2.2.2 Variable Factors

The assessment factors that vary between viewing places with respect to the extent of visual effects, are known as variable factors.

#### View composition type

View composition type means the spatial situation of the Project with regard to the organisation of the view when it is considered in formal pictorial terms. The types of view composition identified are:

- Expansive (an angle of view unrestricted other than by features behind the viewer, such as a hillside, vegetation and buildings.)
- Restricted (a view which is restricted, either at close range, or some other distance, by features between or to the sides of the viewer and the view such as vegetation, buildings and topography (form elements.))
- Panoramic (a 360 degree angle of view unrestricted by any features close to the viewer who is surrounded by space elements.)
- Focal (a view that is focused and directed toward the Project by lateral features close to the viewer, such as road corridors, roadside vegetation, buildings, etc.)
- Feature (a view where the Project is the form element that dominates the view, for example a topography feature, building or structure isolated in close range views.)

It is considered that the extent of the visual effects of the Project is related to its situation in the composition of the view. The visual effect of the Project on the composition of the view is considered to be greater on a focal or a feature view, cognisant of the distance effect, compared to a restricted, panoramic or expansive view.

#### Relative viewing level

Relative viewing level means the location of the viewer in relative relief, compared to the location of the Project. It is conventional in landscape assessment to assess views from locations above, level with and below the relative location of the Project.

It is considered that the visual effects of a Project are related to both the relative viewing level and distance. Viewing levels above the Project, where views are possible over and beyond it, commonly decrease the visual effects, whereas views from level with and close to the Project, dependent on viewing distance, may experience higher effects, particularly if the Project intrudes into horizons.

## Viewing period

Viewing period in this assessment means the influence on the visual effects of the Project which is caused by the time available for a viewer to experience the view. It is assumed that the longer the potential viewing period, experienced either from fixed or moving viewing places such as dwellings, roads or reserves, the higher the potential for a viewer to perceive the visual effects of the Project. Repeated viewing period events, for example views repeatedly experienced from roads as a result of regular travelling or from residences, are considered to increase perception of the visual effects of the Project.

## Viewing distance

Viewing distance means the influence on the perception of the visual effects of the Project which is caused by the distance between the viewer and the Project proposed. It is assumed that the viewing distance is inversely proportional to the perception of visual effects. The greater the potential viewing distance, experienced either from fixed or moving viewing places, the lower the potential for a viewer to perceive and respond to the visual effects of the Project.

This also acknowledges the relationship between distance and the size of the retinal image of a viewed item in the eye. While the relationship is proportional, it is not direct, as there is an inverse exponential relationship between the retinal size of the image and the distance from the viewer. As an example, doubling the distance between a viewer and an item of a given size leads to the image appearing to be one quarter of its former size (by the inverse square of the distance). It is therefore conventional to use an exponential scaling between the effects on close range views and middle range views to acknowledge the rapid decrease in apparent size that occurs in closer range views compared to distant views. For small items such as buildings, classes of <100m, 100m-1000m and >1000m are conventionally used in our methodology.

However, for large infrastructure items such as open cut mines, wind farms, etc. which cover significant horizontal areas, larger distance ranges are necessary. We have adopted the following range classes: close range (<500m), medium range (500-3000m) and distant (>3000m).

## View loss or blocking effects

View loss or blocking effects in this assessment means a measure of the extent to which the Project is responsible for view loss or blocking the visibility of items in the view. View loss is considered in relation to the principles enunciated in the Land and Environment Court of NSW by Roseth SC in Tenacity Consulting v Warringah [2004] NSWLEC 140 - Principles of view sharing: the impact on neighbours and in Rose Bay Marina Pty Limited v Woollahra Municipal Council and anor. [2013] NSWLEC 1046 (Rose Bay Marina). Although Tenacity concerned view losses from residential properties, the matter of what could be construed to be a valuable feature of the view which could be lost, e.g. specific features of views such as whole views and iconic elements viewed across water, alluded to in Tenacity, are of some relevance to the public domain also.

The planning principles in Rose Bay Marina Pty Limited v Woollahra Municipal Council and anor. [2013] NSWLEC 1046 (Rose Bay Marina) have extended Tenacity to considering view loss from the public domain. Rose Bay does not distinguish between views taken from different eye levels (e.g. sitting versus standing position) which is relevant to Tenacity.

It is assumed that view loss and blocking effects would increase the perception of the visual effects of the Project. It is also assumed that view loss and view blocking can be important matters for consideration in regard to short range views from the public domain of roads and lookouts and potentially from nearby adjacent residences. View loss and blocking effects are likely to be more related to the visual effects of overburden emplacements than other parts of the proposed operations.

#### 2.2.2.3 Overall Extent of Visual Effect

Based on the inspection of the pattern of the assessment ratings for the above factors on the relevant analysis sheet for each viewing location an overall rating is arrived at which represents an overall extent of visual effects for a viewing location.

### 2.2.3 The Components of the Visual Impact Analysis

The criteria in Section 2.2.3 concern assessment of the extent of the visual effects of the Project when seen from specific viewing places. The extent of the visual effects is the baseline assessment against which to judge the visual impacts.

Whether a visual effect causes an impact of potential significance however, cannot be equated directly to the extent of the visual effect. A high visual effect can be quite acceptable, whereas a small one can be unacceptable. For example, in the context of the existing approvals to change the topography of the site and for a final landform that presently does not exist in the visual catchment, there are high levels of acceptable change.

To distinguish between the extent of change and the significance of the impact, it is necessary to give a weighting to the assessed levels of effects to arrive at an assessment of the level of impact.

This method therefore does not equate visual effects directly to visual impacts. The approach is to assess visual effects as in Section 2.2.2 to arrive at an overall level of visual effect of the Project for each kind of viewing place and then to assess the level of impact, if any, by giving differential weighting criteria to the level of effect determined. This means that the relative importance of impacts is distinguished from the size of the visual effect. We consider that three weighting criteria are appropriate to the overall assessment of the extent of visual impacts; Physical Absorption Capacity, Visual Compatibility and Visual Sensitivity. Each of these addressed the primary question of the acceptability of the visual effects and changes caused by the Project and how much weight ought to be given to them.

#### 2.2.3.1 Physical Absorption Capacity

Physical Absorption Capacity (PAC) means the extent to which the existing visual environment can reduce or eliminate the perception of the visibility of the proposed Project.

PAC includes the ability of existing elements of the landscape to physically hide, screen or disguise the Project. It also includes the extent to which the colours, textures, line and form and the scale and character of these allows them to blend with or reduce contrast with others of the same or closely similar kinds of items, to the extent that they cannot easily be distinguished.

Prominence is also an attribute with relevance to PAC. It is assumed in the assessment that higher PAC can only occur where there is low to moderate prominence of the Project in the scene.

Low to moderate prominence means:

- Low: The Project has either no visual effect on the landscape or the Project is evident but is subordinate to other elements in the scene by virtue of its small scale, screening by intervening elements, or difficulty of being identified.
- Moderate: The Project is either evident or identifiable in the scene, but is less prominent, makes a smaller contribution to the overall scene, or does not contrast substantially with other elements or is a substantial element, but is equivalent in prominence to other elements and landscape alterations in the scene.

Design and mitigation factors are also important to determining the PAC. Appropriate colours, materials, building forms, line, geometry, textures, scale, character, lighting and appearance of mined areas, overburden emplacements and infrastructure are relevant to increasing PAC and decreasing prominence.

PAC is related to but distinct from Visual Compatibility.

### 2.2.3.2 Visual Compatibility

Visual Compatibility is not a measure of whether the Project can be seen or distinguished from its surroundings. The relevant parameters for visual compatibility are whether the Project can be constructed and utilised without the intrinsic scenic character of the locality being unacceptably changed. It assumes that there is a moderate to high visibility of the Project to some viewing places. It further assumes that novel elements which presently do not exist in the immediate context can be perceived as visually compatible with that context provided that they do not result in the loss of or excessive modification of the visual character of the locality.

Because the Project proposed is on the interface between rural-urban and natural land, with components on each, the question of its visual impacts also depends on its perception both as an entity and in regard to its compatibility with the major scenic character attributes. In this regard, both the mining/ industrial environment and the rural- /natural environment are attributes of relevance. Hence, it is considered that there are two relevant measures of Visual Compatibility, i.e. Compatibility with Mining/ Industrial Features, and Compatibility with Rural/Natural Features.

#### Visual compatibility with mining/industrial features

This assessment is a measure of the extent to which the visual effects of the Project are compatible with existing mining and industrial features. It is assumed that in some views the Project can be seen and clearly distinguished from its surroundings. Compatibility does not require that identical or closely similar features to those which are proposed, exist in the immediate surroundings.

Compatibility with Mining/Industrial Features means that the Project responds positively to or borrows from within the range of features of character, scale, form, colours, textures, materials and geometrical arrangements of mining and industrial features of the surrounding area or of areas of the locality which have the same or similar existing visual character.

As the site has seen mining activity since 1875 and major limestone mining since the 1920s, or nearly 100 years, the compatibility of the visual effects of the SSD application has to also be considered in relation to an existing environment, the scenic resources of which have been fundamentally and in many ways irreversibly changed in a variety of ways (see Section 1.4.2 above).

**Visual compatibility with rural/natural features**

This assessment is a measure of the extent to which the visual effects of the Project are compatible with the adjacent semi-rural and natural features. In some views, the Project can be seen and clearly distinguished from its surroundings. Compatibility does not require that identical or closely similar features to those which are proposed, exist in the immediate surroundings.

Compatibility with rural and natural features means that the Project responds positively to or borrows from within the range of features of character, scale, form, colours, materials and geometrical arrangements of the surrounding area or of areas of the locality which have the same, similar or compatible existing visual character.

### 2.2.3.4 Visual Sensitivity

Three visual sensitivity zones are identified which are based on the view place sensitivity or viewer sensitivity as explained in 2.2.2.1. These are related to the distance zones from the Project site and whether views are from significant public domain or private viewing locations. Impacts on viewing places in the high or medium visual sensitivity zones may be given extra weight if considered appropriate.

## 2.2.4 Overall Extent of Visual Impact

Based on the inspection of the pattern of the assessment ratings for the above factors on the relevant analysis sheet for each viewing location an overall rating is arrived at which represents an overall extent of visual impacts for a viewing location, after applying the weighting factors of PAC, visual compatibility and visual sensitivity.

### 2.2.4.1 Assessment of the mitigation measures proposed

The mitigation measures that are proposed as part of the Project are then assessed in terms of their capability to overcome the visual impacts of the Project. Other mitigation recommendations and management guidelines may be formulated to overcome possible negative visual effects that would lead to potential residual visual impacts.

### 2.2.4.2 Significance of residual visual impacts

Finally and subsequent to the visual effects of the mitigation factors being assessed, a relevant question is whether there are any residual visual impacts of the Project itself, and whether they are acceptable in the circumstances. These residual impacts are predominantly related to the extent of visual change independent of the history of permanent and irreversible change that has occurred in the past.

Whether overcoming these impacts would result in undermining of the potential capacity of the Project site to economically support the intended use is not the focus of a visual impacts assessment.

# 3.0 Project description

## 3.1 Overview

Boral Cement Limited (Boral) owns and operates the Marulan South Limestone Mine (the mine). It is a long standing open cut mine that has produced up to 3.38 million tonnes of limestone based products per year for the cement, steel, agricultural, construction and commercial markets.

The mine is a strategically important asset for Boral, as it supplies the main ingredient for the manufacture of cement at Boral's Berrima Cement Works. This is also a strategically important operation for Sydney based consumers of these products as this represents around 60% of the cement sold in NSW and feeds into more than 30% of concrete sold in Sydney.

The mine operates under Consolidated Mining Lease No. 16 (CML 16), Mining Lease No. 1716, Environment Protection License (EPL) 944 and a combination of development consents issued by Goulburn Mulwaree Council and continuing use rights.

Due to changes between the Mining Act 1992 and the Environmental Planning & Assessment Act 1979 (EP&A Act), when mining moves beyond the area covered by the current Mining Operations Plan, a development consent under the EP&A Act will need to be in place.

An Environmental Impact Statement has been prepared by Element Environment Pty Ltd on behalf of Boral for submission to the Department of Planning and Environment to satisfy the provisions of Part 4 of the EP&A Act. Boral is seeking approval for continued operations at the site through a development application for a State Significant Development including a 30 year mine plan, associated overburden emplacement areas and a mine water supply dam (hereafter referred to as 'the Project').

## 3.2 Site Description

### Site Location

The mine is in Marulan South, 10 km southeast of Marulan village and 35 km east of Goulburn, within the Goulburn Mulwaree Local Government Area in the Southern Tablelands of NSW (Figure 1). Access is via Marulan South Road, which connects the mine and Boral's Peppertree Hard Rock Quarry (Peppertree Quarry) with the Hume Highway approximately 9 km to the northwest (Figure 1). Boral's private rail line connects the mine and Peppertree Quarry with the Main Southern Railway approximately 6 km to the north (Figure 1).

### Land Use and Ownership

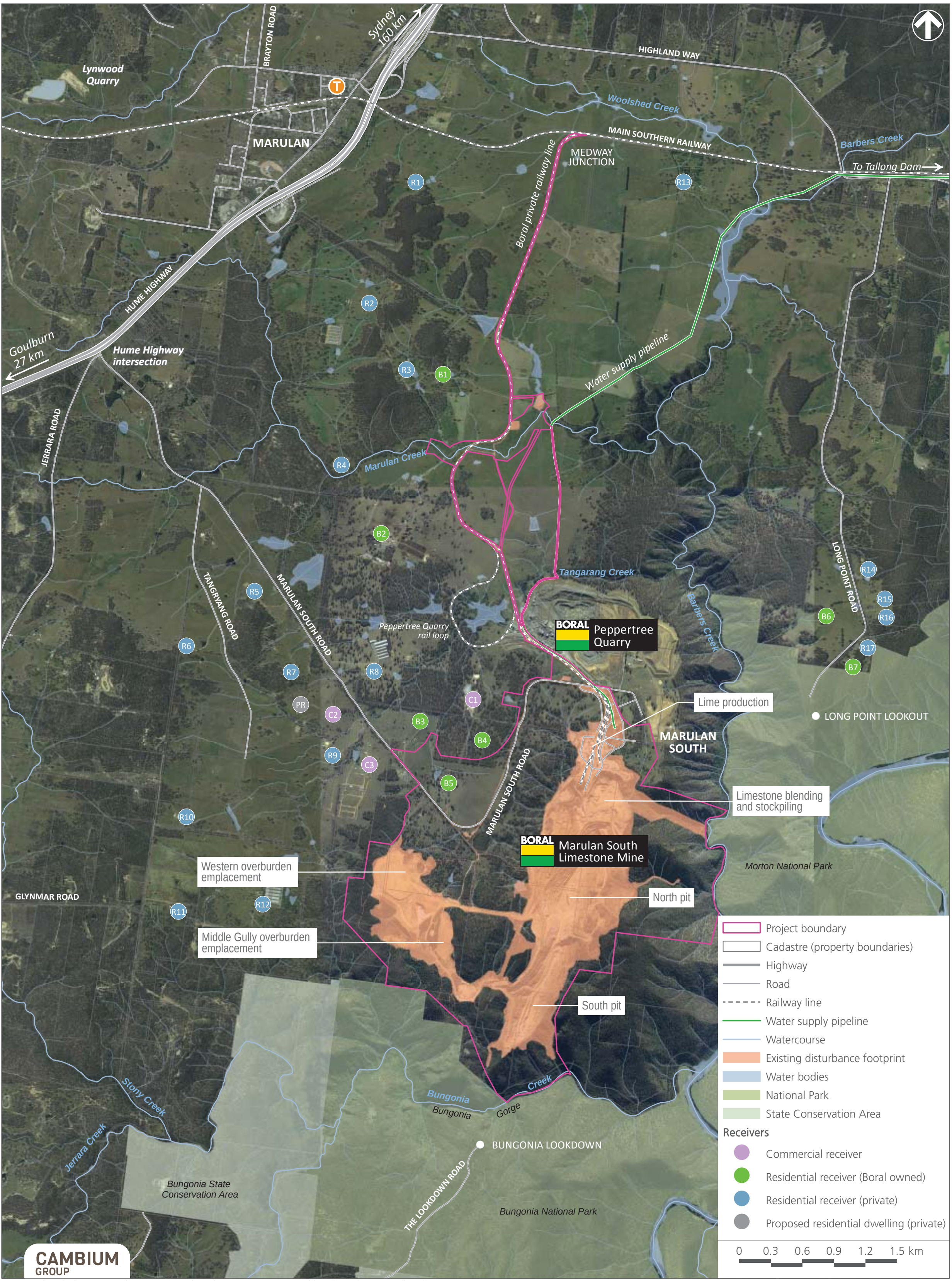
CML 16 (which encompasses ML 1716) covers an area of 616.5 hectares (ha), which includes land owned by Boral (approximately 475 ha), Crown Land (adjoining to the south and east) and five privately owned titles (Figure 3). There is also Boral owned land surrounding the mine that does not fall within CML 16.

Land use surrounding the mine is a mixture of extractive industry, grazing, rural residential, commercial/industrial and conservation.

The mine is separated from the Bungonia State Conservation Area to the south by Bungonia Creek and is separated from the Shoalhaven River and Morton National Park to the east by Barbers Creek.

Figure 7
**Existing disturbance footprint**

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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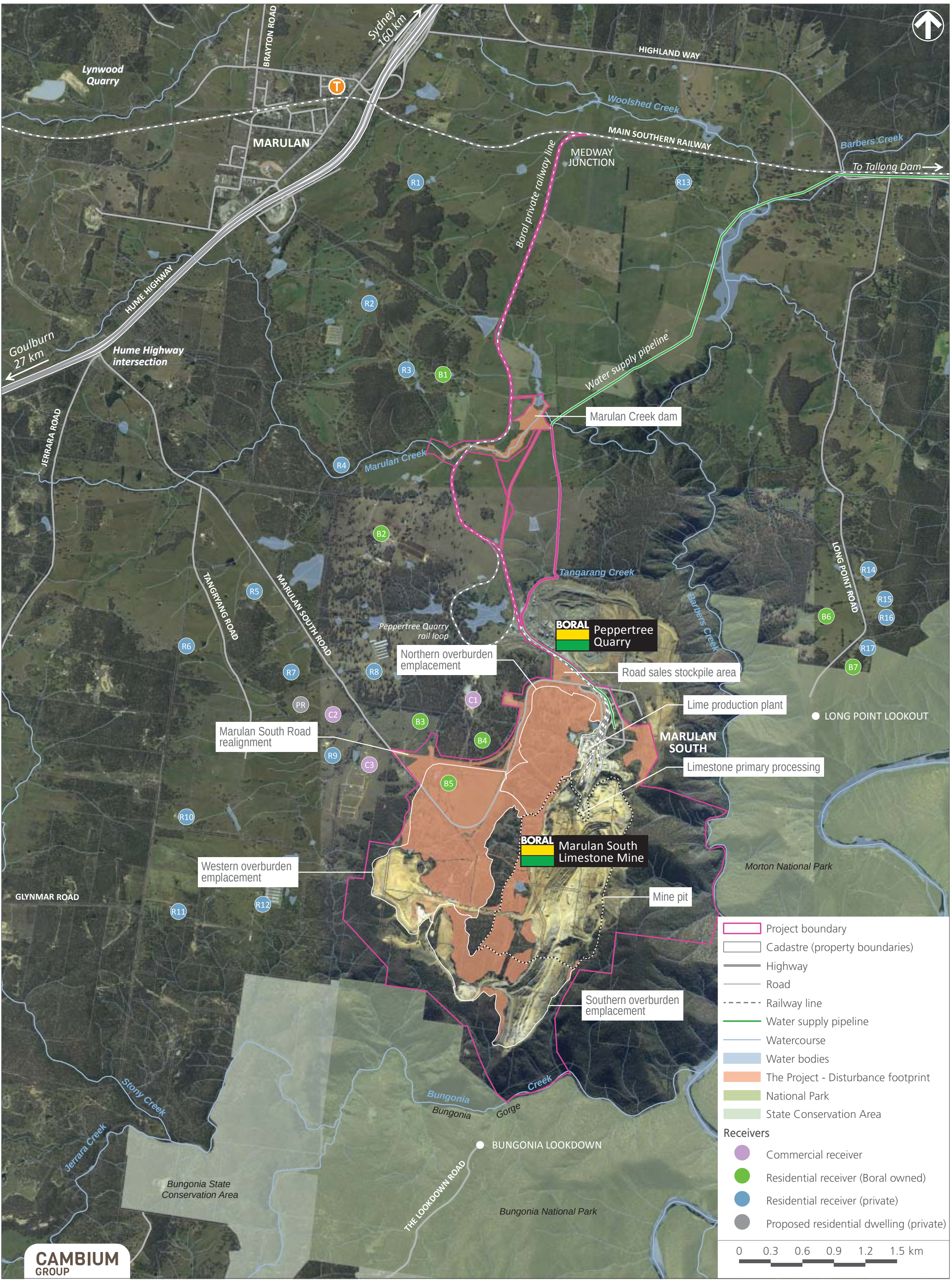
Figure 8
**The Project - Disturbance footprint**

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
**VISUAL IMPACT ASSESSMENT**



Source: LPI (2017), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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Peppertree Quarry, owned by Boral Resources (NSW) Pty Limited, borders the mine to the north. The site of the former village of Marulan South is between the mine and Peppertree Quarry on land owned by Boral. The village was established principally to service the mine but has been uninhabited since the late 1990's. The majority of the village's infrastructure has been removed and only a village hall and former bowling club remains. The bowling club has been converted into administration offices for the mine and the hall is used by the mine services team.

A small number of rural landholdings surround the Boral properties to the north and west, including an agricultural lime manufacturing facility, fireworks storage facility, turkey farm and rural residential (a number of these properties are actively grazed). The main access for these properties is via Marulan South Road. Rural residential properties are also located to the northeast of the mine along Long Point Road. These properties are separated from the mine by the deep Barbers Creek gorge.

## Zoning

The majority of the site is zoned RU1 - Primary Production zone under the Goulburn Mulwaree Local Environmental Plan (LEP) 2009. Mining and extractive industries are permissible in this zone with consent.

The remaining area is zoned E3 - Environmental Management. Under this zone mining and extractive industries are prohibited development, although historically mining has occurred within these areas under "existing use rights" as mining and processing operations commenced well before the commencement of the Mulwaree Planning Scheme Ordinance (PSO) on 15 May 1970. Notwithstanding that both mining and extractive industries are prohibited in the E3 zone these activities are permissible pursuant to State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007. In accordance with Clause 7(1)(b)(i) of this SEPP mining can be carried out with consent in any zone which has agriculture as a permissible land use (with or without consent). Agriculture is permitted with consent in the E3 - Environmental Management zone under the Goulburn Mulwaree LEP 2009. Similarly, Clause 7(3)(a) of this SEPP makes it clear that extractive industries can be carried out with consent in any zone which has agriculture as a permissible land use (with or without consent). Therefore, both mining and extractive industries are land uses which can be carried out provided development consent is granted.

Boral operates the mine pursuant to Section 109 of the EP&A Act and the continuance of an existing use and its expansion is possible provided the necessary approvals are in place. Therefore, there are no environmental planning issues that would prohibit approval of expanded operations at the mine.

Importantly, the Project aims to improve the stability of existing overburden emplacements and improve rehabilitation outcomes over the entire site.

## Topography and Hydrology

The Southern Highlands, similar to the Blue Mountains to the north-west, are predominantly comprised of a level plateau with the occasional high intrusive volcanic remnant mountains, such as Mount Jellore, Mount Gibraltar and Mount Gingenbullen. On the seaward side they decline into a steep escarpment that is heavily divided by the headwaters of the Shoalhaven River.

The Project site and surrounds is characterised by the rolling hills of pasture and grazing lands interspersed with woodland to the west, contrasting with the heavily wooded, deep gorges that begin abruptly to the east of the mine, forming part of the Great Escarpment and catchment of the Shoalhaven River. As such, local relief of Marulan South ranges from around 130 m Australian Height Datum (AHD) to over 630 m AHD.

The Project site is drained by a number of minor ephemeral drainage lines into Barbers Creek to the east and Bungonia Creek to the south. These creeks are tributaries of the Shoalhaven River, which is 1.5 km from the mine (at its closest point) and flows eastwards into Lake Yarrunga, approximately 20 km downstream and enters the Pacific Ocean approximately 15 km east of Nowra (approximately 100 km downstream).

### Geology

The Marulan South limestone deposit lies within the Lachlan Geosynclinal Province. During the Palaeozoic Era (500 to 300 million years ago) thick sedimentary formations were laid down in the region. The formations included sediments, volcanic lavas and ash, and limestone reefs.

A reef complex formed the Bungonia Limestone Group, which was later folded and faulted by crustal collisions and then subsequently levelled by substantial erosion. About 65 million years ago the area was again uplifted giving way to a rejuvenated river system leading to the landscape of today.

The Bungonia Limestone formations at Marulan South consist of a number of generally parallel and north-south striking beds dipping to the west. The Bungonia Limestone includes:

- Eastern Limestone, which is the oldest, easternmost and thickest unit; and
- Mt. Frome Limestone, which is the younger unit that lies to the west of the Eastern Limestone and is made up of three sub-parallel sub-units including the Upper Limestone (furthest west), Middle Limestone and Lower Limestone (furthest east).

Separating the limestone units are fine grained sediments including shales, mudstones, siltstones and minor fine sandstones.

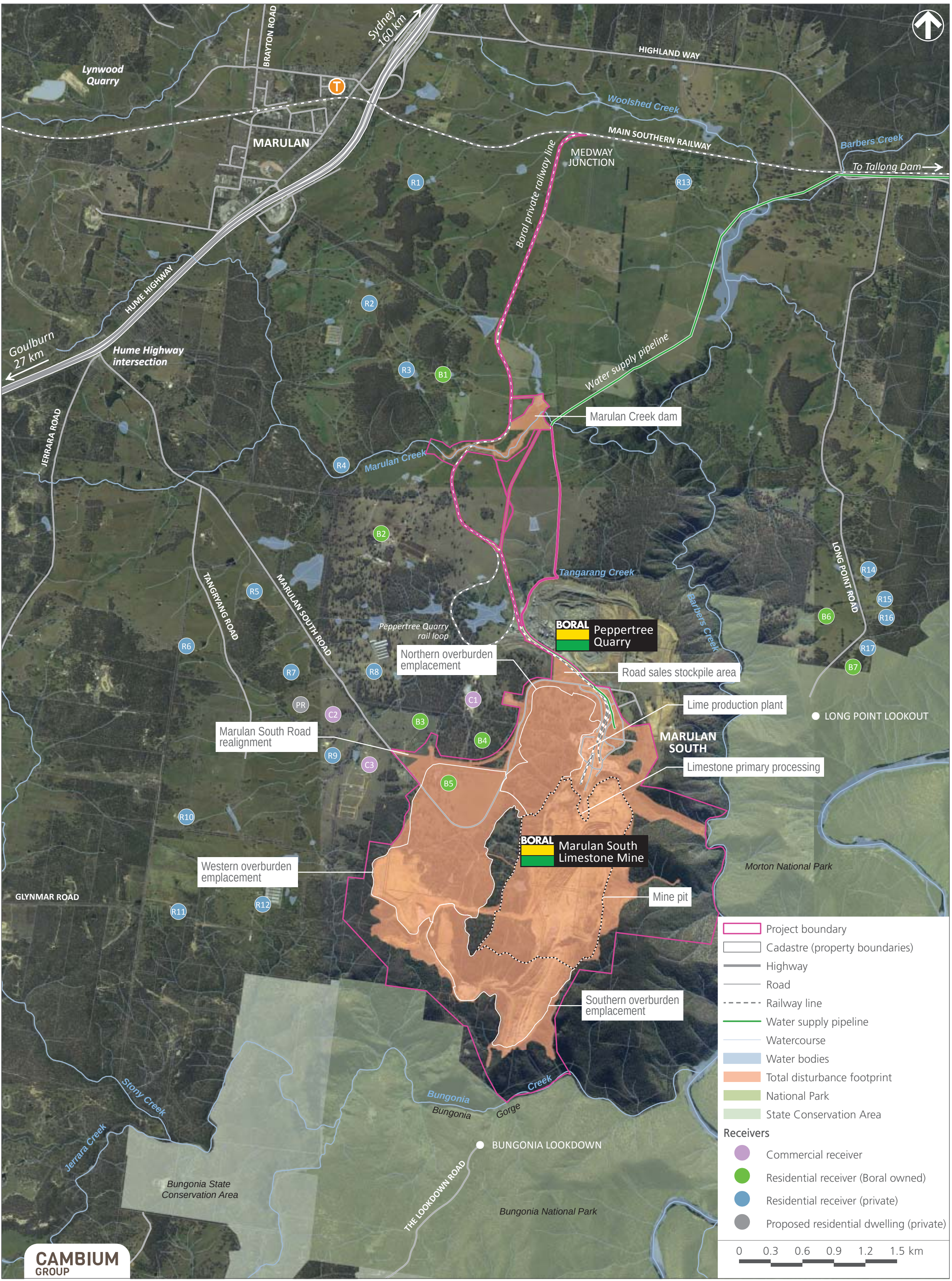
The total horizontal width of the Bungonia Limestone is approximately 670m east-west. The true depth of the Bungonia Limestone is not known as the termination of the limestone is not visible either in the mine or at the bottom of the Bungonia gorge to the south. To date even the deepest drill holes (approximately 300 m) in the mine have ended in limestone.

The Eastern Limestone has the highest grade and was therefore selected for the commencement of mining. The Eastern Limestone is still the focus of current mining operations, however mining of Mt. Frome Middle Limestone commenced in approximately 2016.

The Bungonia Limestone Group is bound to the east by the older Tallong shale beds and in the west by the Tangarang Volcanics (younger shales, volcanic and associated sedimentary rocks). A north-south and various east-west dolerite dykes penetrate the limestone from beneath and the limestone bed is cut off in the north by the Glenrock Granodiorite intrusion, which is extracted by Peppertree Quarry.

Figure 9
## The Limestone Mine - Total disturbance footprint

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
**VISUAL IMPACT ASSESSMENT**



Source: LPI (2017), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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### Climate

The mine is in Australia's cool temperate climatic region, which is characterised by mild to warm summers and cold winters, with common frost and occasional snow fall.

Long term climatic data was obtained from the Bureau of Meteorology (BoM) automatic weather station at Goulburn Airport, approximately 25 km west-southwest of the mine.

The BoM weather station shows that January is the hottest month with a mean maximum temperature of 27.9 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 0.3°C.

Average annual rainfall is 551.9 mm. Rainfall peaks during the summer and the month of June. June is the wettest month with an average rainfall of 60.9 mm over 7.0 days and April is the driest month with an average rainfall of 25.6 mm over 4.0 days.

Relative humidity levels exhibit variability and seasonal flux across the year. Mean 9am relative humidity levels range from 65% in October and December to 88% in June. Mean 3pm relative humidity levels vary from 39% in December to 63% in June. Wind direction is predominantly from the west in winter and from the east in summer.

Wind speeds have a generally similar spread between the 9am and 3pm conditions. The mean 9am wind speeds range from 12.2 km/h in March to 19.8km/h in September. The mean 3pm wind speeds vary from 19.8km/h in April to 26.5km/h in August.

## 3.3 Existing Operations

The mine is sited on a high-grade limestone resource. Subject to market demand the mine has typically produced 3 to 3.38 million tonnes of limestone and 120,000 to 200,000 tonnes of shale per annum.

The mine currently produces a range of limestone products for internal and external customers in the Southern Highlands/Tablelands, the Illawarra and Metropolitan Sydney markets for use primarily in cement and lime manufacture, steel making, agriculture and other commercial uses. Products produced at the mine are despatched by road and rail, with the majority despatched by rail.

Historically limestone mining was focused on the approximately 200-300 m wide Eastern Limestone and was split between a North Pit and a South Pit. A limestone wall (referred to by the mine as the 'centre ridge') rising almost to the original land surface, divided the two pits. The North and South Pits were recently joined in 2016/2017 by mining the centre ridge to form a single contiguous pit, approximately 2 km in length. However, the North Pit/South Pit nomenclature remains important as current mining operation locations continue to be reported with respect to one or other of the old pits.

Limestone and shale are extracted using open-cut hard rock drill and blast techniques. Material is loaded using front end loaders and hauled either to stockpiles or the processing plant using haul trucks. Oversized material is stockpiled and reduced in size using a hydraulic hammer attached to an excavator.

Limestone processing facilities including primary and secondary crushing, screening, conveying and stockpiling plant and equipment are in the northern end of the North Pit. Kiln stone grade limestone is also processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment. Overburden from stripping operations is emplaced in the Western Overburden Emplacement, west of the open cut pits.

The current operations are 24 hour, 7 days per week with personnel employed on a series of 8, 10 and 12 hour shifts to cover the different operational aspects of the mine. Blasting is restricted to daylight hours and on weekdays, excluding public holidays.

## 3.4 The Proposed Project

### Mining Operations

Boral proposes to continue mining limestone from the mine at a rate of up to 4 million tonnes per annum (mtpa) for a period of up to 30 years. This represents an increase in extraction rate from historic levels (peak of 3.38 mtpa) due to forecast increased demand from the construction industry. Shale will continue to be extracted at a rate of up to 200,000 tonnes per annum (tpa).

The proposed 30 year mine plan accesses approximately 120 million tonnes of limestone down to a depth of 335 m AHD. The mine footprint focuses on an expansion of the North Pit westwards to mine the Middle Limestone and to mine deeper into the Eastern Limestone. As the Middle Limestone lies approximately 70 m to 150 m west of the Eastern Limestone, the 30 year mine plan avoids mining where practical the interburden between these two limestone units thereby creating a smaller second, north-south oriented West Pit with a ridge remaining between. The North Pit will also be expanded southwards, encompassing part of the South Pit, leaving the remainder of the South Pit for overburden emplacement and a visual barrier (Figure 8).

In addition to mining approximately 5 million tonnes of shale, the extraction of the limestone requires the removal of approximately 108 million tonnes of overburden over the 30 year period. This material will be emplaced within existing and proposed overburden emplacement areas (Figure 8).

Limestone will continue to be mined using drilling and blasting methods. Shale will continue to be mined by excavator/front end loader. Limestone, shale and overburden will be transported to the primary crusher, stockpile areas and overburden emplacements respectively, using the load and haul fleet of trucks.

Products produced at the mine will continue to be despatched by road and rail, with the majority despatched by rail.

The limestone sand plant, produces a crushed and air classified limestone sand for use in concrete. The mine currently produces 500,000 tpa for Peppertree Quarry and propose to increase production of manufactured sand to approximately 1 million tpa.

Boral’s adjoining Peppertree Quarry currently has approval to emplace some of its overburden in the South Pit mine void. As the South Pit is required for the emplacement of over 30 million tonnes of overburden from the mine after the removal of accessible limestone, Boral proposes to emplace up to 15 million tonnes of overburden from Peppertree Quarry within the Northern Overburden Emplacement (Figure 8).

### Associated Infrastructure

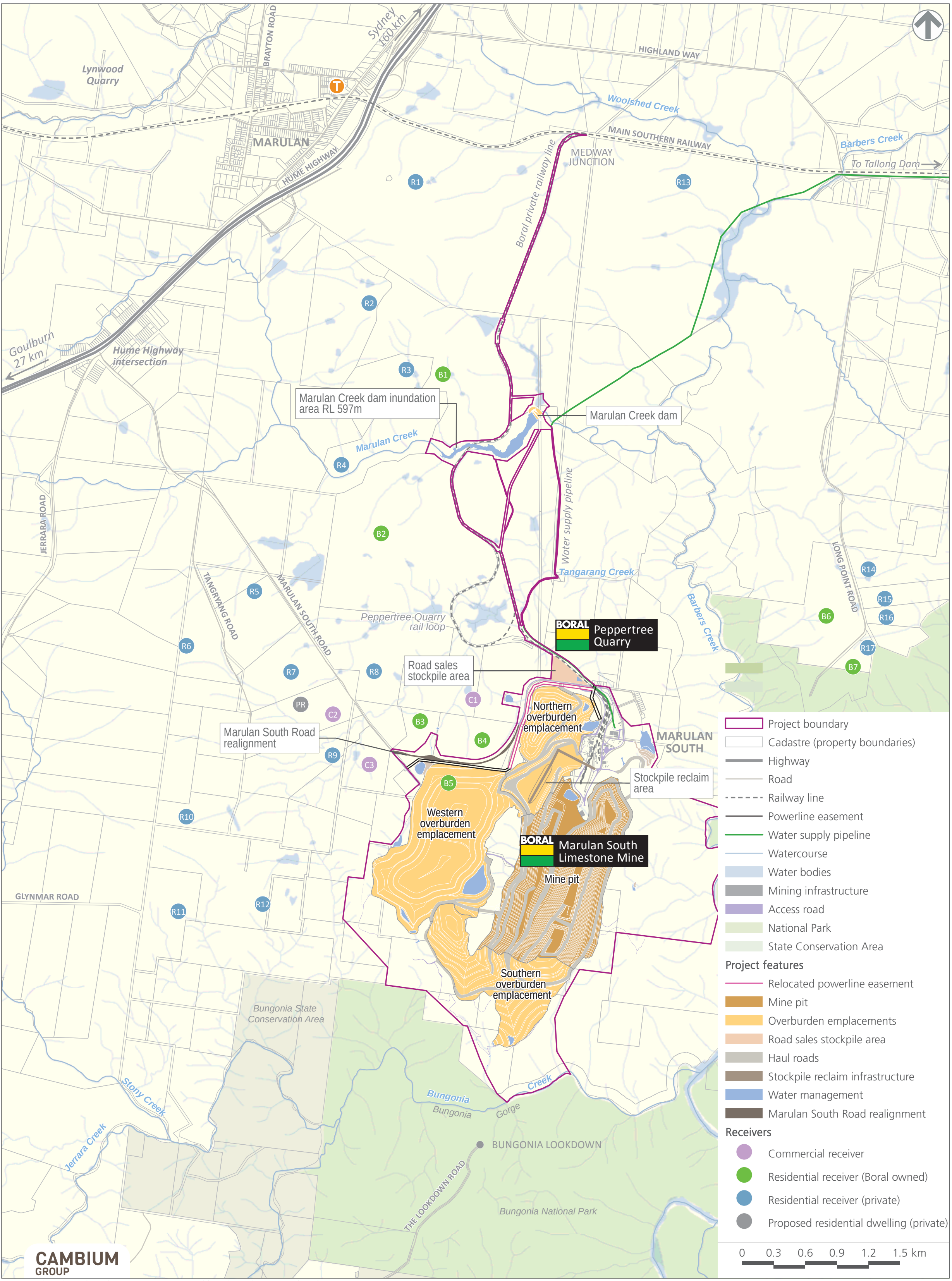
### Processing

The existing facilities for processing limestone will continue to be utilised to produce a series of graded and blended limestone products that are despatched from site for use primarily in cement manufacture, steel making, commercial and agricultural applications.

Figure 10

## The Project

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



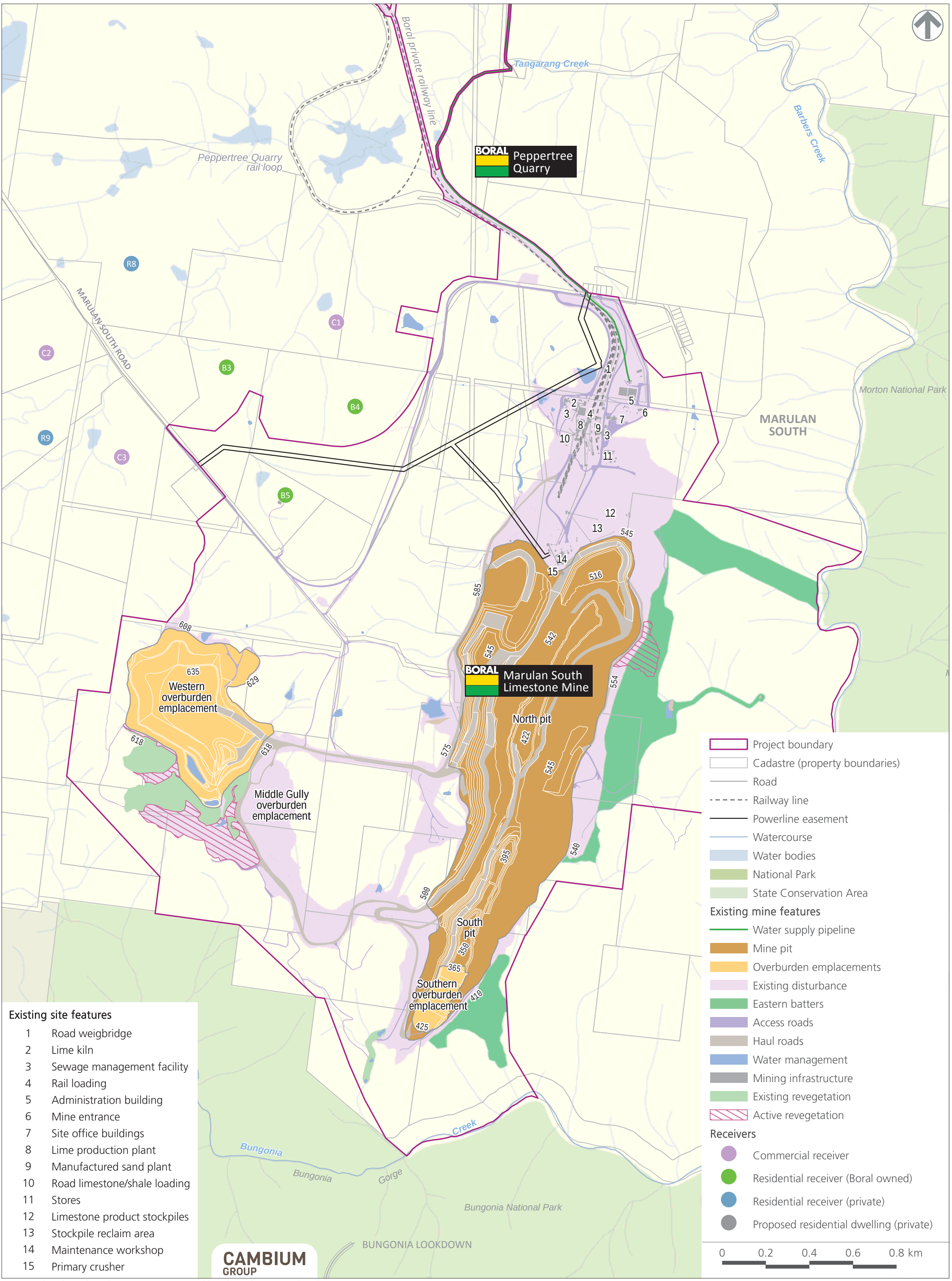
Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

031140_EIS_VIA_F10_180906_v01

Figure 11

## Existing operations - Stage 0

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

031040_EIS_VIA_F11_180906_v01

Limestone processing facilities (Figure 7) include primary and secondary crushing, screening, conveying and stockpiling plant and equipment located north-west of the North Pit and extending to the tertiary crushing, screening, bin storage and despatch (rail and road) systems that form part of the main processing facilities.

Kiln stone grade limestone will also continue to be processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment.

Processing infrastructure and the reclaim and stockpile area at the northern end of the North Pit will be relocated during the life of the 30 year pit to enable full development of the mine plan. The timing and location of this is presented in the EIS.

Shale and white clay will not be processed and will be stockpiled directly from the pit, ready for dispatch by road to the Berrima and Maldon cement operations.

### Water Supply

Water supply for the Project, including dust suppression, processing activities and some non-potable amenities will be from existing and new on-site dams and a proposed new water supply dam on Marulan Creek (Figures 18 and 19). This dam would be located on Boral owned land north of Peppertree Quarry and utilises Boral's adjoining Tallong water pipeline to transfer water to the mine. This dam would require the purchase of water entitlements.

Mine water demand will also be supplemented by Tallong Weir via the Tallong water pipeline.

### Rail

No changes are proposed to the existing rail infrastructure. A 1.2 km long passing line was constructed at Medway Junction during construction of the Peppertree Quarry, which will also be used by the mine to enhance access to the Main Southern Railway.

### Road

Road access from the mine to the Hume Highway is via Marulan South Road. The proposed Western Overburden Emplacement extends northwards over Marulan South Road. Boral propose to realign a section of Marulan South Road, to accommodate the northern portion of the proposed Western Overburden Emplacement (Figure 8).

All public roads within the former village of Marulan South as well as the section of Marulan South Road between Boral's operations and the entrance to the agricultural lime manufacturing facility will be de-proclaimed.

### Power

Power supply to the mine is via a high voltage power line that commences at a sub-station on the southern side of Marulan South Road, immediately west of the Project boundary. A section of this power line will be relocated to accommodate the proposed Northern Overburden Emplacement (Figure 8).

### Transport

The majority of limestone products will continue to be transported to customers by rail for cement, steel, commercial and agricultural uses. Boral seeks no limitation on the volume of products transported by rail.

Manufactured sand will continue to be transported by truck along a dedicated internal road, across Marulan South Road and into Peppertree Quarry for blending and dispatch by rail.

Agricultural lime, quick lime and fine limestone products will continue to be transported by powder tanker, bulk bags on trucks or open tipper trucks along Marulan South Road.

Shale, limestone aggregates, sand and tertiary crushed products will be transported by predominantly truck and dog along Marulan South Road.

The adjoining Peppertree Quarry is currently approved to transport all products by rail. Boral will seek to transport approximately 150,000 tpa of Peppertree Quarry's products from the mine to customers via Marulan South Road. This could be achieved by back loading to a new shared road sales product stockpile area by the trucks carrying the limestone sand to Peppertree Quarry. A new shared road sales product stockpile area is proposed on the northern side of Marulan South Road, immediately west of the mine and Peppertree Quarry entrances (Figure 8). This shared finished product stockpile area, includes a weighbridge and wheel wash and will service both the mine and Peppertree Quarry.

In total, Boral is seeking to transport up to 600,000 tpa of limestone and hard rock products along Marulan South Road to the Hume Highway, as well as 120,000 tpa of limestone products to the agricultural lime manufacturing facility.

# 4.0 Assessment of Visual Effects

## Summary of Visual Exposure

Below is a summary of the likely future visual exposure of the Project. This is considered in more detail in relation to individual viewing locations and situations in Section 5.0.

Visual exposure of the existing operations is low to the adjacent rural land to the south-west, west and north, , where the greatest concentration of potential receivers exists, as the current operations are predominantly below the horizons of view. The site of the proposed Marulan Creek Dam to the north of the Project site is not visible to any publicly accessible viewing place. Detailed analysis of the likely changes in visual exposure caused by the Project show that the overall low visual exposure of the Project is likely to remain low.

The visual exposure of the Project with the exception of the Marulan Creek Dam, would be to a slightly larger area than that of the existing mine operations. This is primarily because of the proposed location of overburden emplacement areas to the west, south-west and north-west of the amalgamated North and South Pits. A consequence of the proposed emplacements is that in some views from the landscape, in particular from the south-west and west, the topography of the intermediate horizon will be slightly changed as out of Pit emplacements are constructed, elevating the existing horizon and increasing the visual exposure of newly formed topography to views. There are no close viewing places or receivers to the north of the site.

Parts of the existing operations are of high exposure to medium to distant views from the east and south (part of the MCauleys Flat track south of the Long Point lookout (see Plates 1/23 and 1/24 in Appendix 1), the Bungonia Lookdown area (see Plates1/21 and 1/22 in Appendix 1) and parts of the Morton NP. This will initially continue to be the situation in the Project.

In the medium range views from the east from isolated residences in the Long Point Road locality, (see Plates 1/40 and 1/41 in Appendix 1), the informal viewing places in the Morton NP accessed from the McCauleys Flat track (see Plates 1/23 and 1/24 in Appendix 1), and the distant views from Badgerys lookout (see Plate 1/29 in Appendix 1), the increased height and visual exposure of the emplacements west of the Pit will not significantly alter the composition of the view. While mining will occur deeper into the west faces of the Pit which are partly visible from the east direction, a similar surface area of excavated faces will be visible as at present. A minor change will occur in the mid-ground horizon of the view caused by increase in the height of the landscape caused by the Western and Northern Overburden Emplacements.

In the medium to long range views from the Bungonia Lookdown area (VP20), where there has been high exposure of the operations for many years (See historic aerial imagery in Appendix 5), the Project will be most exposed. There is now a direct view into the amalgamated Pit (see cover page and Plate 1/21 in Appendix 1), exposing more of the northern floor and western walls and the setting of the processing area, which were not visible before the ‘isthmus’ between the two former pits was removed. The increase in width of the Pit proposed in the Project, toward the west, will also be evident, as will the increase in area occupied by overburden emplacements especially the closest; formed through the gradual backfilling of the former South Pit by the eastern part of the Southern Overburden Emplacement.

For a time, the increasing width of the amalgamated Pit will be evident in the views from the Bungonia Lookdown. The areas proposed in the Project to be occupied by the parts of the Western, Southern and Northern Overburden Emplacements will also be visible (see analytical 3D graphics and the photomontage for VP20 in Appendix 3). However, as noted later in this report and as demonstrated by 3D modelling of the views and a photomontage in Appendix 3, the Southern Overburden Emplacement will, in Stage 3 and by the end of Stage 4, significantly decrease views into the Pit as the surfaces of the overburden emplaced in the Pit are sequentially rehabilitated. The Southern Overburden Emplacement will gradually occlude the view into the floor and of the extent of the Pit to the north and will also block views of a significant part of the proposed increase in width of the Pit toward the west.

## 4.1 Field Assessment

A detailed field assessment was undertaken on three occasions in 2015, backed up by additional observations, new photography of some viewing locations and analysis and assessment of the amended mine plans in 2018.

### 4.1.1 Viewing Locations and Viewing Situations

To assess the visual impacts that would be experienced by viewers, a view point analysis was conducted. This consisted of analysing the likely visual exposure of the Project using topographic, cadastral and aerial images, then visiting the site and locality to ground-truth potential viewing places and situations. A selection of places was abstracted from the total number of potential viewing locations and situations for individual documentation and assessment. The key viewing locations included a number of public domain locations including those on roads, recreational areas and lookouts, as well as the vicinity of a number of Residential Receivers. The location of the viewing places assessed is shown on Figure 6.

The locations were selected to represent the kinds of viewers' experience of the Project that would exist in the immediate area. Locations that represent the main kinds of viewing areas that would be affected were visited and photographed. The photographs were taken with a Canon EOS 5D Mark 3 FX format full-frame digital SLR camera with a fixed 35mm focal length lens. A GPS unit attached to the camera wrote the coordinates of each photograph onto the electronic meta-data of each electronic image file, so the locations could be accurately determined for the purpose of 3D modelling of the likely visual effects of the Project and so viewing locations can be accurately located in the future, if necessary, for monitoring purposes.

At each viewing place a series of observations and assessments were made, as documented at the viewing places shown in Figure 6, Photographic Plates in Appendix 1 and in the assessment sheets in Appendix 6. A variety of other locations were also visited to ascertain the extent of the visual catchment and the characteristics of the views.

### 4.1.2 Visual Catchment

The theoretic visual catchment extends in particular toward the east, south-east and south across a significant area of the Bungonia NP and SCA and Morton NP. The Marulan Creek Dam is not exposed to view from any public or private viewing place other than to land in its vicinity belonging to Boral.

The visual catchment of the remainder of the Project cannot be delineated by a finite boundary, because visibility is strongly influenced by the undulating topography, vegetation and clearing pattern and by the generally low exposure to formalised viewing situations such as roads, lookouts and public recreation areas. Although the potential area over which views may be possible in the Bungonia NP and SCA and Morton NP is large, the number of places that would offer practical access to the views of the Project would be relatively small and typically restricted to small numbers of viewers, predominantly pursuing environmental tourism and recreational activities.

Visibility of the Project would also be constrained by distance, perspective effects, and by intervening elements such as topography and vegetation. In general, other than from distant areas of Morton NP to the south-east, the Bungonia Lookdown area and Badgerys Lookouts, views would typically be from locations slightly to significantly below the Project site in relative elevation. The situation of the existing disturbed area of the mine being below the horizon of the views means that there would be few opportunities to perceive significant visual effects of the workings in the Project from most of this potential catchment.

The visual exposure of the disturbance footprint of the Project to the private domain is limited to partial view from a small number of Residential Receivers. The visibility of the Project site is largely confined to the following public and private domain viewing locations.

### Public Domain locations:

Despite the scale of the existing operations and the continued operations proposed in the SSD application, overall the Project is of low exposure to the public domain.

The few areas of the public domain that are exposed to views of the Project site from roads are:

- Close to medium range views from isolated parts of Marulan South Road (see plates 1/1-1/6 in Appendix 1).
- Medium to distant range views from a short section of Glynmar Road to the west of the Project site (see plates 1/19 and 1/20 in Appendix 1).
- Distant range views from an isolated section of Jerrara Road to the north west of the Project site (see plates 1/15 and 1/16 in Appendix 1).
- Medium range views from residences elevated above Long Point Road to the east of the Project site (see plates 1/40 and 1/41 in Appendix 1).

Other areas of the public domain that are exposed to views are confined to the Bungonia NP and Morton NP to the south, south-east and east. Formal viewing locations (formed lookouts) are confined to:

- the Bungonia Lookdown lookout to the south in Bungonia NP (see Plate 8 and Plates 1/21 and 1/22 in Appendix 1).

Informal lookouts and viewing places associated with tracks into or out of Morton NP include:

- The McCauleys Flat track to the east in Morton NP, accessed from the Long Point Lookout. The lookout itself has a view to the south-east which does not include the site (see Plates 1/25 and 1/26 in Appendix 1) but the adjacent track to McCauleys Flat in the Shoalhaven Gorge provides some partial views towards the Project site over the first section of the track, before it descends into the Gorge (see Plates 1/23 and 1/24 in Appendix 1).

- Badgerys Lookout approximately 6km away to the east in Morton NP (see Plate 1/29 in Appendix 1).
- Tracks in the Bungonia NP.
- Tracks in the Morton NP.

### Private Locations:

Private locations identified as potential sensitive receivers include 17 non-involved residences on rural land (see residential receiver locations marked with blue circles and corresponding numbers beginning with R on Figure 6).

### Commercial Receiver Locations:

Two of the closest commercial receivers C2 and C3 were visited and the views photographed, documented and compared to the 3D modelling (see Plates 1/30 and 1/31 respectively in Appendix 1 and 3D modelling in Appendix 2). A potential future dwelling site proposed on the same property as Receiver C2 was also assessed. A photograph taken by the owner from this location and orientated in the general direction of the Project is at Plate 7.

*Plate 7*

*View from potential residence site at C2, photograph courtesy of the owner of the property. It appears unlikely that there would be a significant view of the Project when the view is compared to that from adjacent to the buildings on the left of the view that is analysed with the assistance of 3D modelling in Appendix 2.*

### Boral Owned Receivers:

Seven residences owned by Boral are identified by green circles and numbers with the prefix B on Figures 2 and 6. As the residences are associated with the Project, they were not visited and the views have not been documented. 3D graphics were prepared for a selection of them however and these show that with the exception of B3, these residences would typically also have low visual exposure to the Project.

### 4.1.3 3D Modelling to Represent Views

Cambium Group were commissioned to prepare a 3D terrain model of the site and surrounding environment using 1m contour survey data acquired in 2014 for the landscape surrounding the Mine and 1m contour survey data acquired in April 2017 for existing Mine operations. The topography of the Project at its maximum final landform height was added to the model. To represent views from individual sensitive receiver locations, a virtual camera was located at each receiver and the view was simulated in 3D graphics (see Appendix 2). A geo-referenced and orthorectified aerial photograph was draped over the topography model. As an aid to predicting the likely effect of vegetation on the views, the vegetation plotted in the view cone from each virtual camera was added to the model. The model was then rendered with the same colour coding for the overburden emplacement areas as in the key plan at the first page of Appendix 2. This is intended to identify and differentiate the individual overburden emplacement structures and not to represent the likely visual effects of the Project.

Following initial site visits, photography and ground truthing of the visual exposure predicted by the models, the height and density of the vegetation was amended to better reflect the evidence in the photographs (see Appendix 2).

3D modelling of the composition of the views from each of 17 residential, 4 Boral-owned and three commercial receivers (see examples in Appendix 2) was carried out as a first stage of assessment of the likely visual exposure of the Project to views from the dwellings. This was assisted by interpretation of aerial images and topographic information on which features such as buildings, vegetation and topography that could affect visual exposure was identified, using ortho-rectified high resolution aerial imagery captured on 2 November, 2014.

The views from Receivers were modelled in 3D with topography, but initially with no representation of vegetation, to demonstrate the theoretical visibility of the Project in the ‘worst case’. The 3D model was then populated with vegetation plotted from the aerial imagery so as to predict the likely effect of the vegetation on visibility.

Of the 17 Residential Receivers, it was determined that 11 do not have potential views of the Project from the dwellings (see Table 4.2). Of the remaining six, the owners were contacted by Boral staff and visited by RLA, with the exception of one receiver, access to which could not be secured. The views from the receivers with potential views of the Project were photographed and the views were documented and compared to the views predicted by initial 3D modelling. The views are included in the photographic plates in Appendix 1 and for selected Receivers, in Appendix 2.

Following inspection and photography from the selected receivers it was evident that the initial 3D modelling had been too conservative as regards the representation of the height, density and range of tree forms and vegetation height that had been adopted in the rendering of the models. The initial tree height and density for vegetation interpreted from the aerial imagery registered to the topography used to prepare the 3D models had been set at 15m height and vegetation form of an open woodland density on the basis of the average quoted for similar vegetation types in the BAR by Niche Environment. Examination of photographs taken from the commercial sites and the residential receiver dwellings and compared to the 3D model predicting the visibility of the proposed overburden emplacement areas showed that the vegetation was on average up to approximately 5m too low. The open woodland vegetation form adopted was also incorrect, leading to a higher predicted view through or below vegetation canopy than would occur in reality.

The models in Appendix 2 which show the likely effect on views of the vegetation were adjusted to better reflect the correct vegetation height and density shown in representative photographs taken from the same locations as the 3D cameras. This cross check assists in predicting the likely visual exposure of the Project from the dwelling not assessed (R7). It is likely, based on the experience and observations of the other five dwellings visited and analysed, the topography and its setting among significant areas of vegetation, that R7 does not have a significant view of the Project from the dwelling.

### 4.1.4 Rendered Photomontages to Represent Views

Three locations were identified for the preparation of fully rendered photorealistic photomontages, i.e., the Bungonia Lookdown lookout (VP20), a dwelling (R15) on Long Point Road and a location on Marulan South Road (VP6), close to the Western Overburden Emplacement and the western apex of the Marulan South Road Realignment. The photomontages are shown in Appendix 3.

The technology of production of the photomontages, prepared by Cambium Group using photographs taken by and geotagged by RLA was as follows:

View point camera locations used to prepare photomontages were obtained by a GPS mounted to a Canon EOS 5D Mark III camera using a Canon EF 35mm F1.4L USM lens with co-ordinates and elevation data recorded in World Geodetic System (WGS84). The geotagged images were captured by RLA. Co-ordinates were exported to a MS Excel data file and imported to ArcGIS then re-projected to the Marulan South Limestone Mine SSD Project co-ordinate system, being Map Grid of Australia (MGA94). These co-ordinates were exported from ArcGIS as a DWG file and opened in AutoCAD 2014. Using AutoCAD, view point elevation was cross checked with the elevation recorded by the GPS and compared with LiDAR contour data and ortho-rectified aerial photography. Photographs with a focal length of 35mm were then selected for the purposes of photomontage and corrected for distortion using specific camera and lens profiles for the Canon EOS 5D in Adobe Photoshop. Camera co-ordinates were then merged with the 3D mine model and virtual cameras were setup using these locations and adjusted for elevation based on earlier findings. Camera matching was then undertaken using a combination of the existing 3D infrastructure survey, 3D terrain model and virtual views, set up as part of the desktop study. Final photomontages were rendered with foreground and background vegetation adjusted using aerial photography and virtual views as an indicator.

The photomontages are based on analytical 3D models of the Mine Plan at four stages over the 30-year life of the Project, being Stage 1 (end of 5 years' activity), Stage 2 (13 years), Stage 3 (19 years) and Stage 4 (30 years). The 3D analytical models were colour coded the same way as in the analytical photomontages in Appendix 2 and correspond to the oblique aerial images of the Project shown on the first page of Appendix 2.

The view from The Lookdown, VP20, was chosen as the viewing location that best illustrates the visual effects of the progress of the Project, as it is the only publicly accessible location that has views of each of the features and effects of the stages proposed. A series of analytical and photorealistic photomontages were prepared to illustrate the location of each of the proposed landform modifications, the progress of construction of landform and extensions to the Mine footprint and the progress and effect of landscape rehabilitation. The series of photomontages is included in Appendix 3.

## 4.2 Visual Effects Analysis

### 4.2.1 Baseline Factors

#### 4.2.1.1 Visual character

The landscape setting of the mine (see Figure 2, Local Context) is within an area of intermediate character between the rural and semi-rural landscapes of the nearby tablelands to the west and north and the natural gorges and undeveloped landscapes of the Bungonia NP, SCA and Morton NP to the south and east. These aspects of the setting can be seen in the oblique aerial photographs shown in Plates 1 and 2 and in Appendix 4. The Marulan Creek Dam is situated in the creek valley which runs through cleared agricultural land of relatively flat topography to the north of the Peppertree Quarry site.

The rural landscape is predominantly cleared and of rolling topography but features some extensive areas of remnant vegetation on the plateau, steeper slopes and in drainage lines. The rural land supports uses such as grazing, rural smallholdings and poultry farms. The rural plateau landscape gives way to steep natural topography of the river valleys to the east and south. Remnant woodland and open grassland occurs most commonly on the plateau tops, whereas open and low open woodland, clothes the side slopes of Bungonia and Barbers Creeks and the Shoalhaven River gorge.

Between these two visually distinctive land systems sits the mine site. The reason for its location between the two lies in its underlying geology and stratigraphy. The Palaeozoic strata containing limestone reefs have been folded and eroded to produce near vertical beds that strike approximately north-south and dip variably at steep angles, to the west. The easternmost seams (Eastern Limestone) which would originally have outcropped just below the brow of the escarpment, have the highest limestone grade and have been and will continue to be the most sought-after resource. The linear form of the resource explains the linear form of the current Pit, once two separate mines (see historic images in Appendix 5).

Textural changes also follow the topography and land uses, with smooth, grassed surfaces of the agricultural land giving way to coarse, rough and broken slopes with exposed soil, outcropping rock and talus sparsely covered by small trees and shrubs and with minimal understorey, on the south and east side slopes below the existing Pit.

Typical of karst landscape, which responds to the water-worn erosion of limestone geology, slot canyons, undercut cliffs, caves and precipitous changes of slope characterise the Bungonia Creek gorges to the south of the site and attract scenic and environmental tourism to the Bungonia NP, SCA and Morton NP.

The steep and gorge-like side slopes to the south and east of the existing Pit are constraints on appropriate locations for emplacement of overburden. As a result of the near vertical bedding and truncation of the resource to the north by a granodiorite intrusion and to the south by the topography of the Bungonia Creek Gorge, continued extraction demands utilisation of further out-of-Pit overburden emplacement areas. For optimal management of the environmental impacts of the emplacements in the Project, the main expansion areas are proposed to the west of the Pit. Currently the overburden emplacements west of the Pit are of low external visibility.

The formal aesthetic qualities of the Pit and the processing area structures (beyond it to the north), dominate views to the north from the Bungonia Lookdown area. They are less prominent in other lookout views such as the Adams lookout and adjacent tracks in the Bungonia NP and Badgerys lookout. Where these features of the mine are visible, the line, form, texture and colour of the Pit, benches, roads and overburden emplacements if un-rehabilitated, significantly contrast with the natural and semi-natural adjacent landscape.

The existing scenic resources have been identified in Section 1.4.2. A significant and relevant aspect of the visual character of the existing mine and therefore the visual impact merits of the Project, is the existing and in some respects permanent changes that have occurred to the visual character of the underlying landscape over a long period of extraction of the resources of the mine.

The existing, historical, permanent and contrasting character of the mine compared to the adjacent either natural or semi-natural/rural landscape is a baseline factor to be taken into account in considering the visual effects and impacts of the Project. As a result of its long history of use and some permanent changes to its landscape, the mine site has a higher capacity to absorb proposed changes than an un-mined landscape.

#### 4.2.1.2 Scenic quality

Scenic quality is a baseline against which the effects of changes to the physical environment can be predicted to impact either positively or negatively on the perceptions and emotional reactions of viewers. Research literature concerning general relationships between aspects of the physical environment and predicted judgments of scenic quality or other expressions of this, such as scenic beauty and scenic preference would predict that the rural setting of the mine and its locality would be of moderate scenic quality. While it shows the presence in many views of slightly varied topography, managed landscape and vegetation, it does not contain significant water bodies, diversity, or areas of high scenic integrity (naturalness). It also exhibits factors which decrease scenic quality, such as cleared and unmanaged vegetation, lack of prominent topography and large scale industrial structures.

By comparison, the views from inside the natural reserves of Morton NP and Bungonia NP and SCA of the unmodified landscapes which are probably the main motivation for their visitation would be predicted to be moderate-high in scenic quality, as they contain significant topographic variation, naturalness, complexity, diversity of forms and vegetation and also some water bodies. In that context, the highly and permanently modified landscapes of the existing mine would be predicted to be of low scenic quality in themselves. However they are also of historical interest, possibly also of aesthetic interest to some viewers and are isolated within a vast setting that is dominated by higher quality natural landscapes.

As is noted above with regard to scenic character, the baseline for scenic quality is also significantly modified by the existing and long history of mining. This has to some extent irreversibly changed the scenic quality of the setting. In this context it would be unrealistic and unreasonable to take the theoretical, past moderate-high scenic quality of the landscape, pre-mining, as the base line against which to judge the effects of the Project.

It is therefore reasonable to determine that the visual quality of the mine, in the context of its setting, which is composed of both moderate and moderate-high quality landscape, has been significantly degraded in the past and is at best of low to moderate scenic quality.

A low to moderate scenic quality baseline means that subject to other considerations, the landscape has a higher potential to absorb visual impacts than one of higher scenic quality.

#### 4.2.1.3 View place sensitivity

The public domain viewing locations are constituted by those located on roads, lookouts and reserves. The view place sensitivity for public domain viewing locations is rated as high for locations with a clear view that is less than 500m from the Project site. However there are no viewing locations rated as being high sensitivity. (Refer to Photographic Plates in Appendix 1).

The view place sensitivity was rated as medium for locations between 500-3000m from the Project site. The majority of all viewing places including 20 locations fall into this category. Viewing places close to or within the site are rated as being in the low sensitivity class including VPs 1 to 6 and others in the medium or distant viewing class including VP14, VP15, VP16, and VP17 are also rated as being low sensitivity locations. Two commercial locations are also considered to be low sensitivity. The Badgerys lookout (VP25) and one residence in the distant class (Glenrock R13) are also in the low sensitivity class, being beyond 3000m (at approximately 6km and 5km distances, respectively.).

#### 4.2.1.4 Viewer sensitivity

The viewer sensitivity is rated high for any dwellings within 500m of the Project site. No Residential Receivers that have clear visibility of the Project are in this category. Viewer sensitivity is rated medium for all dwellings between 500m and 3000m. All Residential Receivers other than Glenrock are in this category, the closest of which that has a potential view of some aspect of the Project is R10, which is approximately 1.8km from the nearest part of the Project (the Western Overburden Emplacement) (see Plate 1/36 in Appendix 1). Glenrock is at a distance of approximately 5km from the nearest part of the Project (see Plates 1/37-1/39 in Appendix 1).

It is to be noted from these results that the Project overall has low accessibility to the public, has no significant exposure to roads with high viewer numbers in the public domain or to close views from Residential Receivers. It is therefore generally exposed to views from locations of medium to low sensitivity to the likely visual effects of the Project.

### 4.2.2 Variable Factors

**Staging of construction of overburden emplacements and extraction**

The main visible effects of construction of new landform and creation of new space by the extraction of the limestone and shale resources, which could affect view composition, are summarised below.

Stage 1: (5 years)

1. Construction of the Northern Overburden Emplacement to final landform, with rehabilitation established.
2. Expansion to the north and increase in the height of the existing Western Overburden Emplacement.
3. Early stage of construction of the south-west part of the Southern Overburden Emplacement.
4. Removal of overburden and expansion of extraction toward the west in the Pit.

Stage 2: (8 years)

1. Revegetation of the final landform of the Northern Overburden Emplacement.
2. Minor extension to the north and completion of construction of the southern section of the Western Overburden Emplacement, with rehabilitation established.
3. Extension of the south-west part of Southern Overburden Emplacement, plus beginning of back-filling of the southern section of the Pit.
4. Deeper extraction of resource to the west and north-west in the Pit.

Stage 3: (6 years)

1. Diversion of Marulan South Road and construction of northern part of proposed Western Overburden Emplacement to final landform, with rehabilitation established.
2. Extension of construction of the Southern Overburden Emplacement to become continuous landform across the southern part of the Project, with further filling of the Pit void,
3. Extension of extraction to the west, north and east in the Pit.

Stage 4: (11 years, plus 5 years to complete rehabilitation)

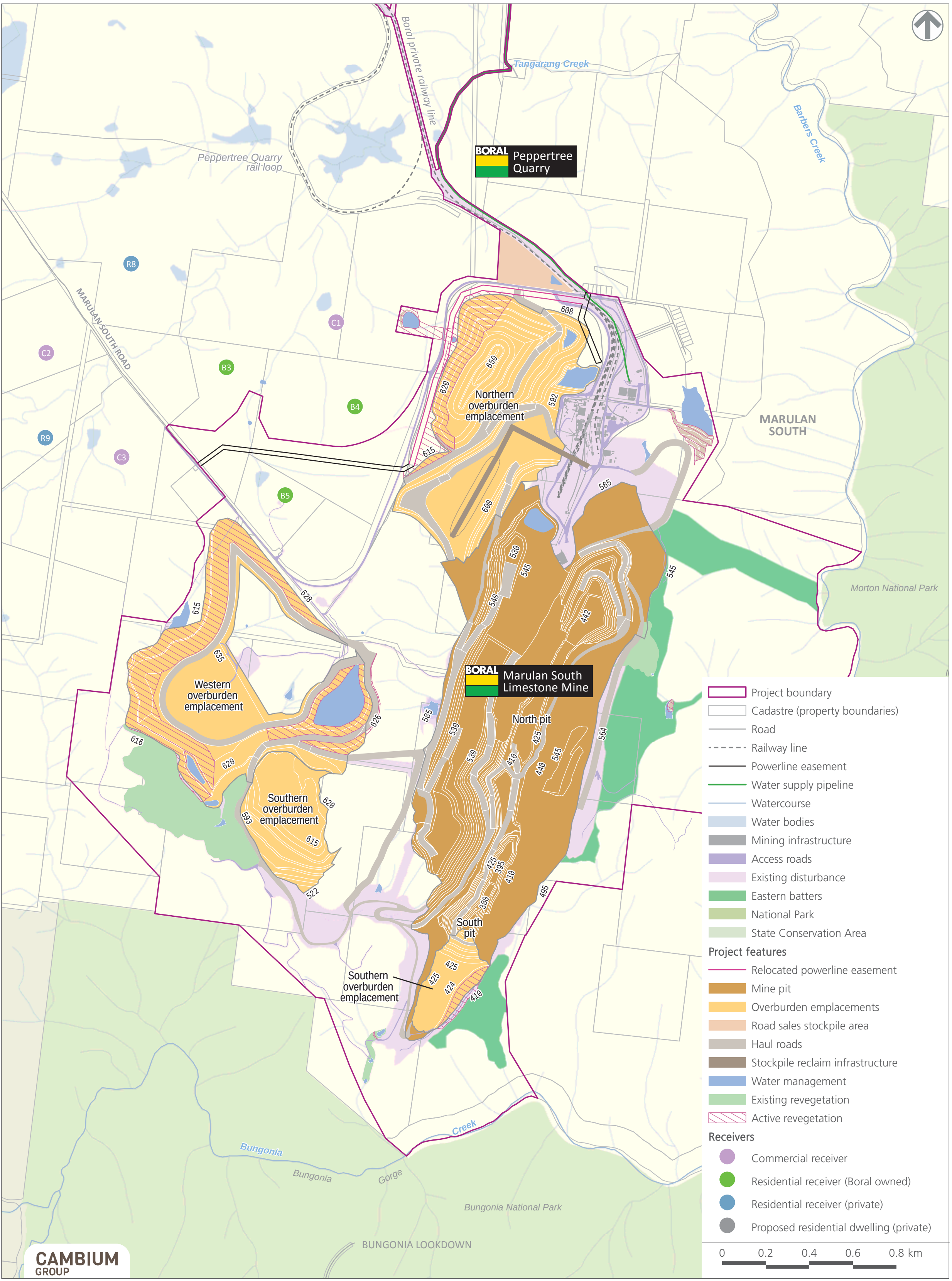
1. Southern Overburden Emplacement completed to final landform with rehabilitation established.
2. Extension of extraction in depth and toward the east in the Pit.
3. Completion of rehabilitation and revegetation.

With the exception of close views from within the Project including VPs 1-5 and VP20 and VP21 which are at medium range located between 500m and 3000m from the Project, overall there would be low effects on view composition caused by the Project.

Figure 12

## The Project - Stage 1 (5 years)

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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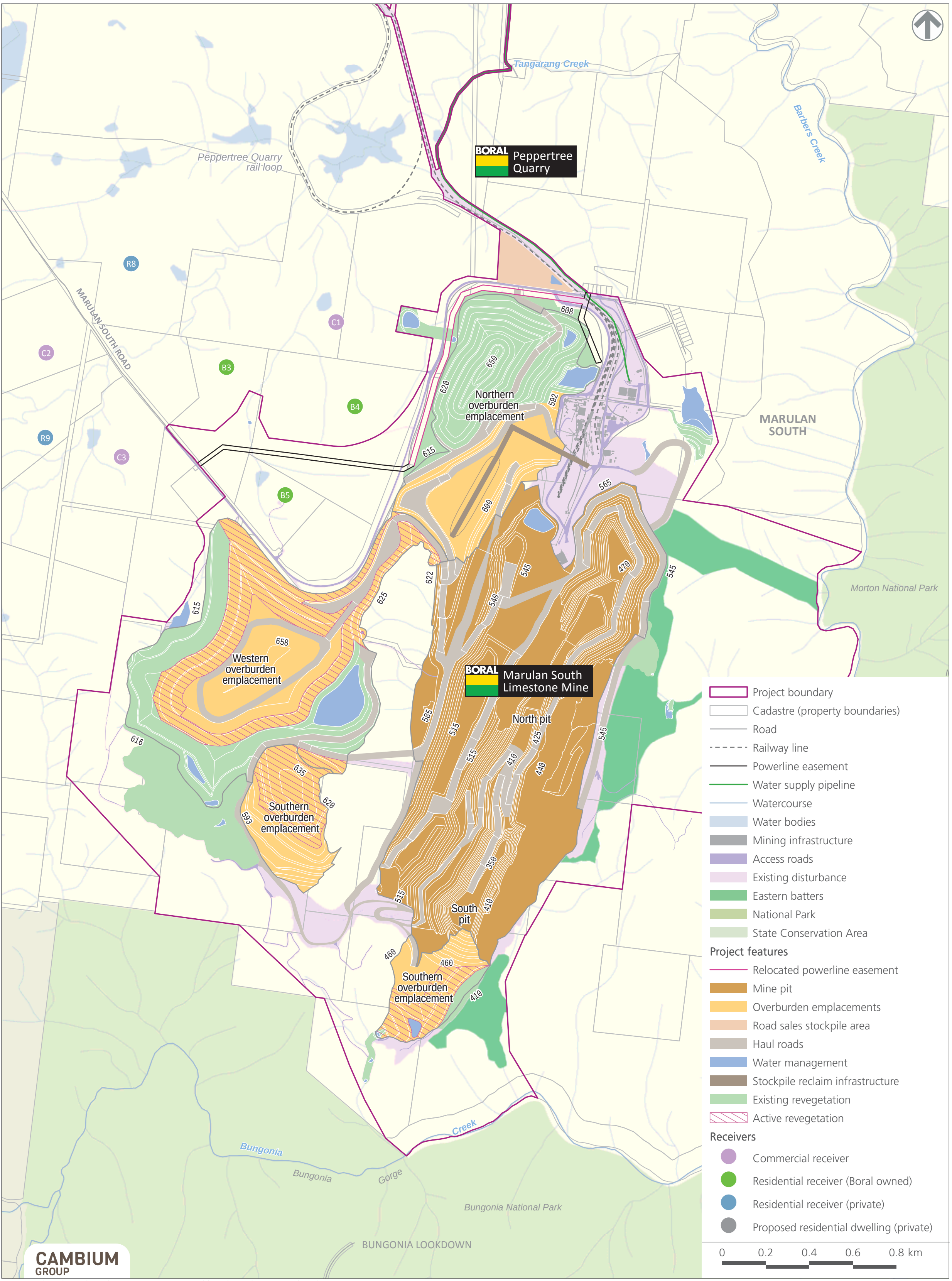
Figure 13
## The Project - Stage 2 (8 years)

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



| | |
|---|---|
| ▭ | Project boundary |
| ▭ | Cadastre (property boundaries) |
| — | Road |
| - - - | Railway line |
| — | Powerline easement |
| — | Water supply pipeline |
| — | Watercourse |
| ▬ | Water bodies |
| ▬ | Mining infrastructure |
| ▬ | Access roads |
| ▬ | Existing disturbance |
| ▬ | Eastern batters |
| ▬ | National Park |
| ▬ | State Conservation Area |

Project features

| | |
|---|---|
| — | Relocated powerline easement |
| ▬ | Mine pit |
| ▬ | Overburden emplacements |
| ▬ | Road sales stockpile area |
| ▬ | Haul roads |
| ▬ | Water management |
| ▬ | Stockpile reclaim infrastructure |
| ▬ | Existing revegetation |
| ▨ | Active revegetation |

Receivers

| | |
|---|---|
| ● | Commercial receiver |
| ● | Residential receiver (Boral owned) |
| ● | Residential receiver (private) |
| ● | Proposed residential dwelling (private) |

0 0.2 0.4 0.6 0.8 km

Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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Aspects of all of the stages proposed in the Project would be visible from the Bungonia Lookdown (VP20), which would experience some visual effects on view composition of each of the four stages of the Project. There would be changes to the detail of what is visible and some changes to view composition, throughout the life of the Project. Lesser effects on view composition would occur for views from VP 21 as a result of screening effects of the Eastern Batters and approved overburden emplacements of Peppertree Quarry.

The likely visual effects of the project on the view from The Lookdown were modelled as the basis for preparation of analytical and photorealistic photomontages as noted in Section 4.1.4 above. The models and the photomontages also illustrate the process and progress of rehabilitation, as well as the potential for cumulative impact with the adjacent development of the Peppertree Quarry as approved under Modification 4 and proposed under the current Modification 5 application.

An analysis of the visual effects demonstrated by the photomontages in Appendix 3 follows.

#### 4.2.2.1 Analysis of visual effects seen from The Lookdown

The photomontages show each of the major elements of the Project in bright and different colours as an analytical tool. The proposed 30-year footprint produced by expansion of the Pit is shown in green, the Northern Overburden Emplacement in yellow, the Southern Overburden Emplacement in light brown and the Western Overburden Emplacement in magenta.

The first image is the existing view. The next four images show, in analytical 3D, the proposed landform structures progressing through each of the four stages, culminating in the 30-year landform proposed as the end of the Project. This gives an understanding of the total areas subject to either extraction or landscape construction.

Understanding the sequence of landform modification that is proposed and the likely visual impacts effects is more complex, because rehabilitation of overburden emplacements follows their establishment at different rates and stages, while the expansion of the Pit continues until the end of the 30-year Mine Plan.

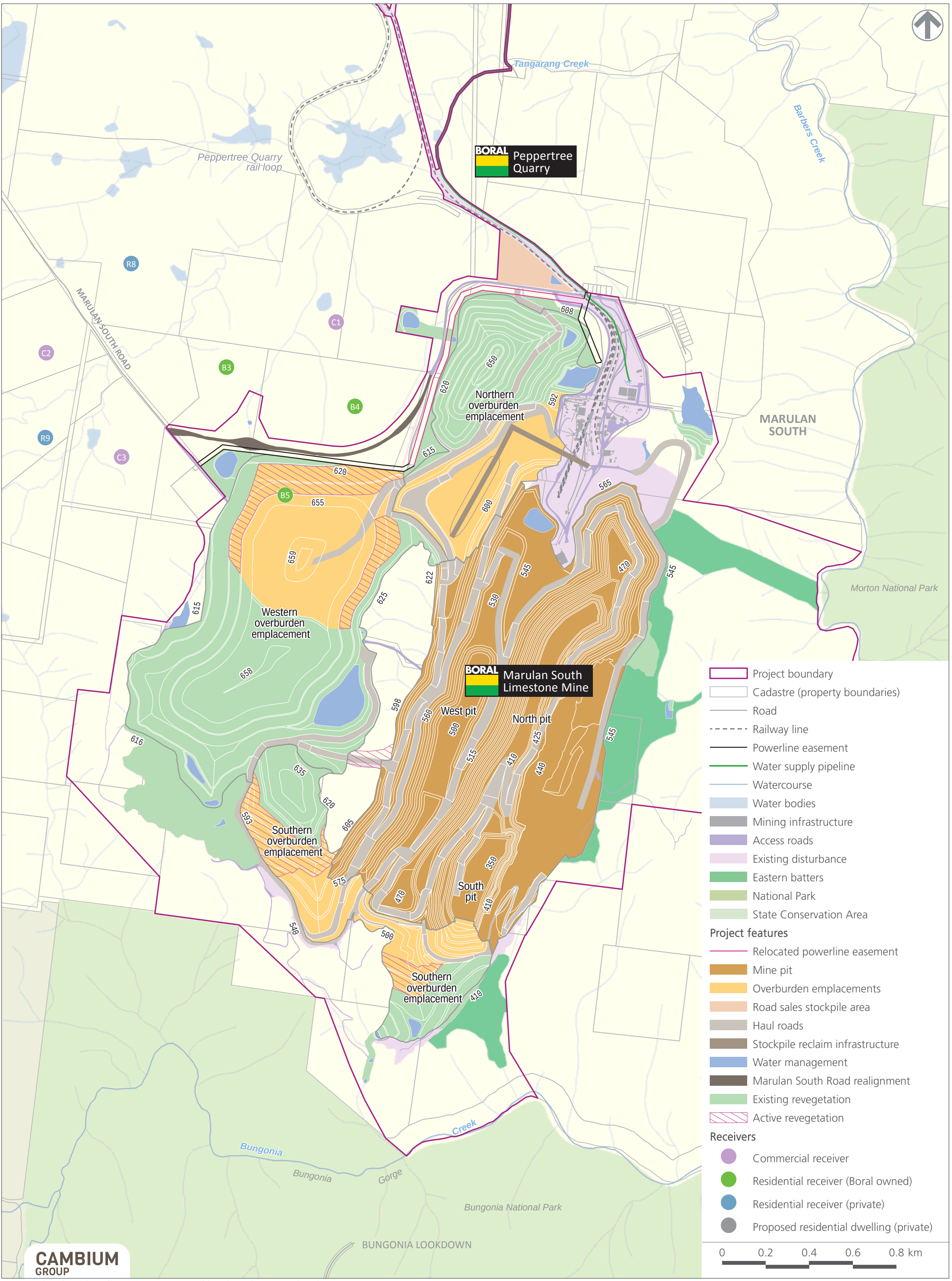
To illustrate the progress of visual effects, Cambium Group prepared detailed sequential photomontages, showing the progress of rehabilitation of each individual stage proposed to demonstrate these effects and also to analyse the perception of cumulative impact. The photomontages have been rendered to show the canopy coverage on the existing revegetation areas informed by the rehabilitation strategy. The assumptions are shown on the legends to the photomontages, in an orange colour.

The image titled Photomontage – Stage 1 Revegetation shows the likely state of rehabilitation at the end of Stage 1, at 5 years' Project duration. Ground covers can be seen on final landform of the Southern Overburden Emplacement and part of the Western Overburden Emplacement on the right and left of the image, respectively. The Northern Overburden Emplacement, visible as a narrow, yellow band toward the centre of the view horizon in the analytical photomontage for Stage 1, shared with Peppertree Quarry, has been rehabilitated by the end of this stage. The beginning of the extension of the Pit toward the west is evident.

Following the sequence, the image titled Photomontages – Stage 2 Revegetation shows both the progress of construction of the Southern Overburden Emplacement that is beginning to occlude

Figure 14
## The Project - Stage 3 (6 years)

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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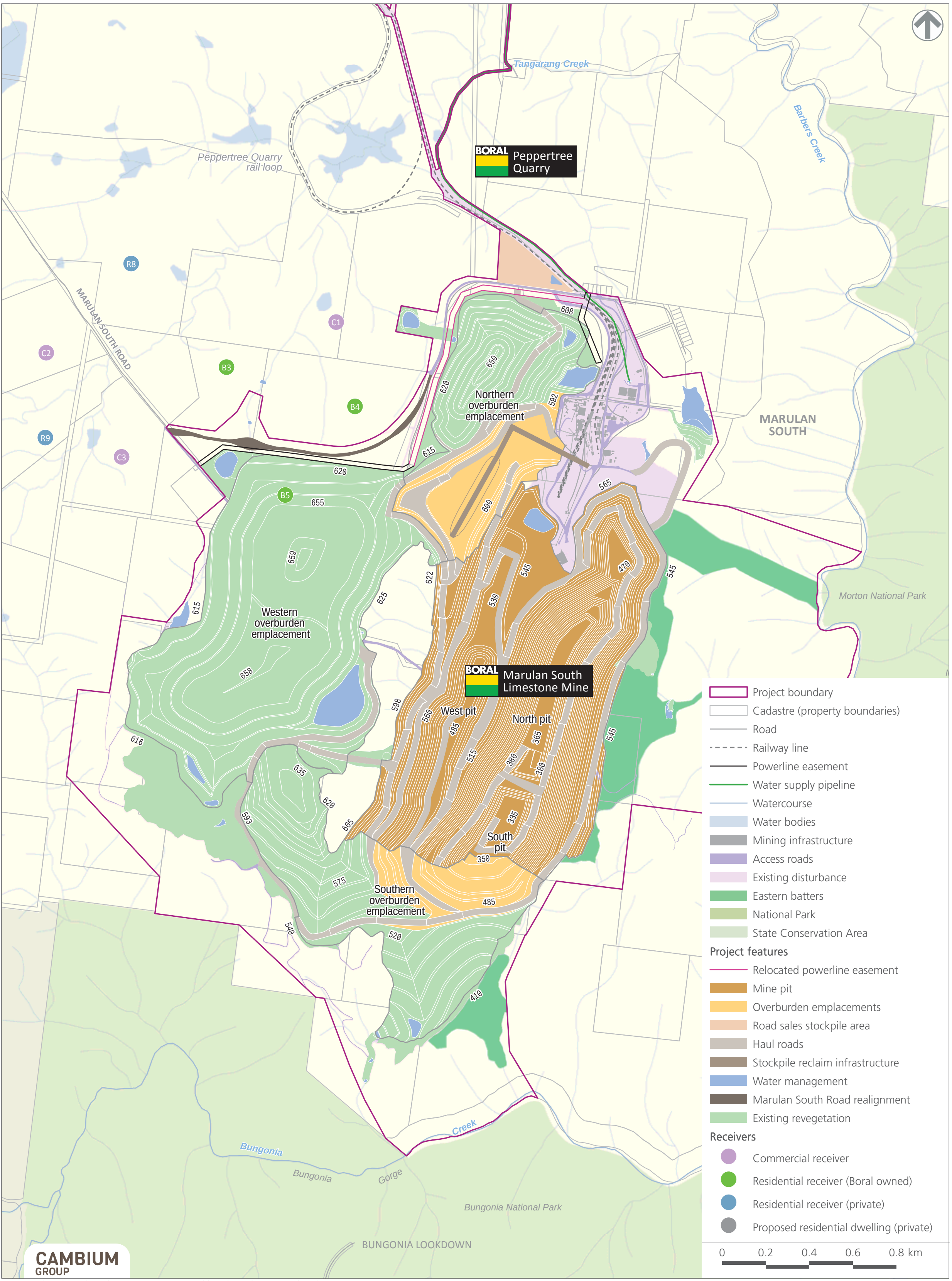
Figure 15
**The Project - Stage 4 (11 years)**



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

031040_EIS_VIA_F15_180906_v01

the view into the existing Pit and the rehabilitation of both the eastern and western sections of the Southern Overburden Emplacement and the crest of the Western Overburden Emplacement, visible on the left side of the view. The proposed extension of the Pit toward the west continues in Stage 2 with a greater area of the upper walls/benches visible.

The image titled Photomontages – Stage 3 Revegetation shows the completion of expansion of the brow of the Pit toward the west and the progressive rehabilitation of the Western Overburden Emplacement to the horizon on the left of the view. Rehabilitation is advancing to the south east toward the viewer along part of the Southern Overburden Emplacement on the left of the view, which now appears continuous with the finalised Western Overburden Emplacement above it. Further construction of the Southern Overburden Emplacement, effectively the back-filling of the former South Pit, can be seen increasing the screening of view into the floor of the Pit.

The image titled Photomontage – End of Stage 4+5 years Revegetation shows the final proposed landform, with revegetation completed, five years after mining is completed under the proposed 30 year Mine Plan. The backfilling of the South Pit by the Southern Overburden Emplacement, which occupies much of the middle ground of the view, largely occludes the view into the expanded pit.

As further analytical aids in Appendix 3, Cambium Group have also prepared a series of pair-wise comparisons that show the analytical 3D photomontage end landform of each stage proposed and the intended end landscape character as a photorealistic photomontage, following revegetation.

#### 4.2.2.2 Effect on view composition

An early but minor change to composition of the view from VP20 would be caused by out of pit overburden emplacement to the north-west of the existing Pit by construction of the landforms of the Northern Overburden Emplacement, shared with Peppertree Quarry, in Stage 1. The crest of the emplacement, which would be largely finished in form before rehabilitation had the opportunity to soften the horizon, would be partly visible from VP20 and also from VP21. By the end of Stage 1, the horizon formed by the Northern Overburden Emplacement would be revegetated and rehabilitated.

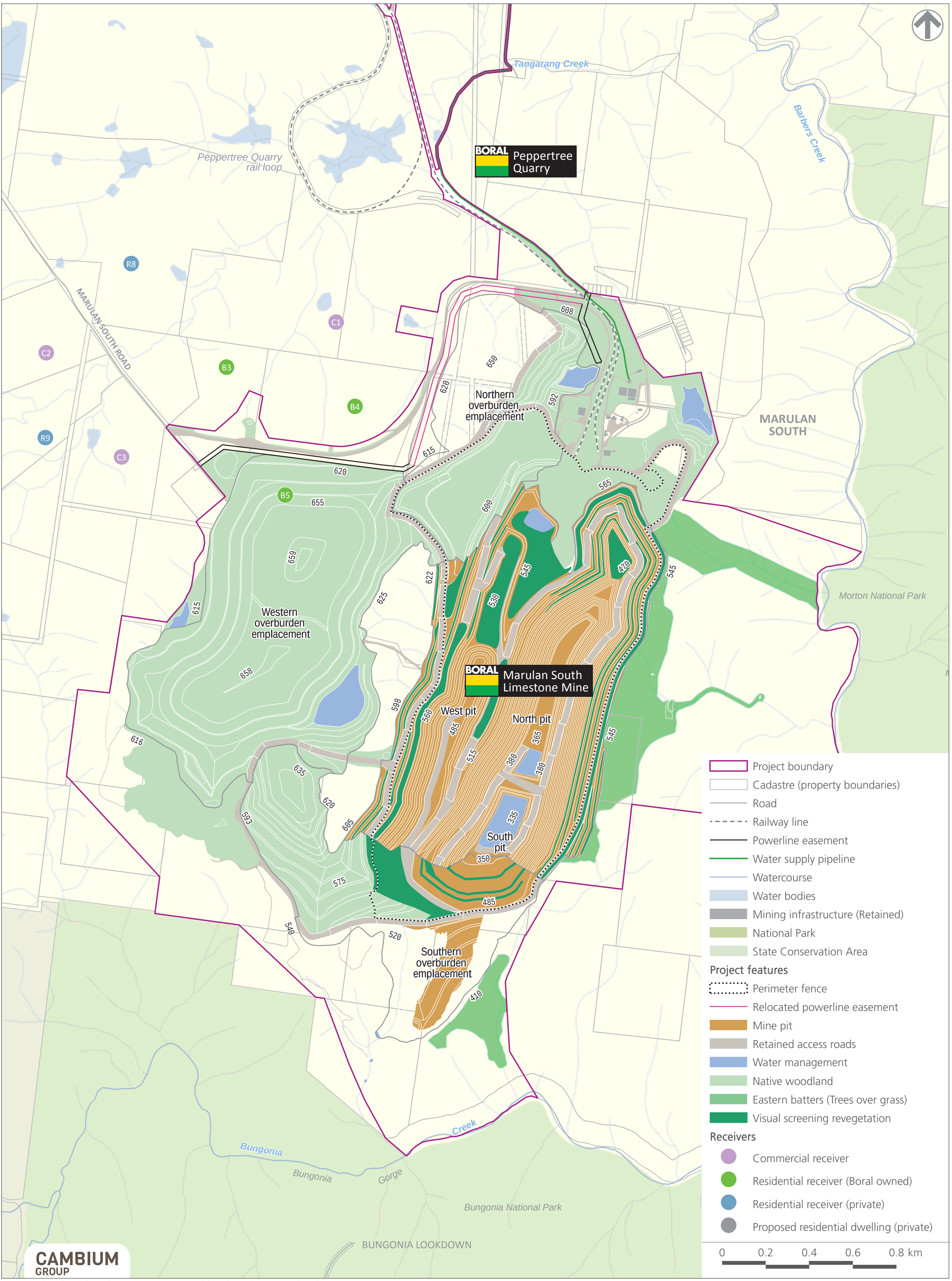
In the view from VP21, The Northern Overburden Emplacement would be significantly screened by the Southern Overburden Emplacement of Peppertree Quarry approved in Modification 4, which would have been completed before construction begins on the proposed Northern Overburden Emplacement. Vegetation used in rehabilitation of the Peppertree Quarry Southern Overburden Emplacement would be likely to partly and then increasingly screen the view of the proposed Northern Overburden Emplacement.

Minor construction of the south-west part of the Southern Overburden Emplacement and expansion of the Western Overburden Emplacement toward the north during Stage 1 would not have a significant effect on view composition from either VP20 or VP21. The photorealistic photomontages in Appendix 2 show that by the end of Stage 2, the horizon formed by part of the Western Overburden Emplacement would be revegetated and by Stage 3, most of the adjacent part of the Southern Overburden Emplacement in its vicinity would also be rehabilitated and revegetated. The final landform would not significantly differ from the existing appearance.

The expansion of extraction above the existing west wall of the Pit, toward the west, in Stage 1, including removal of overburden, would begin an increase in the horizontal extent of the Pit visible from VP20 that would continue until the end of Stage 3. During that stage, back-filling of the southern

Figure 16
## The Project - Final landform

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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part of the existing Pit would begin as part of the eastward and southern extension of the Southern Overburden Emplacement, reducing views into the south part of the Pit and of the increased extraction area behind. Stages 1-3 of the construction of the Southern Overburden Emplacement would be of little visibility to VP21 and of no significant visibility to other viewing locations.

The expansion of the Western Overburden Emplacement to the north following realignment of Marulan South Road in Stage 3 would have overall minor effects on view composition, as it would be of low visibility other than from a short section of the road itself. The crest of the emplacement was predicted to be partly visible, if the effect of vegetation used in rehabilitation is ignored, from VP20, VP21 and Residential Receivers R5, R10, R13, R14 and R15, based on the analytical photomontages in Appendix 2.

Analysis of the likely effects of the Project on the views when vegetation present in the existing environment is taken into account, indicates that there would be at the most a low effect on the composition of views from the Residential Receivers. Any effect would be largely confined to visibility of the northern part of the Western Overburden Emplacement, which would be constructed in Stage 3. Rehabilitation of the lower lifts using native woodland vegetation would be likely to result in the crest of the emplacement being screened by tree vegetation established below the crest level and therefore screening the later emplacement of the crest behind. The Residential Receivers would have no view of the Southern Overburden Emplacement and with the exception of R14 and R15 are unlikely to have any view of the Northern Overburden Emplacement, which would be completed with rehabilitation in place by the end of Stage 1.

The staging would also mean that, seen from R14 or R15, where only a small proportion of the crest of the Northern Overburden Emplacement could be potentially visible, the earlier established Southern Overburden Emplacement approved in the Peppertree Quarry Modification 4 would be completed and rehabilitated. The vegetation used in rehabilitation would be likely to substantially or totally screen the view of the Northern Overburden Emplacement that is behind it, from these viewing locations. A similar outcome would occur for the view from VP21, where, by the end of Stage 1, the Northern Overburden Emplacement would be largely hidden by the rehabilitated Southern Overburden Emplacement approved in Peppertree Quarry Modification 4.

In Stage 3, seen from the Bungonia Lookdown at VP20, the construction of the Southern Overburden Emplacement would begin to significantly limit views into the Pit. The emplacement would be of minimal visibility from VP21. A significant change to view composition would be caused by the effect of backfilling of the south part of the Pit behind the existing rim, by the Southern Overburden Emplacement. In Stages 3 and 4 the backfilling and newly constructed topography would gradually occlude the view into the Pit and successively of the floor and of mining activity on the western walls of the Pit.

In summary, the gradual changes in topography caused by construction of the overburden emplacements after Stage 1 would at the most have a low effect on view composition for almost the entire visual catchment. The exception would be for close views of the Northern Overburden Emplacement in Stage 1 and the Western Overburden Emplacement in Stage 3, which would affect the composition of views from a short section of Marulan South Road in its immediate vicinity. While the new topography would be higher than the existing landform, it would not become a feature element, block views of scenic items beyond, or dominate the view.

Effect on view composition would generally be low for views from the east, which are essentially confined to a short section of the McCauleys Flat track represented by VP21 and distant view from Badgerys lookout (VP25). The Project would be evident, but as it is primarily confined to activities on the west and south sides of the existing Pit at distances of more than 2.5km from the McCauleys Flat track and over 6km from Badgerys lookout, the proposed changed in topography would have a low effect on the existing view composition.

### Effect of relative viewing level

The topography of the rural land that dominates the setting to the south-west, west and north of the Project site is relatively uniform. It has no major ridge systems to interrupt view lines, other than an area of low hills between the Project site and the majority of the part of Jerrara Road that is to its west-north-west and another of more pronounced and separate range of hills between the site and Marulan township, to the north-north-west (see Figures 1 and 2).

The hill areas however are also predominantly vegetated with open forest and woodland, with varied understorey, as mentioned above. Significant areas, of either uncleared or regrowth vegetation, also occur on some landholdings. The combination of rolling topography and significant areas of vegetation means that there are very few locations which would provide significant viewing opportunities that are elevated above the surrounding countryside, or the Project site.

Two exceptions are the Bungonia Lookdown (VP20) and part of the McCauleys Flat track (VP21). From each, there are opportunities to view downward into and over parts of the Project site. The opportunity is less for the VP21, as the eastern batters and higher topography to the east of the Pit prevent views into most of the Pit and in particular, into the former South Pit.

As a result, only the views from the Bungonia Lookdown lookout and McCauleys Flat track locations (VPs 20 and 21) have an increased rating of medium for the extent of visual effects caused by viewing position.

Opportunities for views from relatively below the landform proposed in the Project are confined to Marulan South Road between the proposed Marulan South Road Realignment and the proposed terminus of the public road at the entrance to the Aglime Fertilisers' Manufacturing plant. The Western Overburden Emplacement and Northern Overburden Emplacement will be visible from this section of road, which runs adjacent to the edge of a section of each emplacement. The road sales stockpile area, which is proposed to be shared with Peppertree Quarry will also be visible, adjacent to and north-west of the entry to the mine from Marulan South Road. VPs 1 and 2 are the only locations from which the road sales stockpile area and the northern slopes of the Northern Overburden Emplacement would be visible from what will be a private road, once this section of Marulan South Road is de-proclaimed.

As a result, the effect of viewing level for the assessment of the existing environment is increased for VPs 1, 2 and 6. VPs 3, 4 and 5, which provide assessments of the existing views on parts of the road before it will be re-aligned, will be subsumed in the Project.

### Effect of viewing period

The effect of viewing period is a baseline factor that acknowledges that greater visual effects occur for places from which there are potential sustained individual views, either from fixed locations such as dwellings or moving (dynamic) locations, such as roads.

The Project has very low overall exposure to views from the dwellings identified as Residential Receivers. 3D modelling confirmed by documentation and photography of representative views (Appendix 2) showed that of the 17 potential Residential Receivers, only R10, R13, R14 and R15 may experience sustained views of some part of the final proposed landform of the Project, with views of part of the crest of the Western and Northern Overburden Emplacements. No Receivers have a view of the Marulan Creek Dam site. A photomontage of the view likely from R15 is in Appendix 3. The rating for the potential effect of viewing period for Residential Receivers is therefore only increased for R10, R13, R14 and R15.

The Project has very low exposure to public roads and no areas on roads from which there are sustained views. A fleeting and distant view is possible from VP14 and VP15 on Jerrara Road, between areas of elevated topography and vegetation which otherwise block views. Views from Marulan South Road between VP7 and VP13, where the road runs directly toward the centre of the Project site, are blocked in the foreground and middle distance by vegetation in the road reserve and on properties to the north-east and south-west of the road (see for example Plates 1/11, and 1/13 and 1/14 in Appendix 1). Views of the Project, including the stanchions of the re-aligned high voltage powerline, would be largely confined to an area almost immediately in the vicinity of the proposed realignment of the road to the east of its existing alignment adjacent to the entry to Receiver B3 (see Plates 1/5 and 1/6 in Appendix 1 and the photomontage for VP6 in Appendix 3). Views of the Western Overburden Emplacement and re-aligned power line would be possible over a short distance between this location and approximately the entrance to Receiver C1.

The effect of viewing period for views from roads is therefore only increased for the view from this part of Marulan South Road. It is noted below that this part of the road is considered to be of low sensitivity as a viewing situation for a unique reason, as it essentially leads only to land of existing industrial, mining or quarrying uses. In addition, it is proposed that the road beyond the entry to the Aglime Fertilisers' Manufacturing plant be de-proclaimed in the Project, meaning that the public section of the road affected would only be between the start of the proposed Marulan South Road Realignment and the intersection at the access road to the Aglime Fertilisers' Manufacturing plant.

Areas from which short term but sustained views are possible include VP20 (the Bungonia Lookdown lookouts), VP 21 (McCauleys Flat track) and VP 25 (Badgerys Lookout). The effect of viewing period for views from lookouts and reserves is therefore increased for these public viewing places.

### Effect of viewing distance

With the exception of view places in the last few hundred metres of Marulan South Road, no viewing places are in the close range category and most are in the medium range category between 500-3000m from the nearest part of the disturbance footprint of the Project. In the private domain, Receivers R1-R3 and R13 are in the distant viewing category above 3000m, but R1-R3 have no view of the disturbance footprint of the Project. R13 has a theoretical view of the crest of the Northern Overburden Emplacement from a distance of approximately 5km based on the 3D modelling, but field assessment indicates that vegetation in the middle distance and rehabilitated overburden emplacements associated with Peppertree Quarry will be likely to significantly limit or totally block views of this feature. Other receivers R5, R8, R10, R14, and R15 are in the medium distance range, but R8 has no view of the Project.

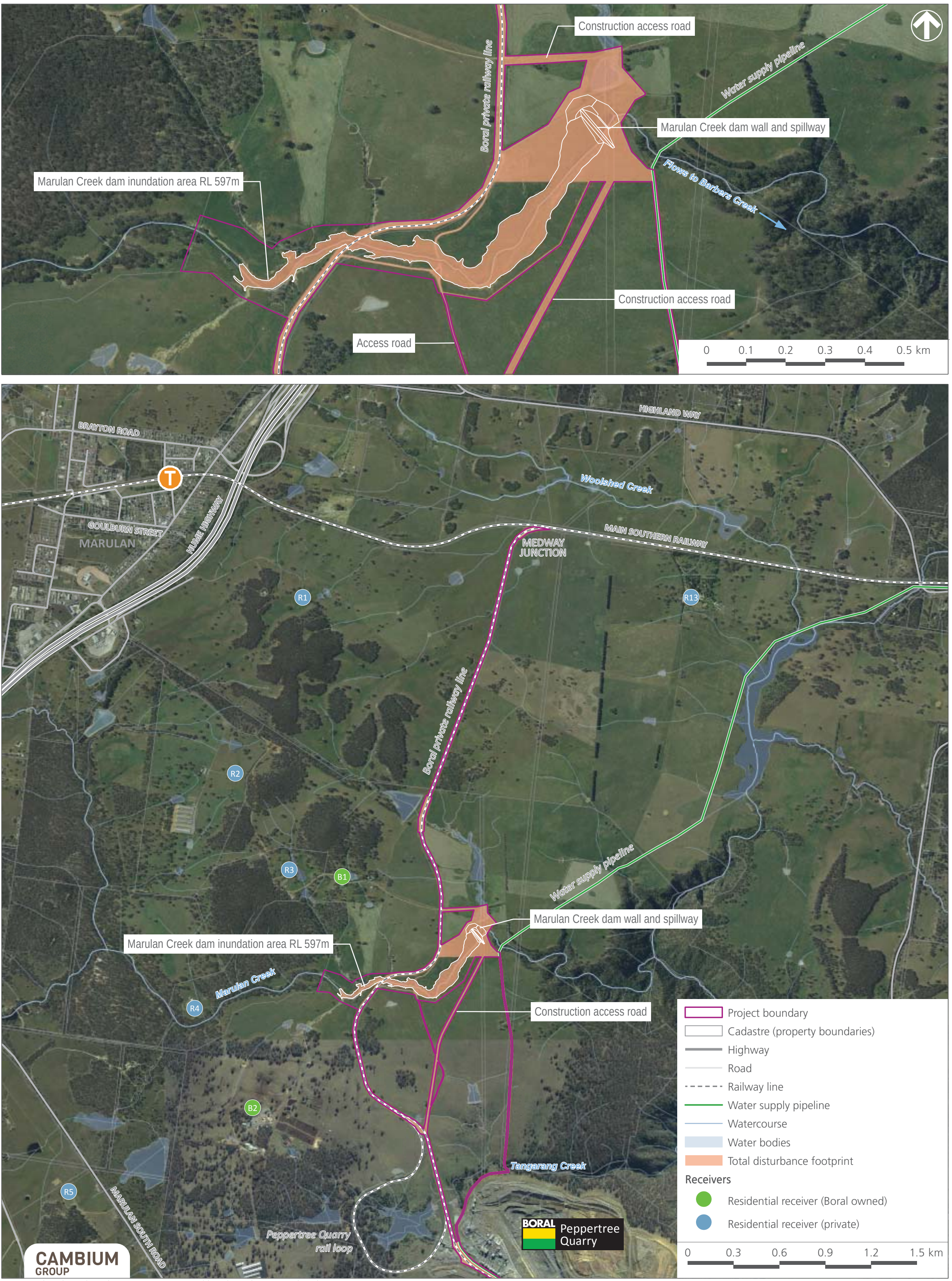
In summary, for Residential Receivers, the effect of viewing distance does not change the extent of visual effects.

VP20 (the Bungonia Lookdown lookout) is the only viewing place that has views of parts of the disturbance footprint of the Project that span across two distance classes (medium to distant). It has

Figure 17

## Marulan Creek dam - Disturbance footprint

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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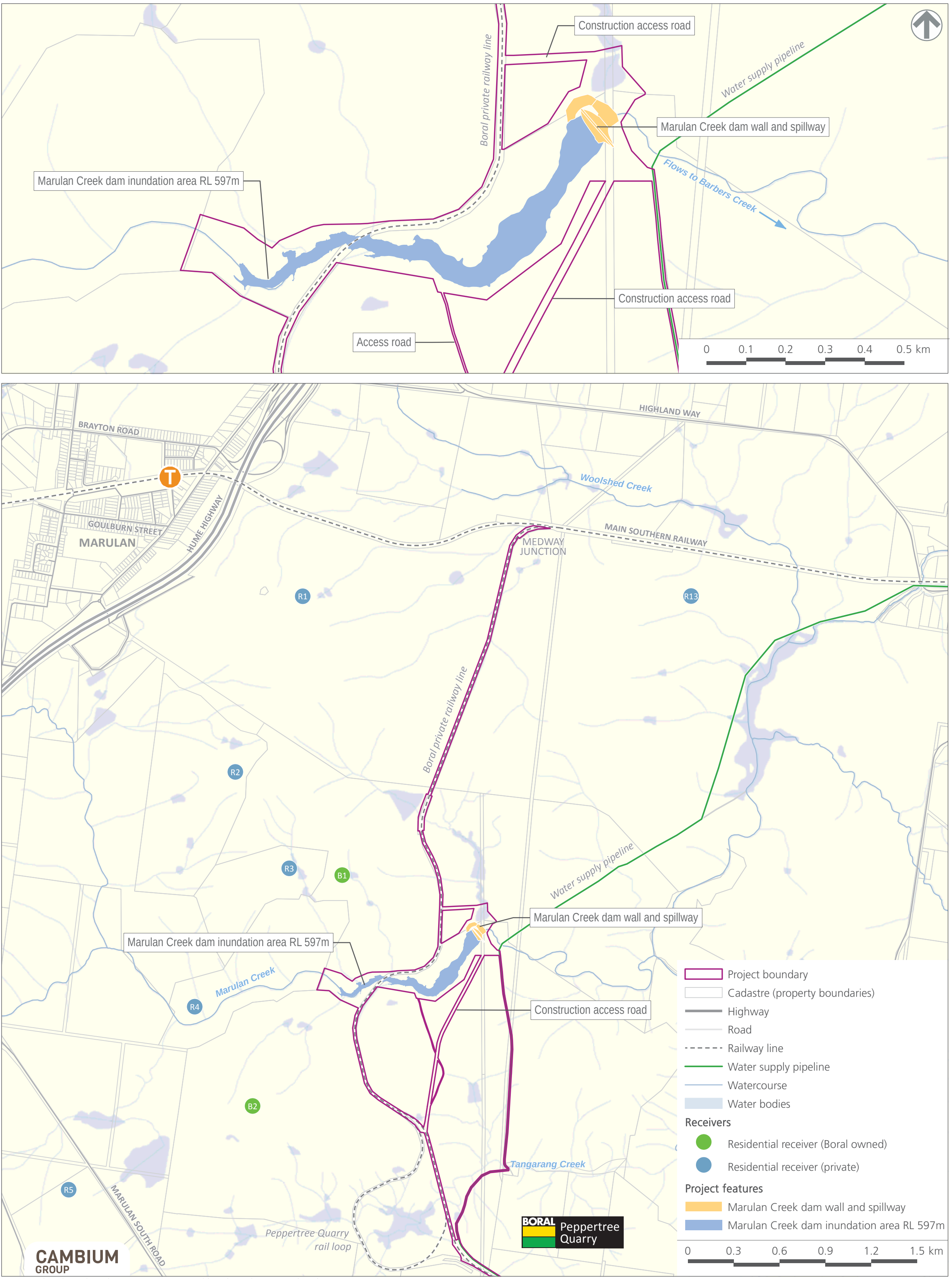
Figure 18

## The Project (Marulan Creek dam)



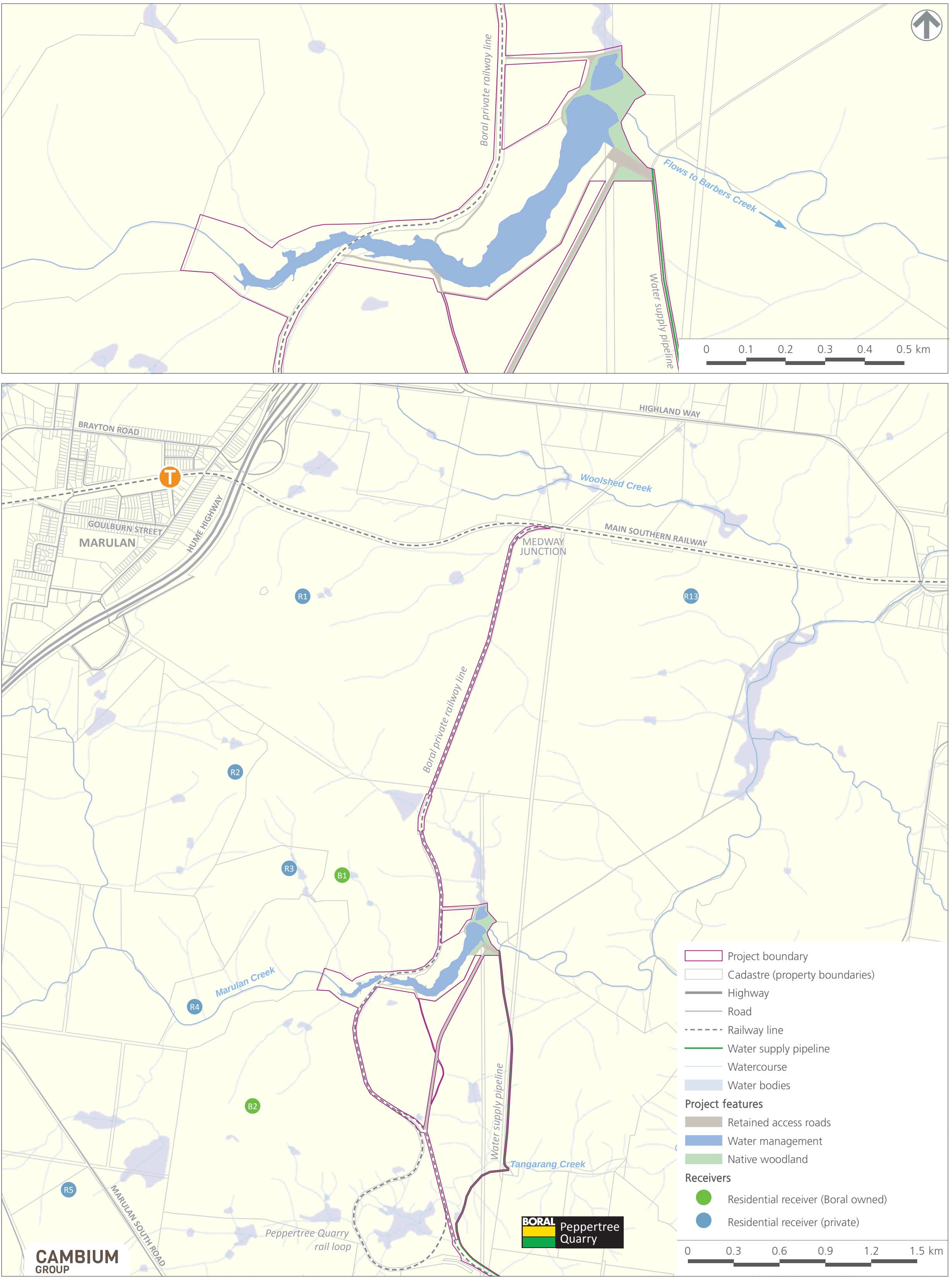
Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

031040_EIS_VIA_F18_180906_v01

Figure 19

## The Project - Final landform (Marulan Creek dam)

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
VISUAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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views along the axis of the amalgamated Pit extending from a distance of approximately 900m from the nearest part of the rim of the South Pit to approximately 3.8km to the kilns of the processing area and medium distance views of the Southern Overburden Emplacement. The effect of viewing distance is therefore rated as medium to low on all viewing places and situations. Overall, viewing distance has either a neutral effect on the rating for the extent of visual effects or decreases it.

### View loss or blocking effects

As the Project has overall low visual exposure, the landform structures with a vertical component that are proposed to be constructed, such as the Western, Northern and Southern Overburden Emplacements, would not cause significant view loss or view blocking effects. The 3D modelling of views from Sensitive Receivers (Appendix 2) shows that the majority have no view of the landform structures and that in those that have any view, the proposed landform will not rise to a level that obscures scenic features beyond.

Some view blocking will occur however, for the views from VP20 (the Bungonia Lookdown) and VP21 (McCauleys Flat track) viewing places. In the case of the Bungonia Lookdown, view blocking into the South Pit will occur as the Southern Overburden Emplacement gradually blocks the existing views into the Pit and along its extent toward the north (see photomontage in Appendix 3). The lowering and widening of the floor and sides of the Pit, particularly on the east side, will become hidden from view as the topography in the foreground of the view gradually rises into the view line. The Western Overburden Emplacement will be largely out of view. It is likely that vegetation used in rehabilitation would be screening the crest of the emplacement before the final lifts are completed. The 3D analytical model of the final landform in the view from the Bungonia Lookdown in Appendix 3 shows the Western Overburden Emplacement in magenta (Appendix 3) to be largely hidden from view even if rehabilitation is not taken into consideration as a mitigation factor.

Ultimately, the view blocking effects on views from the Bungonia Lookdown lookout (VP20) will be beneficial rather than a negative impact, as they will reduce the visual exposure of the disturbance footprint of the Project.

There will be minor blocking effects on existing views seen from VP21. Higher topography to the east of the existing Pit and the Eastern Batters block views into the floor of the Pit and the southern parts of the Pit. The faces of part of the western wall of the Pit are visible and therefore the extension of mining toward the west will be partly visible, however this will not cause any loss of views. The Western and Northern Overburden Emplacements would be partly visible, however they would not rise sufficiently above the existing topography to cause significant view loss to landscape beyond. No specific scenic items are visible that would be blocked by the increased height of the topography that is proposed.

The assessment of view loss also considered the planning principles in Tenacity and in Rose Bay Marina. There is no significant loss of views to residences or the public domain, as scenic, iconic, water, land-water interface or whole views are not lost in the Project. It is therefore not necessary to go through the four-step process of the planning principle for view loss in Tenacity, as the principle has no work to do in that situation.

The planning principles in Rose Bay extended Tenacity to considering view loss from the public domain which includes roads, lookouts and reserves. The principle does not concern general changes in the character or quality of the view. The extent of view loss is considered negligible or minor from roads, lookouts and reserves and therefore the Rose Bay principles are not relevant.

### Night time lighting

No change is proposed in the Project to the amount or purpose of night lighting. Three kinds of lighting are potentially relevant to visual impacts. These are:

1. General and security lighting, that is of low luminance;
2. Lighting for safe working in the mine environment, which is of higher luminance and may not only be perceived directly, but may also cause a "glow" effect, by reflected or direct light causing illumination of the adjacent atmosphere; and
3. Vehicle and directional lighting used to guide vehicles at night.

With regard to perception of night lighting generally, the visibility of lighting other than the effect on type 2 above, is governed by the same principles as the visibility of the existing operations. Types 1 and 3 require direct line of site to be perceived, although Type 3 lighting may have the localised effect of illuminating features adjacent to the vehicles particularly as they move (e.g. trees or rock faces) or be perceived as movement of the light source when in more distant views.

Sites that have the highest potential night time visibility are the adjacent lookouts to the south and tracks to the east (VP20 and VP21), from which all of the three types of lighting may be visible at times. However, as the lookouts are predominantly used for daytime activities, the visibility of night time lighting from these is not considered to be an issue that increases the sensitivity rating of the viewing places.

Lighting has several specific functions. The first is security lighting in and around the existing facilities and processing area. Security lighting is an essential health, safety and security feature of the existing processing plant and associated facilities. This lighting has been a feature of the existing operation since its establishment. For the reasons outlined above in relation to visual exposure of the existing operation, most of the security lighting would not be visible to the rural landscapes to the north, west and south west of the mine, as it is on structures that are below the horizons of the views. The increase in topography of some of the landscape proposed as future overburden emplacement areas will lead to a decrease in the visibility of this part of the lighting employed at the mine.

There are however isolated locations from which the tops of some of the tallest of the processing plant structures are partly visible, for example from VP14 on Jerrara Road and R15 on Long Point Road. As these structures have individual security light or luminaires on them, their lamps will be visible at night from some isolated locations. In addition, some other individual lamps on high structures may be visible at night, seen through vegetation that screens the view of the structures in daylight and particularly when seen from moving view points, such as in vehicles. The human eye's capacity to see very low luminance light sources at night assists in this effect.

However the general principles of visual exposure identified above still apply. The security lighting will remain of overall low visibility, because by its nature, it does not have sufficient luminance even in the areas where there are several luminaires adjacent to each other, to cause a "glow" effect.

A second purpose for lighting is for night time mining activities in the Pit. Movable high intensity lighting is used for this purpose, with the light directed onto the work area. As there is no proposed change in the Project to the mining activity or the lighting to be employed, there will not be any quantitative or qualitative change to the perception of night time lighting caused by type 2 lighting in the Project, compared to the existing situation.

The light would only be directly visible from isolated locations at night from VPs 20 and 21, as the location of the light sources is below the view horizon in other views. If stripping of overburden was occurring at night on the upper west side of the existing pit above its view horizon, light may also be directly visible from the residence R15.

High intensity lighting can also be reflected off surfaces even if not directly visible and cause illumination of secondary features adjacent to the source, for example rock faces and vegetation. It can also cause a glow effect by illuminating dust or water vapour in the atmosphere in certain circumstances. The glowing effect can be visible above the location of the light source and therefore the visual catchment of the light is increased.

The third type of light concerns vehicle lights and directional lighting to guide vehicles involved in the handling of extracted material at night, whether to the crushers or to overburden emplacements. Vehicles engaged in these activities have their own headlights, which could also be visible from off site in some circumstances, particularly during emplacement of overburden material at night. Visibility would be restricted to the few receivers and view points that would be able to view the overburden emplacement areas.

As emplacement of overburden progresses within the Western and Northern Overburden Emplacement , overburden emplacement would be undertaken starting at the perimeter of each new lift relative to potential view directions. The outer dumping area on each lift will have the effect of sequentially blocking views of vehicle lights which, without this mitigation, might be visible from receivers to the north-west, west and south-west and from the last section of Marulan South Road.

A further source of night time light that is not confined to the Project site is light from vehicles using Marulan South Road at night. The Project will result in a small increase in heavy vehicle trips in the order of 2-3 heavy vehicle loads per hour (total of 4-6 two-way trips) on an average day using Marulan South Road and the Hume Highway.

Most of the heavy vehicle traffic will be during daylight hours, therefore it is likely that the number of additional heavy vehicles travelling at night along Marulan South Road, as a result of the project, would be lower.

Potential visual exposure to light from vehicles would otherwise remain as at present in terms of the number of vehicle movements at night. There would however, be a minor change to the exposure of vehicle lights to the surrounding environment in the vicinity of the proposed Marulan South Road Realignment.

Travelling south from the proposed terminus of the public road adjacent to the entry to the Aglime Fertiliser facility, the road is proposed to curve westward (Figure 8), to meet the existing Marulan South Road in the vicinity of the east boundary of the Foti Fireworks facility (C3). Light spill to the adjacent landscape overall would be reduced by the diversion in Stage 3 and the construction of the northern section of the Western Overburden Emplacement area. Relatively dense vegetation to the north and north-west and the Western Overburden Emplacement to the south of the road would tend to largely confine light from headlights to the alignment of the road until vehicles emerge into more open landscape close to the end of the diversion. For a distance of approximately 400m after passing the Western Overburden Emplacement, vehicle lights would be directed approximately west, before the road re-joins the existing alignment of Marulan South Road.

The closest residential receiver from the point where the road emerges from between the Western Overburden Emplacement and vegetated area to its north is R9 (Figure 6), at a distance of approximately 950m. Vegetation and topography between R9 and the road are likely to help to screen or diffuse potential light spill and it is unlikely that the re-alignment of the road would significantly change potential light spill to this residential receiver.

The distance between the same point discussed above and a potential residence site in C2 (indicated by PR on Figure 8, a photograph from which is at Plate 7), is approximately 1.3km. The axis of light from trucks on the new road diversion is approximately west and PR would not be directly exposed. Trucks then return to the existing alignment closer to PR. As there is no proposed change to usage, there would be no increase in the risk of light spill to PR, the location of which was clearly decided in the knowledge of the existing use of the road by trucks at night.

Notwithstanding the above, Boral should undertake, in determining the final alignment of the diversion, to minimise the risk of light spill to PR and, if requested by the owner, provide an earth bund or a tree belt to reduce potential light spill.

#### Cumulative impacts

There is potential for some cumulative impacts to occur between the proposed Project and the further extraction and development of the adjacent Peppertree Quarry. The two operations are also intended to share the Northern Overburden Emplacement during what would be Stage 1 of the mine's proposed SSD and simultaneously, Modification 5 of the Peppertree Quarry when approved. It is likely, given the probable time frames of the two applications, that the Peppertree Quarry Modification 5 would be approved first.

As the earliest stage of both proposals involve the Northern Overburden Emplacement, which is proposed to be completed and rehabilitated by the end of Stage 1, and is also of low visibility from the visual catchment of both Marulan Limestone Mine and Peppertree Quarry, the potential for cumulative impacts is limited.

In addition, for the most part, the effects of the two operations on each other are neutral or positive for the mine's SSD, in that the approved overburden emplacements in Peppertree Quarry would either have no effect or would tend to add screening to the mine's SSD. For example, the approved Southern Overburden Emplacement in Modification 4 of Peppertree Quarry would screen the mine's proposed Northern Overburden Emplacement in views from the Long Point Road area, R14 and R15 and from VP21. It would also be likely to screen the last lifts of the Western Overburden Emplacement, which is proposed to be constructed in Stage 3 of the mine's SSD, from views from the same direction.

Overall, there is a low potential for cumulative impacts and in general the effect would be to reduce, rather than increase, the impacts of the Project.

### 4.2.3 Overall Extent of Visual Effects

The overall extent of visual effects of the Project was established through an evaluation of all of the impact factors for each viewing location as presented in Table 4.2 on the next page. In summary, the overall visual effects rating of the Project on its total visual catchment has been assessed as low to medium.

## 4.3 Visual Impact Analysis

### 4.3.1 Physical Absorption Capacity

The physical absorption capacity (PAC) for the Project would be high for the majority of the visual catchment, with the exceptions of the two viewing places VP20 and VP21. Of these, the view from VP20 (the Bungonia Lookdown lookout) would experience an initial low PAC for the Southern Overburden Emplacement and expansion of the existing Pit to the west and north-west, increasing throughout

## Table 4.2: Overall Visual Effects

| | | | | Impact Weighting factors | | | | |
|---|---|---|---|---|---|---|---|---|
| Receiver number | Direct visibility (any part of Project) Y/N | Distance class | Overall level of visual effects | Physical Absorption Capacity | Compatibility mining and industrial features) | Compatibility (urban and natural features) | Sensitivity | Overall Visual Impact |
| VP1 | Y | Close* | Low | High | High | High | Low | Low |
| VP2 | Y | Close* | Medium | High | High | Medium | Low | Low |
| VP3 | Y | Close* | Medium | High | High | Medium | Low | Low |
| VP4 | Y | Close* | Medium | High | High | Medium | Low | Low |
| VP5 | Y | Close* | Medium | High | High | Low | Low | Low |
| VP6 | Y | Close | Low-medium | High | High | Medium | Low | Low |
| VP7 | Y | Close | Low | High | High | Medium | Medium | Low |
| VP8 | N | Medium | Low | High | High | High | Medium | Low |
| VP9 | N | Medium | Low | High | High | High | Medium | Low |
| VP10 | N | Medium | Low | High | High | High | Medium | Low |
| VP11 | N | Medium | Low | High | High | High | Medium | Low |
| VP12 | N | Medium | Low | High | High | High | Medium | Low |
| VP13 | N | Medium | Low | High | High | High | Medium | Low |
| VP14 | Y | Distant | Low | High | High | Medium | Low | Low |
| VP15 | Y | Distant | Low | High | High | Medium | Low | Low |
| VP16 | N | Distant | Negligible | High | High | High | Low | Low |
| VP17 | N | Distant | Negligible | High | High | High | Low | Low |
| VP18 | Y | Medium | Low | High | High | High | Medium | Low |
| VP19 | Y | Medium | Negligible | High | High | High | Medium | Low |
| VP20 | Y | Medium | Medium | Low | High | Medium | Medium | Medium |
| VP21 | Y | Medium | Medium | Medium | High | Medium | Medium | Medium |
| VP22 | N | Medium | Negligible | High | High | High | Medium | Low |
| VP23 | N | Medium | Negligible | High | High | High | Medium | Low |
| VP24 | N | Medium | Low | High | High | High | Medium | Low |
| VP25 | Y | Distant | Low | High | High | Medium | Low | Low |
| R5 | N | Medium | Low-medium | High | High | Medium | Medium | Low |
| R8 | N | Medium | Low | High | High | High | Medium | Low |
| R10 | Y | Medium | Low | High | High | Medium | Medium | Low |
| R13+ | Y | Distant+ | Low | High | High | Medium | Low | Low |
| R14 | Y | Medium | Low | High | High | Medium | Medium | Low |
| R15 | Y | Medium | Low | High | High | Medium | Medium | Low |
| C2# | N | Medium | Low | High | High | Medium | Medium | Low |
| C3# | N | Close | Low | High | High | Medium | Low | Low |

* View Point at or inside Project site
# Commercial receiver
+ Heritage item

the life of the Project as the Southern Overburden Emplacement gradually occludes views into the amalgamated Pit. There would be high PAC throughout the Project for the Western Overburden Emplacement and the Northern Overburden Emplacement as seen from VP20. Hight PAC would also occur as a result of sequential rehabilitation of the overburden emplacements, which would assist in screening views of landform structures.

In the view from VP21 (McCauleys Flat track), there would be medium PAC for mining of the upper benches on the west side of the Pit and for the Western Overburden Emplacement and Northern Overburden Emplacement, as a significant part of both would be hidden by existing and emerging topography associated with approved overburden emplacements of Peppertree Quarry. When the staging is taken into account, PAC would generally increase. For example the northern part of the Western Overburden Emplacement would not be constructed until the end of Stage 3, by which time rehabilitation would be many years established on the approved Modification 4 Southern Overburden Emplacement in Peppertree Quarry. This is between the viewer and the Project, increasing PAC and decreasing or eliminating visibility of a substantial part of the Project.

The Marulan Creek Dam would be of the highest level of PAC, as it is not visible from any known public viewing places.

The generally high or medium levels of PAC are considered to justify down-weighting the significance of visual impacts.

### 4.3.2 Visual Compatibility

#### Visual compatibility with mining/industrial features

The visual compatibility of the Project with mining/industrial features would be high for all viewing locations. The Project does not include significant changes to any of the existing infrastructure, machinery used, methods of mining, means of construction of overburden emplacements, lighting or overall rehabilitation strategies. A minor change to the existing processing area is the relocation of the stockpile reclaim area by 180 degrees to the west (on the south-eastern platform of the Northern Overburden Emplacement). This is to allow space for the expansion of the pit to the north.

As there are no close range view places other than on Marulan South Road, which will be de-proclaimed and become a private road beyond the entrance to the Ag-lime manufacturing plant, the main visual changes of the Project would be most evident as colour and textures of the faces of overburden or rehabilitation areas. The proposed woodland vegetation form in the proposed rehabilitation strategy would result in colours and textures of landform structures that are of high compatibility with the existing landscape, as depicted in the photomontages in Appendix 3.

The generally high visual compatibility with mining/industrial features are considered to justify down-weighting the significance of visual impacts.

#### Visual compatibility with rural and natural features

The Project is of low visibility from the adjacent rural landscapes. The exception is part of the Western Overburden emplacement, visible from a short section of Marulan South Road and the re-aligned high voltage powerline in its vicinity. The intended natural, grassed, woodland character of the rehabilitation of the overburden emplacement would be compatible with the adjacent rural landscape. The powerline when re-aligned would also be compatible with the rural landscape, as it would have a similar appearance to the existing powerline.

With regard to natural features, notwithstanding the natural character of adjacent land to the south and east of the Project site, the Project site and land to its west and north in the proposed disturbance footprint, demonstrate a significant history of disturbance. The natural features of the adjacent landscape are of overall moderate quality in the area proposed for the expansion of the disturbance footprint. The Project is therefore of higher visual compatibility with those features than would be the case if the disturbance footprint was proposed to expand to the south and east.

As a result of a more rigorous standard of rehabilitation in the Project compared to historical precedents, the visual compatibility for rehabilitation of overburden emplacements, where they are visible, would be medium, rather than medium to low, as in the past. While historical overburden emplacements such as the Eastern Batters have gradually become colonised by vegetation including native species, the likely visual compatibility of the rehabilitation with existing natural features that is proposed in the Project would be higher, as the natural form, line, colour, textures and vegetation of the constructed landforms would be more rapidly established.

The medium levels of visual compatibility with rural and natural features are considered neutral as weighting factors (i.e. to neither increase nor decrease the significance of visual impacts).

### 4.3.3 Visual Sensitivity

The medium sensitivity zone applies to the largest proportion of all viewing places and situations assessed (20 out of 33). Of the 20, only 8 have views of any part of the Project and none will have a significant view of all of the Project. The highest level of sensitivity determined among the 8 viewing places analysed was medium, for VP20 and VP21, the Bungonia Lookdown and McCauleys Flat track and for two Residential Receivers (R14 and R15) on Long Point Road. The sensitivity of part of one Commercial Receiver (C2) is rated medium because of the potential construction of a residence at this location. Commercial receivers C2 and C3 are otherwise all in the low sensitivity range.

The low sensitivity zone applies to 13 locations in total. Six are of low sensitivity because they have long range views. Six on Marulan South Road (VPs 1-6) have close views, but are on a low sensitivity road. VP14 and VP15 have distant views that include part of existing plant infrastructure and part of the existing Peppertree Quarry Eastern Overburden Emplacement. The majority of the form of the overburden emplacements in the Project are unlikely to be significantly visible from either location.

As the majority of all viewing locations are of medium or low sensitivity, it is considered that this factor should act as a down-weight on the significance of visual impacts.

### 4.3.4 Applying Weightings to Overall Extent of Visual Impact

The overall extent of visual impacts of the Project was established through an evaluation of all of the impact factors for each viewing location presented in the Data Sheets in Appendix 6. These overall assessments of the visual impacts of the Project are shown in summary in Table 4.2. The overall visual impacts rating of the Project on its total visual catchment has been assessed as low, with medium impacts on VP20 (the Bungonia Lookdown) and VP 21 (McCauleys Flat track). No Residential Receivers are considered to be exposed to a medium level or greater than medium level of visual impacts.

The weighting factors in 4.3.1 to 4.3.3 above are considered to be either neutral or to justify a down-weighting of the significance of the overall extent of visual impacts. After applying this weighting, the overall extent of visual impacts is considered to be low.

## 4.4 Assessment of the Proposed Mitigation Measures

This part of the assessment considers whether specific mitigation measures will satisfactorily mitigate visual impacts. It is acknowledged that indirect visual impacts can be caused by factors such as attention attracted by noise and the visibility of dust and traffic, all of which are in a sense visible evidence of the Project. It is outside RLA's expertise to comment on these indirect technical aspects, which are the subject of individual specialist studies that will be included in the EIS.

### 4.4.1 Proposed Landform

Notwithstanding the low overall visibility of the final proposed landform to most of the visual catchment, the compatibility of the constructed landforms in the Project to existing and future landform has been carefully considered in regard to mitigation of visual impacts.

Two features of the Project are somewhat different from the existing environment, i.e. the location and scale of the proposed out-of-Pit overburden emplacements. In most of the visual catchment, the visual character of the overburden emplacements is not a significant constraint and will not cause significant visual impacts. However, in views from the natural settings in the Bungonia Lookdown and McCauleys Flat track areas (VP20 and VP21), the visual effects of the overburden emplacements will be evident to varying degrees as a result of initial contrasts with colour, line, form and texture of the existing environment. While these changes will be seen in the context of a long history of change, which includes similar features, it is acknowledged that the current community expects a higher standard of visual impacts mitigation of permanent change to the environment. The proposed standard of rehabilitation in the Project will be substantially higher than has been demonstrated in the past, returning overburden emplacements to a woodland appearance compatible with natural landscape.

The final landforms proposed for the overburden emplacements have a significant benefit by comparison to the historical precedents of parts of the Eastern Batters, being primarily constructed on relatively flat land, or alternatively (e.g. The Southern Overburden Emplacement), being primarily constructed on an existing concave base.

In addition, the proposed overburden emplacement landforms are compatible with the existing post-mining and natural topography, to the extent that is reasonably possible. The embankments of the overburden emplacements are compatible with the gradients of natural precedents in the vicinity and there is opportunity for minor variations in the topography of the embankments so as to prove a natural appearance, as set out in the Soils, Land Resource and Rehabilitation Assessment report (SLRRA)(LAMAC Management, 2018).

All the proposed new landform features in the Project will be subject to progressive rehabilitation (see below), with the objectives, relative to visual impacts, as stated by in the SLRRA by LAMAC of:

- Rehabilitated land will be geotechnically stable and will not present a greater safety hazard than surrounding land to land-users, public, livestock and native fauna accessing or transiting the post-mining area.
- Rehabilitated landforms will not negatively impact visual amenity for nearby residents and users of conservation reserves

Achieving these objectives will create appropriate landforms with vegetation that is compatible with existing natural environments and of an appropriate standard with regard to mitigation of the visual impacts of the proposed new landforms of the Project.

#### 4.4.1.1 Specific recommendations

While the final landform is considered appropriate with regards to visibility and character, there may be some visibility and visual impacts of associated mining and overburden emplacement activities. The 3D graphics (Appendix 2) indicate that even close receivers such as C3 will not have significant views of the overburden emplacements and it will be receivers further away (such as R10, R13, R14 and R15) that may perceive some stages of activities associated with the Project. For most of the visual catchment, it will be many years until any evidence of the development comes into view. As rehabilitation of the overburden emplacements is proposed to sequentially follow the construction of major lifts, only part of any overburden emplacement will be bare of vegetation at any point in time and in many cases the vegetation established from earlier rehabilitation will screen further emplacement of overburden behind.

The Western Overburden Emplacement in Stage 3 and the Northern Overburden Emplacement in Stage 1 are likely to be of high visibility to part of Marulan South Road in the vicinity of VPs 1-6. However, VPs 3-5 will be subsumed by the Western Overburden Emplacement after the re-alignment of Marulan South Road and would no longer provide view opportunities. View opportunities will however be regained by other viewing places along the realigned section of Marulan South Road for a short distance from the point of re-alignment until it reaches its intended public terminus at the entry to the Aglime Fertiliser facility.

So as to minimise the visibility of the overburden emplacements and associated development activities, in particular the Western and Northern Overburden Emplacements, it is recommended that the outer lip of the perimeter lifts act as a visual barrier to emplacement activities behind. A policy should be put in place to begin all new lifts on the margins relative to potential view directions (eg. on the south-west and west sides of the Western Overburden Emplacement and the north margins of the Northern Overburden Emplacement), progressing as sequential rows of tipped material away from the main view direction, so the initial dumping area acts as a barrier to view. In concert with pre-planting of a tree screen and rehabilitation of the final emplacement faces sequentially (see below) this will be effective in assisting in mitigating the impacts of developing these overburden emplacements.

The effect of the emplacement of overburden along the perimeter of emplacements at the start of each lift, will also be to minimise the visibility of the active overburden emplacement and associated development activities behind when they rise high enough to be partly visible, from some limited locations.

### 4.4.2 Rehabilitation

The proposed approach to rehabilitation is outlined in the SLRRA (LAMAC) and is summarised in the EIS. Current rehabilitation practices on site and those proposed by LAMAC for the rehabilitation of future landforms associated with the Project will result in a very different outcome than the approaches taken to the rehabilitation of the Eastern Batters that were established in the early days of the mine's development.

Overburden emplacement embankments will be progressively rehabilitated through stabilisation and revegetation techniques with the final landform representing dense to moderately dense native woodland on all overburden emplacement areas on moderate to steep slopes, with more open native woodland established on the flatter tops of overburden emplacements.

The Eastern Batters above Barbers Creek and Bungonia Creek will also be rehabilitated further to achieve a dense to moderately dense native tree canopy that blends with the surrounding Morton NP and Bungonia NP and SCA.

These rehabilitation objectives will create appropriate colour, texture and scenic quality, by providing a vegetation cover that is compatible with the existing and adjacent natural environment. In this way, the major contrasts of existing overburden and infrastructure material emplacements with the surrounding environment will be minimised. The process will be achieved sequentially as each of the overburden emplacement areas is established.

With regard to views from the few Receivers affected, the overall low visibility of the overburden emplacements and the sequential rehabilitation proposed, will satisfactorily mitigate impacts and potentially block views of the construction of the upper and final levels before they are completed. This is because vegetation will likely grow into the horizon formed by the upper levels of the emplacements before the final landform is achieved. This will be particularly evident in close range views of the Western Overburden Emplacement and Northern Overburden Emplacement when viewed from Marulan South Road. The upward viewing angle is such that as vegetation is established on the lower slopes, it will sequentially block the view of higher slopes, or the crest of the emplacements.

Initially, landscape structures for the stabilisation and drainage of the outer slopes of the overburden emplacements may be visible by way of their line and form, such as graded drains, benches and rock-lined water drop structures. Their visibility will decrease as vegetation establishes and forms a canopy. Because of shadows cast by even small individual plants, the visibility of surfaces and of most linear drainage structures will significantly decrease well before maturity of any of the canopy species. Larger horizontal structures such as benches on the Southern Overburden Emplacement, noted in the SLRRA as necessary to reduce slope lengths and erosion, will take longer to be visually absorbed in the medium distance views from the Bungonia Lookdown.

In general however, vegetation screening of individual landform structures in not critical to visual impacts mitigation, as they are predominantly seen either minimally, or from a distance, with the exception of views of the Northern Overburden Emplacement and Western Overburden Emplacement from a short section of the realigned Marulan South Road and medium range views from VP20, VP21, R14 and R15.

#### 4.4.2.1 Specific recommendations

One location requiring consideration of establishment of an early tree screen applies to the western and northern foot slopes of the Western Overburden Emplacement and Northern Overburden Emplacement areas, which are both potentially visible at close range from the realignment of Marulan South Road (see for example, photomontage for VP6 in Appendix 3). In a practical sense the road is a low sensitivity location, because from the point of the proposed Marulan South Road realignment, it leads solely to industrial land (Aglime Fertiliser facility), land owned by Boral, the mine, or Peppertree Quarry. However, it will remain a public road up to the Aglime Fertiliser facility entrance. Screening of the foot of the Western and Northern Overburden Emplacements adjacent to Marulan South Road, will assist in mitigating the visual impact of the early stages of emplacement development, containing light spill from vehicles (see below) and rapidly establishing a vegetated appearance, which will be carried upward as the lifts increase the heights of the emplacements. As mentioned above, vegetation will soon have the capability of disguising the future growth in height of the emplacements, as they are only seen in close view from the road and in an upward view direction.

A buffer of open to moderately dense woodland/forest form vegetation as is proposed by LAMAC for the crests of the overburden emplacements, would be appropriate, pre-planted and established, and would complement and be compatible with the remnant and regrowth woodland in the vicinity and with the rehabilitation intended for the embankments of the overburden emplacements.

### 4.4.3 Lighting

While visiting each of the residential Receivers documented, the owners were asked by RLA whether they could perceive night lighting from the mine. Each owner had the opportunity without prompting, to express whether that lighting, if perceivable, was considered to be obtrusive, or otherwise. Some of the residents reported seeing light at night in some contexts, primarily as glimpses of security lights on the processing plant, seen while driving in the area. None of the residents expressed concern about brightness, glare or nuisance caused by night lighting. One resident to the west of the mine reported sometimes seeing a "glow" at night in the general vicinity of the Peppertree Quarry processing area as distinct from individual lights visible at times associated with the mine processing area. This "glow" is presumably a reference to reflected light or the illumination of the atmosphere by type 2 lighting in the processing area of the quarry, as the security lighting of the mine is of insufficient luminance, based on night-time observations, to cause that visual effect. A distinction was made between the perceived colour of the "glow" that was visible in the vicinity of the mine and of Peppertree Quarry. Mine light appeared yellow to orange, while the Peppertree Quarry light appeared bluish or white by comparison. Notwithstanding, residents also reported being generally unconcerned by lighting associated with the mine.

None of the residents reported seeing headlights of vehicles or directional lighting associated with the emplacement of material in the existing overburden emplacement areas at night.

#### 4.4.3.1 Specific recommendations

It is noted that there is no proposed change to the extent or purpose of illumination in the Project. As far as we are aware, there have also been no complaints in relation to lighting on the mine's complaints register.

It is recommended that during the course of the Project a strategy relating to lighting be introduced to reduce lighting to the lowest level possible that also maintains an appropriate standard of safety and security and to minimise obtrusive lighting.

Type 2 mobile lighting used for in-pit works would employ lamps that produce light in the red or yellow areas of the spectrum rather than the blue or white and be shrouded as much as possible to reduce lateral spread of the light and excess reflection of light, as well as being directed downward.

A strategy is also required for control of the potential visibility of type 3 lighting associated with night time use of vehicles in the Project, specifically the potential for headlight or directional lighting during development or contouring of overburden emplacements at night, if that occurs. As there are no viewing places which look down on the overburden emplacements from roads or Residential Receivers, light spill would only require a policy for night-time overburden emplacement to minimise potential spill from vehicle lights. It is therefore recommended that for each new lift on the western and south-western edges of the WOE, or the northern margins of the Northern Overburden Emplacement, overburden emplacement should begin at the margins of the lift relative to potential view directions and then progress in rows behind the margin, providing a light barrier to vehicle headlights.

Overburden emplacement work will also be carried out at night in the South Pit, where light spill will be increasingly controlled by the work being generally below view lines and also shielded by walls of the Pit. Some light will be visible at times, however as it was concluded that night-time view impacts are not significant on the Lookdown or VP21 because of the use of these areas being largely confined to daylight hours, it is considered that the above strategy would be successful in mitigating light spill of type 3 light from vehicles.

### 4.4.4 Southern Overburden Emplacement

Retaining the south lip of the South Pit as recommended by the OEH in response to SEARs for the Project, is a fundamental principle of mitigation of impacts on views from the Bungonia Lookdown and will achieve the OEH's recommendation in that regard. However, the construction of the Southern Overburden Emplacement will also be more beneficial to views from tracks in the vicinity of the Lookdown where the overall landform created will decrease or eliminate views of mining operations in the Pit well before the end of mine life. The Adams Lookout has significantly less exposure to the visual effects of mining, but views into part of the Pit are possible, which will be mitigated by the construction of the Southern Overburden Emplacement.

The Southern Overburden Emplacement and its extension to the west fulfils two different objectives of the Project. It allows for a significant proportion of the total overburden emplacement volume from the mine itself and it is also the most profound mitigation measure for the visual impacts of the Pit in views from the Bungonia Lookdown (VP20) and adjacent areas such as Adams lookout that would ever have been enacted.

Backfilling of the southern-most portion of the former South Pit will be significant in Stage 3 and completed by Stage 4, significantly blocking views into the Pit from Bungonia Lookdown.

#### 4.4.3.3 Specific recommendations

Out of all proposed overburden emplacement areas on the Project site, the southern slopes of the Southern Overburden Emplacement should be the most carefully considered when planning, implementing and monitoring the rehabilitation of these embankments. Due to the visibility of the Southern Overburden Emplacement to the Bungonia Lookdown to the south and the proximity of this emplacement area to the Bungonia Gorge and Creek, it is important to stabilise the outer slopes of this emplacement and establish a woodland vegetation form as quickly as possible.

## 5.0 Residual Visual Impacts and Conclusions

The Project is quite remarkable, as despite the scale of the disturbance footprint, it has a low overall visual exposure to its visual catchment. Despite there being a number of rural properties and commercial operations within 3km of the closest part of the Project, (medium viewing distance and sensitivity classes) there is low visual exposure of the Project to those receivers and most have no views of it.

The Project is not exposed to view from roads that carry either through traffic or significant numbers of viewers and is not in a destination that would attract visitation by tourists. The road to the mine, Marulan South Road, reaches a dead-end in the vicinity of the Boral-owned Peppertree Quarry and mine entrances.

The Project features a number of out-of-pit overburden emplacements to ensure the greatest possible flexibility in the operation of the mine over the 30-year development consent period. With the assistance of proposed rehabilitation methods, these overburden emplacements will have only minor effects and impacts on the visual environment.

However, parts of the Project are exposed to views from two reserves of natural landscape, Bungonia NP and Morton NP. There would be some residual visual impacts on these locations, as mitigation will reduce, but not eliminate impacts, especially during the construction of the overburden emplacements and during the establishment of vegetation on the emplacement slopes.

VP20 is the only viewing location assessed that has a substantial view of the proposed extension of the mine Pit to the west and of parts of most of the overburden emplacements, however, views of the Western Overburden Emplacement and Northern Overburden Emplacement would be minimal.

By the end of the development consent period (30 years), the view into the mine Pit would have been significantly and sequentially reduced as the Southern Overburden Emplacement and its extension to the west occludes the view and replaces it with a rehabilitated infill landform of a natural appearance, vegetated with native woodland species that help blend the emplacement with the surrounding natural landscapes of the Bungonia NP and Morton NP. The final landform of the Southern Overburden Emplacement will be the most profound mitigation work that has ever been implemented to reduce visual impacts of the mine on views from the Bungonia Lookdown.

The visual exposure of night time lighting has been considered. No change is proposed in the Project in the use and purpose of lighting. The security and general lighting wold be unchanged and will be of low visual exposure. The use of lighting for mining activities and to guide vehicles being used at night is also proposed to be unchanged.

A policy of minimising unnecessary or potentially obtrusive light sources and gradually replacing existing luminaires and lamps with those producing light in the most appropriate colour spectrum and lowest practical luminance levels is recommended. An objective will be to reduce the “glow” effect of type 2 lighting (flood lighting) on the atmosphere.

Night time lighting of mining operations in the Pit would be most visible from the Bungonia Lookdown (VP20) and McCauleys Flat track (VP21), however night time use of the reserves would be minimal. As a result, the impacts of night lighting on such viewing locations is considered to be minor.

This visual assessment finds that while there are some residual visual impacts, these are minor in significance. The visual impacts have also been considered in relation to the extensive and to some extent permanent changes to the visual environment that have occurred in the past. The residual impacts that will occur are considered compatible with both the mining/industrial and the rural/natural visual environment

# Appendix 1: Photographic Plates

*Plate 1/1*

*VP1, approximately 200m east of the entries to Marulan Limesone Mine (on the left) and Peppertree Quarry (on the right). The proposed  Northern Overburden Emplacement would be partly visible on the left and the road sales area on the riight. The site of the view is inside Boral land in a location where the view is not easily available to the public.*

*Plate 1/2*

*VP2, Marulan South Road looking east at the location of the proposed Northern Overburden Emplacement. This section of road is proposed to be de-proclaimed in the Project.*

*Plate 1/3*

*VP3, existing Marulan South Road, looking approximately south west over part of the land proposed to be occupied by the Western Overburden Emplacement, the road being re-aligned to approximately follow the power line easement on the right of the image. The part of the road in the foreground will not exist in the Project.*

*Plate 1/4*

*VP4, Marulan South Road, looking approximately north east across part of the land proposed to be occupied by the Western Overburden Emplacement. The road will be re-aligned to run adjacent to the dense vegetation visible on the left. The part of the road in the foreground will not exist in the Project.*

Plate 1/5
*VP5 near the entry to B3 and the beginning of the proposed Marulan South Road Re-alignment*

Plate 1/6
*VP6, View along the approximate route to be taken by the Marulan South Road Re-alignment, the Western Overburden Emplacment on the right. This image is used in preparation of a photomontage in Appendix 3.*

Plate 1/7

VP7, View of Foti Fireworks, C3, a seen from Marulan South Road. The office building is on the right. The ridge on the left and vegetation in the view lines prevent views of the Project from occurring.

Plate 1/8

VP8, View of C2 from Marulan South Road, opposite the entrance to R8, which is on the north side of the road.

*Plate 1/9*
*VP8, View of entrance to R8 from Marulan South Road.  The residence faces the road (away from the Project).*

*Plate 1/10*
*VP9, View of R7 from Marulan South Road. Access to R7 could not be secured. 3D modelling and interpretation of aerial photographs indicates that R7 is unlikely to have views of the Project.*

Plate 1/11

*VP10, Marulan South Road. In common with most views between VP6 and VP13, vegetation in properties and undulating topography combine to block views toward the Project.*

Plate 1/12

*VP11, View of R5 from Marulan South Road. The residence faces north toward the road and away from the Project. Pine tree belts, one visible in this photograph and another along the access road to the residence on the right of the photograph are likely to confine views to the north in the future.*

*Plate 1/13*
*VP12, Marulan South Road, looking south east toward the Project site.*

*Plate 1/14*
*VP13, Marulan South Road, looking south east toward the Project site.*

Plate 1/15

*VP14, Jerrara Road. Part of the tallest structures in the Marulan Limestone Mine processing area are distantly visible. Vegetation to their left in this view will prevent views of the Project from this location.*

Plate 1/16

*VP15, Jerrara Road. Part of the overburden emplacement at Peppertree Qarry is distantly visible from this isolated location. Structures in the Marulan Limestone Mine processing area are not visible. it is likely based on 3D modelling that mid-ground topography and vegetation will block views of the Project from this location.*

*Plate 1/17*

*VP16, Jerrara Road near the intersection with Oak Valley Road. Residences in this locality do not have views of the Project because of the relative height of intervening topography*

*Plate 1/18*

*VP17, Jerrara Road near the intersection with Oak Valley Road. Residences in this locality do not have views of the Project because of the relative height of intervening topography that is vislble in the background*

Plate 1/19

*VP18, Glynmar Road near the entry to R10. Part of the Eastern Overburden Emplacement at Peppertree Qarry is distantly visible from this location. Structures in the Marulan Limestone Mine processing area are not visible. It is likely based on 3D modelling that mid-ground topography and vegetation will block most of the views of the Project from this location.*

Plate 1/20

*VP19, Glynmar Road. Part of the Eastern Overburden Emplacement at Peppertree Qarry is distantly visible from this location. Structures in the Marulan Limestone Mine processing area are not visible. It is likely that mid-ground topography and vegetation will block most of the views of the Project from this location.*

*Plate 1/21*

*VP20, The Lookdown northern lookout, Bungonia NP.*

*This view has been used as the base for a photomontage in Appendix 3. The Southern Overburden Emplacement and its extension to the west will significantly mitigate views of the Mine and rehabilitation will gradually replace bare surfaces with vegetation similar in character to what is visible in the foreground.*

*Plate 1/22*

*VP20, The Lookdown northern lookout, Bungonia NP, looking east toward the Shoalhaven River gorges in Morton NP. Views like this and the karst landscapes of the Bungonia SCA and NP are likely to be the primary reasons for visitation.*

*The landscape in the foreground on the right is similar to the character intended in rehabilitation of the Project.*

Plate 1/23

*VP21, View from a point west of the McCauleys Point track south of Long Point Lookout before it turns east and descends into to Shoalhaven River gorge, looking south-west. The Project will not significantly alter the composition of the view.*

Plate 1/24

*View from a point approximately 10m west of the location of Plate 1/23, west of the McCauleys Point track, looking west. Some of the structures in the processing area of the Mine are visible on the left, with the approved Southern and Eastern Overburden Emplacement of the Peppertree Quarry visible in the centre and right of the view. Structures in the processing area of Peppertree Quarry are also visible in the right centre. The approved Peppertree quarry overburden emplacements will significantly screen the Project in this view.*

*Plate 1/25*

*VP22, Long Point Lookout, View from the lookout to the east into Shoalhaven River gorge. The lookout has no view of the Project.*

*Plate 1/26*

*VP22, View toward the Project site from the parking area at Long Point lookout. Intervening topography blocks the view.*

Plate 1/27

*VP23, View of R17 from Long Point Road. The residence does not have views of the Project.*

Plate 1/28

*VP24, View of R15 and the location of R16 from Long Point Road. R15 on the left is a location from which a view has been used to prepare a photomontage in Appendix 3.  R16 is out of sight over the foreground dam wall to the right, but it has no view of the Project because of a dense and high screen of trees, visible on the right.*

*Plate 1/29*

*VP25, morning view from Badgerys Lookout at a distance of over 6km. The colour of the west wall of the Pit, which is partly visible over the east lip and intervening topography is evident. Some individual tall structures in the mine processing area are visible. The upper part of the Western Overburden Emplacement would be visible but no significant change in the composition of the view would result from implementation of the Project.*

*Plate 1/30*

*C2, view from adjacent to the buildings at C2, taken by Boral Staff in 2016. 3D graphics and observations of existing vegetation indicate that this site would not be likely to have a significant view of the Project. A future residence site to the south west of the commercial buildings was also inspected. It is also unlikely to have any view of the Project, as the view is more screened by vegetation and foreground topography.*

*Plate 1/31*

*C3 view from the commercial office. 3D graphics indicate that the site would not have views of the Project as a result of blocking of the view by foreground topography and by vegetation in the middle distance.*

*Plate 1/32*

*R5, 359 Glynmar Road*

*View from the south east corner of the veranda of the residence. 3D graphics indicate that the site would not have significant views of the Project as a result of blocking of the view by foreground topography and by vegetation in the middle distance. The avenue planting of pine trees along the driveway, partly grown, is likely in time to form a substantial vegetative screen.*

*Plate 1/33*

*R5, view in the same direction as Plate 1/34, from the veranda and near the front door of the residence. The same observations made above are relevant to this view.*

*Plate 1/34*

*R8, 381 Marulan South Road*

*View of the east side of the residence, which faces the Project site. The shadow on the left of the photograph is that of a large shed, which blocks most of the view east. The formal orientation of the residence is to the entrance drive and the road, on the south west, or other, side.*

*Plate 1/35*

*R8, view toward the Project site from land east of the shed. Dense vegetation in the view line will prevent there being any direct views of the Project.*

*Plate 1/36*

*R10, 290 Glynmar Road*

*View from east-facing outdoor entertainment area. Part of the overburden emplacement at Peppertree Qarry is distantly visible from this location. Structures in the Marulan South Limestone Mine processing area are not visible. it is likely that part of the final landform of the Western Overburden Emplacement may become visible in the final lifts but that mid-ground topography and vegetation will block most of the views of the Project from this location.*

*Plate 1/37*

*R13, Glenrock, 248 Highland Way*

*View from near the stables area south-east of the residence. Part of the overburden emplacement at Peppertree Quarry is distantly visible from this location at a distance of approximately 5km. 3D modelling indicates the potential for a narrow band of visibility of part of the Northern Overburden Emplacement but it is likely that mid-ground topography and vegetation on the rehabilitated quarry overburden emplacements will block views of the Project from this location.*

*Plate 1/38*

*R13, Glenrock*

*View from the rear axis of the residence. Part of the overburden emplacement at Peppertree Qarry is distantly visible from this location only while foreground trees are not in leaf.  The same observations in regard to the likely visibility of the Project made in relation to Plate 1/39 above apply to this  view.*

*Plate 1/39*

*R13, Glenrock*

*View of the rear of the residence from the south. The formal orientation of the residence is to its gardens to the north.*

*Part of the eastern overburden emplacement at Peppertree Quarry is distantly visible from this location looking south. Upper level windows may provide slightly greater views, but are likely to be to bedrooms or service areas.*

*Plate 1/40*

*R14, 387 Long Point Road*

*3 D modelling indicates that the residence will not have significant views of the Project. Vegetation in the middle distance blocks any direct view lines.*

*Plate 1/41*

*R15, 443 Long Point Road*

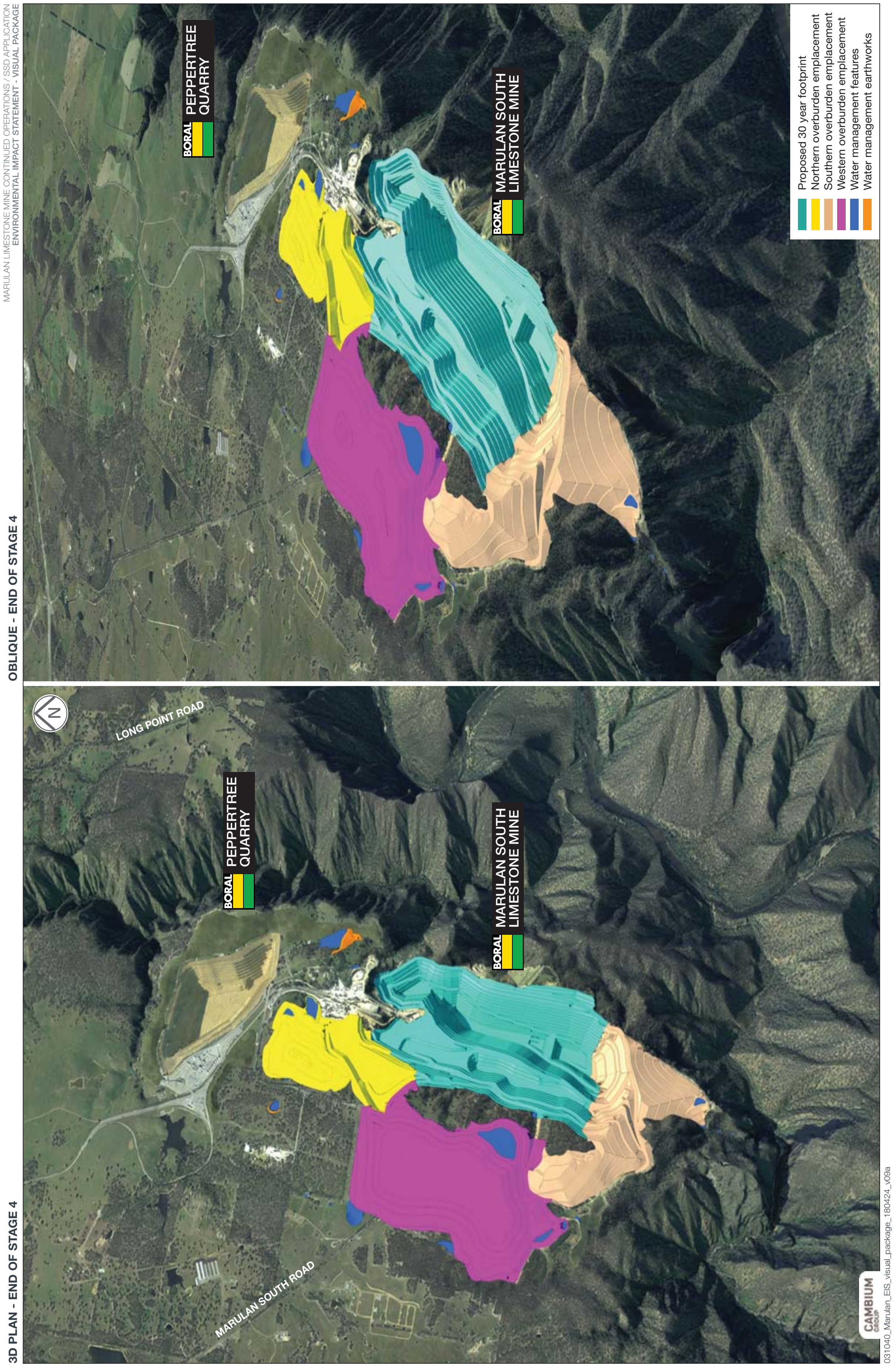
*View from the balcony. Part of the tallest structure in the Mine processing area is visible below the background horizon.3D modelling indicates that the residence will have very minor views of part of the Project, being the last lifts of the Northern and Western Overburden emplacements. Vegetation in the middle distance blocks any direct view lines of most of these features. This view was analysed and used as the base for a photomontage in Appendix 3.*

*Plate 1/42*

*R15, viewing toward R16 (445 Long Point Road)*

*The dense vegetation screen between R16 and the direction of the Project (to the right in this photograph) blocks views.*

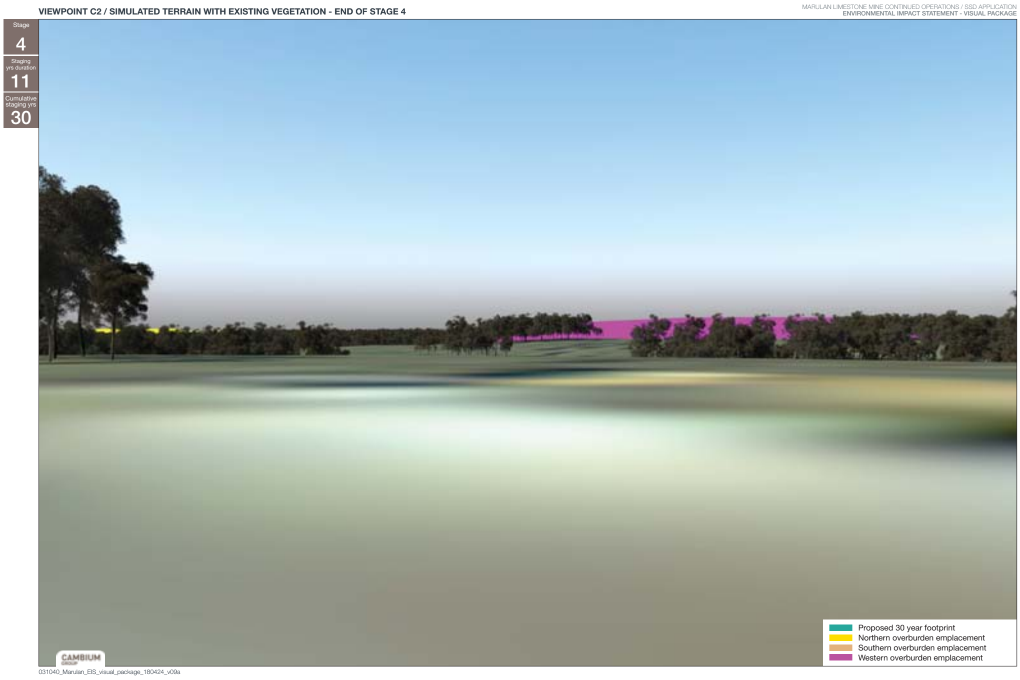
# Appendix 2: Analytical 3D Graphics of Views from Receivers



*Key Plan to Analytical 3D Graphics Prepared by Cambium Group. Vertical view on the left, oblique from the south on the right. Colour coded project areas shown are for the end of Stage 4*

*Receiver C2*

*3D render of terrain and proposed landforms only*

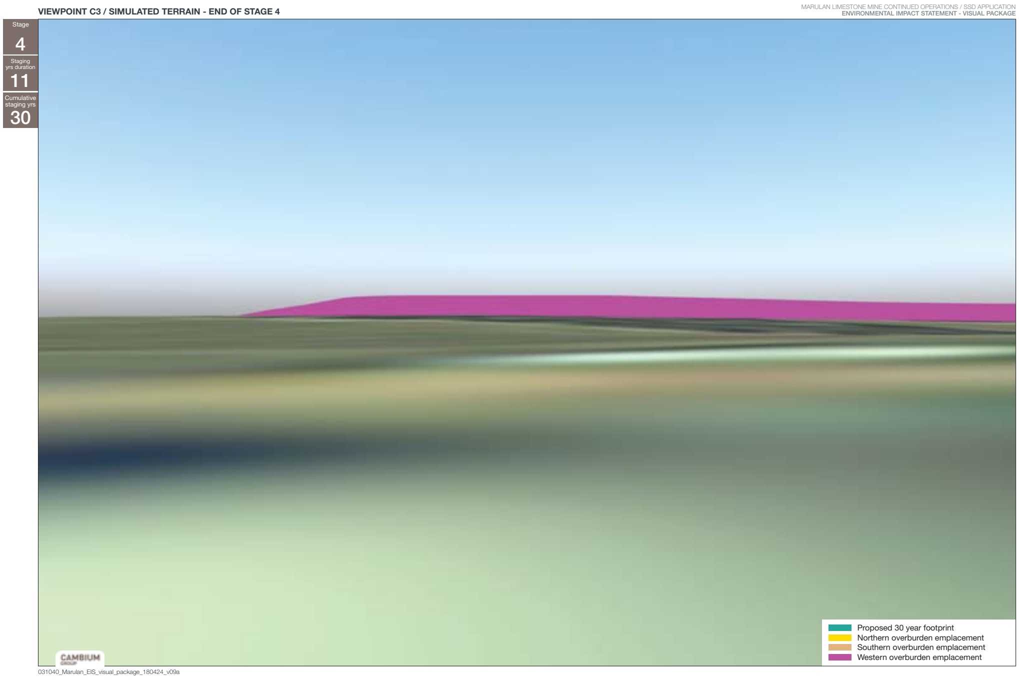


*Receiver C2*

*3D render of terrain and proposed landforms with vegetation*

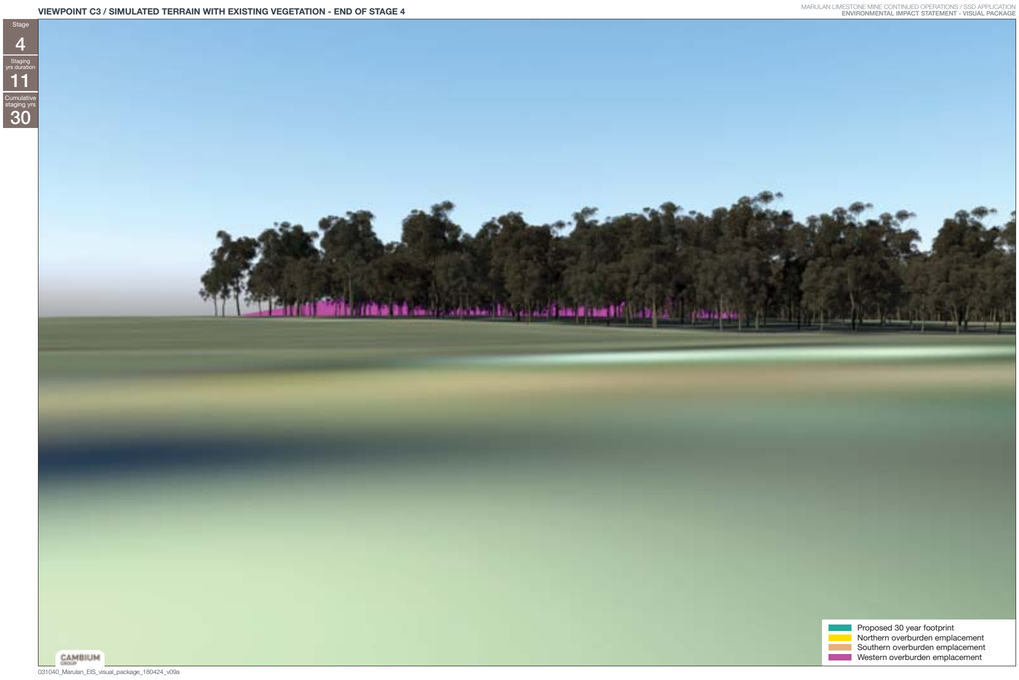
*Receiver C2*

*Photographic image from a point just north east of buildings at C2. The combined graphics indicate that C2 is unlikely to have a view of the Project*



*Receiver C3*

*3D render of terrain and proposed landforms only*



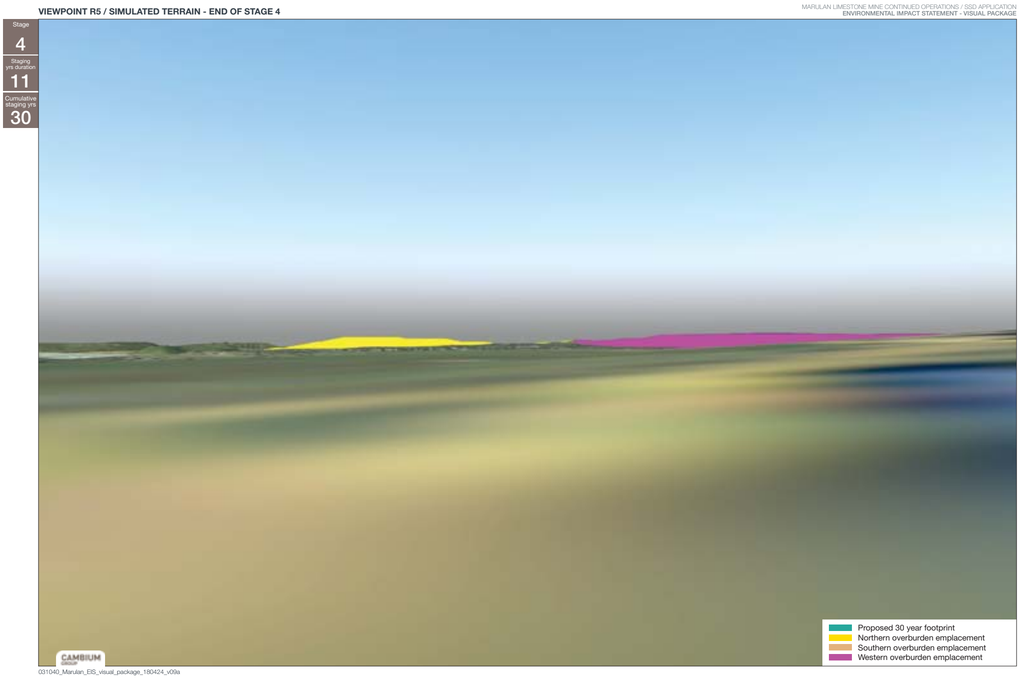
*Receiver C3*

*3D render of terrain and proposed landforms with vegetation*

*Receiver C3*

*Photographic image from office balcony at C3*

*The centre of the photograph is slightly to the left of the centre of the 3D render. The combined graphics show that C3 will not have a view of the Project*



*Receiver R5*

*3D render of terrain and proposed landforms only*

*Receiver R5*

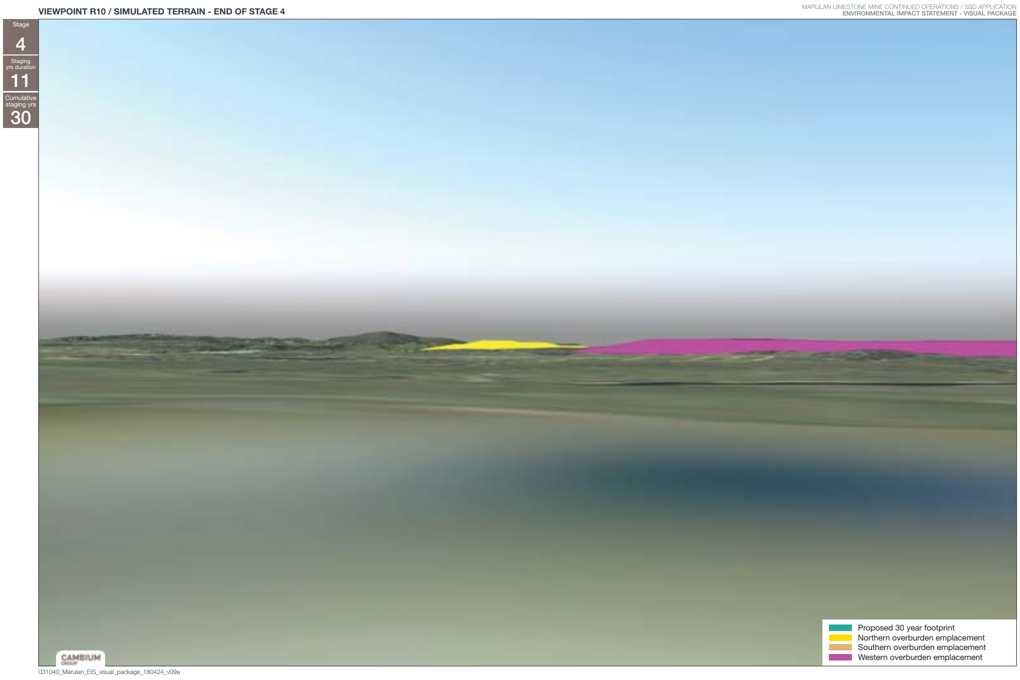
*3D render of terrain and proposed landforms with vegetation*

*Receiver R5*

*Photographic image from the dwelling balcony at R5*

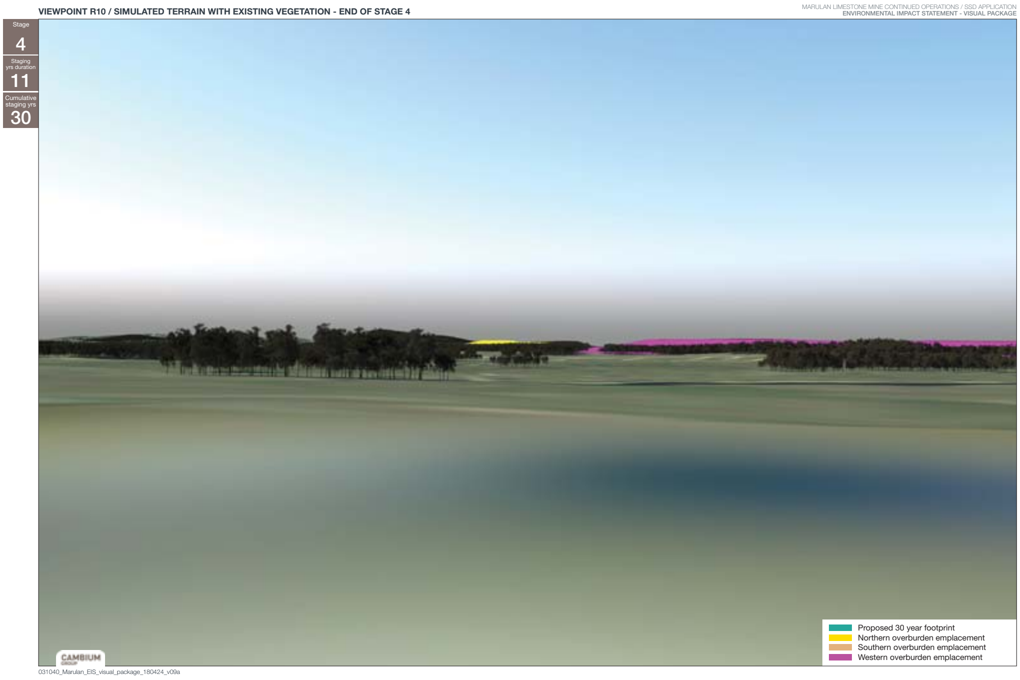
*The centre of the photograph is slightly to right of the centre of the 3D render.*

*It is unlikely that R5 will have a view of the Project.*



*Receiver R10*

*3D render of terrain and proposed landforms only.*



*Receiver R10*

*3D render of terrain and proposed landforms with vegetation.*

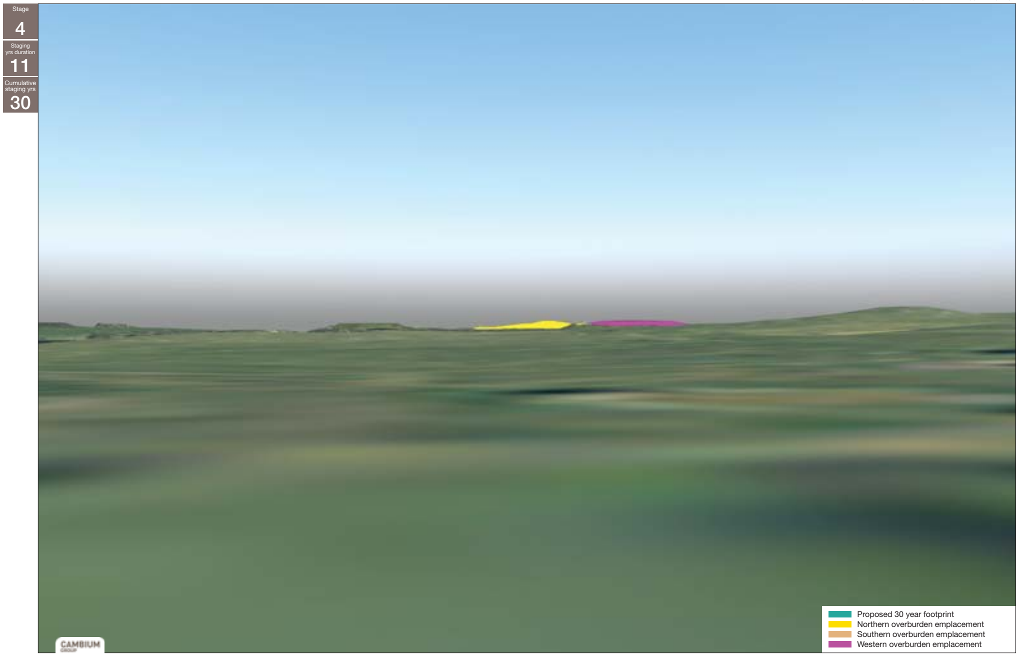
*Receiver R10*

*Photographic image from the pool edge at R10.*

*R10 may have a minimal view of part of the Western Overburden Emplacement area, rehabilitation of which will minimise its visibility.*

**VIEWPOINT R13 / SIMULATED TERRAIN - END OF STAGE 4**

MARULAN LIMESTONE MINE CONTINUED OPERATIONS / SSD APPLICATION
ENVIRONMENTAL IMPACT STATEMENT - VISUAL PACKAGE



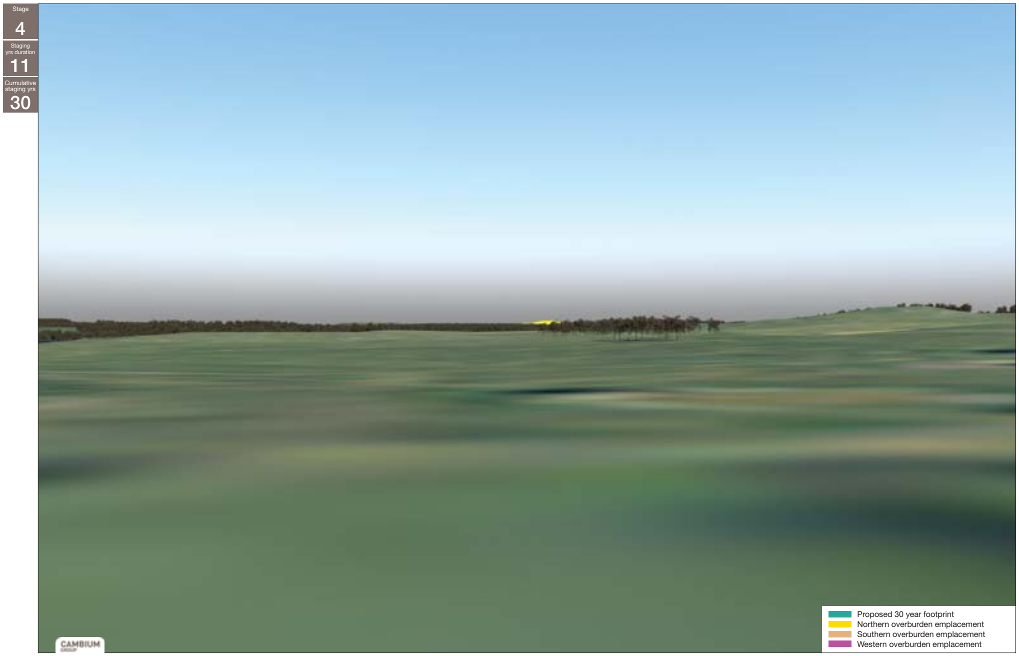
031040_Marulan_EIS_visual_package_180424_v09a

*Receiver R13*

*3D render of terrain and proposed landforms only. The render ignores the foreground vegetation.*

**VIEWPOINT R13 / SIMULATED TERRAIN WITH EXISTING VEGETATION - END OF STAGE 4**

MARULAN LIMESTONE MINE CONTINUED OPERATIONS / SSD APPLICATION
ENVIRONMENTAL IMPACT STATEMENT - VISUAL PACKAGE



031040_Marulan_EIS_visual_package_180424_v09a

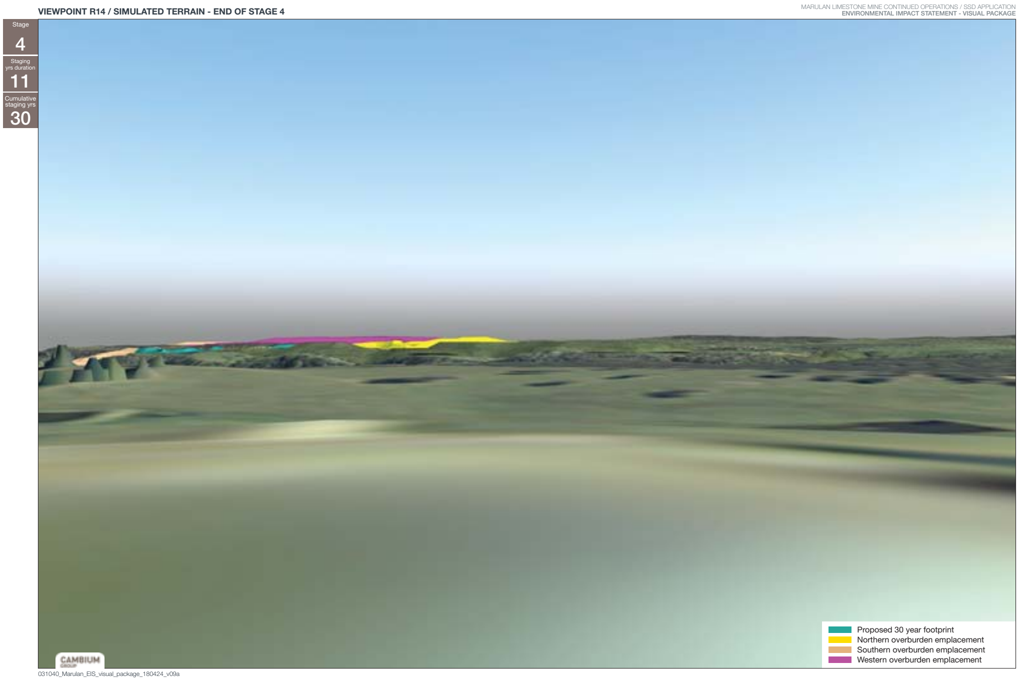
*Receiver R13*

*3D render of terrain and proposed landforms with vegetation. The render ignores the foreground vegetation.*

*Receiver R13*

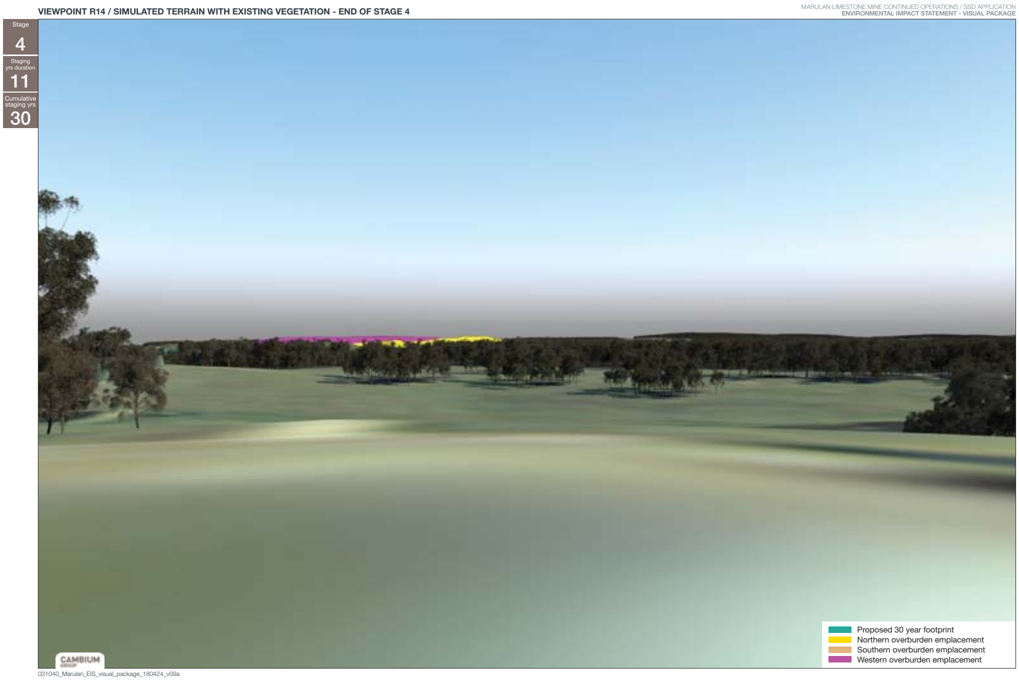
*Photographic image on the axis from the rear of the residence.*

*R13 may have a minimal view of part of the Northern Overburden Emplacement area, rehabilitation of which will minimise its visibility.*



*Receiver R14*

*3D render of terrain and proposed landforms only.*



*Receiver R14*

*3D render of terrain and proposed landforms with vegetation.*

*Receiver R14*

*Photographic image taken from veranda north side of residence.*

*It is unlikely that R14 will have a view of any part of the Project.*

**VIEWPOINT 20 (9946) LOOK DOWN / EXISTING - STAGE 0**

MARULAN LIMESTONE MINE CONTINUED OPERATIONS / SSD APPLICATION
**ENVIRONMENTAL IMPACT STATEMENT - VISUAL PACKAGE**

Stage
0
Staging yrs duration
0
Cumulative staging yrs
0

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, existing view*

## VIEWPOINT 20 (9946) LOOK DOWN / ANALYTICAL LANDFORM PHOTOMONTAGE - STAGE 1

Stage
1

Staging yrs duration
5

Cumulative staging yrs
5

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, analytical landform photomontage Stage 1*

MARULAN LIMESTONE MINE CONTINUED OPERATIONS / SSD APPLICATION
**ENVIRONMENTAL IMPACT STATEMENT - VISUAL PACKAGE**

## VIEWPOINT 20 (9946) LOOK DOWN / ANALYTICAL LANDFORM PHOTOMONTAGE - STAGE 2

Stage
**2**

Staging
yrs duration
**8**

Cumulative
staging yrs
**13**

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, analytical landform photomontage Stage 2*

MARULAN LIMESTONE MINE CONTINUED OPERATIONS / SSD APPLICATION
**ENVIRONMENTAL IMPACT STATEMENT - VISUAL PACKAGE**

**VIEWPOINT 20 (9946) LOOK DOWN / ANALYTICAL LANDFORM PHOTOMONTAGE - STAGE 3**

Stage
3

Staging yrs duration
6

Cumulative staging yrs
19

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, analytical landform photomontage Stage 3*

**VIEWPOINT 20 (9946) LOOK DOWN / ANALYTICAL LANDFORM PHOTOMONTAGE - END OF STAGE 4**

Stage
4

Staging yrs duration
11

Cumulative staging yrs
30

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, analytical landform photomontage Stage 4*

## VIEWPOINT 20 (9946) LOOK DOWN / PHOTOMONTAGE - STAGE 1 REVEGETATION

25% canopy coverage on existing revegetation (3 to 5m high trees) + groundcover on active revegetation

Stage
1

Staging yrs duration
5

Cumulative staging yrs
5

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, photomontage re-vegetation Stage 1*

**VIEWPOINT 20 (9946) LOOK DOWN / PHOTOMONTAGE - STAGE 2 REVEGETATION**

60% canopy coverage on existing revegetation (6 to 10m high trees) + 25% canopy coverage on active revegetation (4 to 8m high trees)

Stage
2

Staging yrs duration
8

Cumulative staging yrs
13

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, photomontage re-vegetation Stage 2*

**VIEWPOINT 20 (9946) LOOK DOWN / PHOTOMONTAGE - STAGE 3 REVEGETATION**
60% canopy coverage on existing revegetation (6 to 12m high trees) + 25% canopy coverage on active revegetation (4 to 8m high trees)

Stage
**3**

Staging
yrs duration
**6**

Cumulative
staging yrs
**19**

031040_Marulan_EIS_visual_package_180424_v09a

*VP 20, The Lookdown, photomontage re-vegetation Stage 3*

## VIEWPOINT 20 (9946) LOOK DOWN / PHOTOMONTAGE - END OF STAGE 4 + 5 YEARS REVEGETATION

60% canopy coverage on existing revegetation (10 to 20m high trees) + 25% canopy coverage on 30 year mine plan areas ( 3 to 5m high trees) + (2 to 5m high shrubs) in pit

Stage
4

Staging yrs duration
11

Cumulative staging yrs
30

+

Post closure yrs
5

=

Staging yrs duration
16

Cumulative staging yrs
35

*VP 20, The Lookdown, photomontage End of Stage 4 plus 5-years' re-vegetation*

## VIEWPOINT VP6 (4662) MARULAN SOUTH ROAD / EXISTING - STAGE 0

Stage
0
Staging yrs duration
0
Cumulative staging yrs
0

031040_Marulan_EIS_visual_package_180424_v09a

*VP 6, Marulan South Road, existing view*

## VIEWPOINT VP6 (4662) MARULAN SOUTH ROAD / ANALYTICAL LANDFORM PHOTOMONTAGE - END OF STAGE 4

Stage
4

Staging yrs duration
11

Cumulative staging yrs
30

031040_Marulan_EIS_visual_package_180424_v09a

*VP 6, Marulan South Road, analytical Landform Photomontage*

## VIEWPOINT VP6 (4662) MARULAN SOUTH ROAD / PHOTOMONTAGE END OF STAGE 4 + 5 YEARS REVEGETATION

60% canopy coverage on overburden emplacements (10 to 20m high trees)

Stage
4

Staging yrs duration
11

Cumulative staging yrs
30

+

Post closure yrs
5

=

Staging yrs duration
16

Cumulative staging yrs
35

031040_Marulan_EIS_visual_package_180424_v09a

*VP 6, Marulan South Road, Photomontage end of Stage 4 plus 5-years' re-vegetation*

**VIEWPOINT R15 (4639) / EXISTING - STAGE 0**

Stage
0

Staging yrs duration
0

Cumulative staging yrs
0

031040_Marulan_EIS_visual_package_180424_v09a

*Receiver R15, existing view*

## VIEWPOINT R15 (4639) / ANALYTICAL LANDFORM PHOTOMONTAGE - END OF STAGE 4

Stage
4

Staging yrs duration
11

Cumulative staging yrs
30

031040_Marulan_EIS_visual_package_180424_v09a

*Receiver R15, analytical landform photomontage*

**VIEWPOINT R15 (4639) / PHOTOMONTAGE END OF STAGE 4 + 5 YEARS REVEGETATION**
60% canopy coverage on overburden emplacements (10 to 20m high trees)

Stage
4
Staging yrs duration
11
Cumulative staging yrs
30
+
Post closure yrs
5
=
Staging yrs duration
16
Cumulative staging yrs
35

031040_Marulan_EIS_visual_package_180424_v09a

*Receiver R15, Photomontage end of Stage 4 plus 5 years' re-vegetation*

## VIEWPOINT VP6 (4662) MARULAN SOUTH ROAD / EXISTING - STAGE 0

Stage
0

Staging yrs duration
0

Cumulative staging yrs
0

031040_Marulan_EIS_visual_package_180424_v09a

*VP 6, proposed realignment of Marulan South Road, existing view*

## VIEWPOINT VP6 (4662) MARULAN SOUTH ROAD / ANALYTICAL LANDFORM PHOTOMONTAGE - END OF STAGE 4

Stage
4

Staging yrs duration
11

Cumulative staging yrs
30

031040_Marulan_EIS_visual_package_180424_v09a

*VP6, analytical landform photomontage*

## VIEWPOINT VP6 (4662) MARULAN SOUTH ROAD / PHOTOMONTAGE END OF STAGE 4 + 5 YEARS REVEGETATION

60% canopy coverage on overburden emplacements (10 to 20m high trees)

Stage
4

Staging yrs duration
11

Cumulative staging yrs
30

+

Post closure yrs
5

=

Staging yrs duration
16

Cumulative staging yrs
35

*VP 6, photomontage end of Stage 4, plus 5 years' re-vegetation*

# Appendix 4: Oblique Aerial Images

*Plate 4/1*
*Oblique aerial image looking east*
*Image courtesy of Boral, taken by Col Douch, 2015.*

*Plate 4/2*
*Oblique aerial image looking north*
*Image courtesy of Boral, taken by Col Douch, 2015.*

*Plate 4/3*

*Oblique aerial image looking south, showing part of the existing Western Overburden Emplacement, with rehabilitation areas in the view centre*

*Image courtesy of Boral, taken by Col Douch, 2015.*

*Plate 4/4*

*Oblique aerial image looking north east, showing the amalgamated Pit and the lip of the former South Pit, on the right*

*Image courtesy of Boral, taken by Col Douch, 2015.*

# Appendix 5: Historical Aerial Images

*Plate 5/1*

*Aerial image 1984*

*The village of Marulan South is visible at the top, right of the image. The overall disturbance footprint of the Mine is similar to the existing situation.*

*Image courtesy of Boral*

*Plate 5/2*

*Aerial image, March 2008*

*The village of Marulan South is no longer present. The increased depth of mining in the North and South Pits is evident as is extended overburden emplacement to the south west.*

*Image courtesy of Boral*

# Appendix 6: Data Sheets

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP1 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | RLA_9930 | 34,45.6453 | 150,2.0141 | 623 |
| | | | | |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity (N/A*) | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP2 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | RLA_9933 | 34,45.6524 | 150,1.4856 | 627.2 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | [✓ Restricted] | Panoramic | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | X | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| **Overall Extent of Visual Effect** | | **Medium** | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| **Overall Extent of Visual Impact** | | **Low** | | |

| | | | | |
|---|---|---|---|---|
| View Place or Viewer Sensitivity | | | | |
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP3 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | IMG_4435 | 34,46.0775 | 150,1.3387 | 653 |
| | | | | |
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| | | | | |
|---|---|---|---|---|
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | | X | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | | X | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | | X |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Medium | |
| ***Weighting factors*** | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP4 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | IMG_4645 | 34,46.3089 | 150,1.0017 | 641.1 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | [✓ Restricted] | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | | X | |
| Effect on Scenic Quality of View | | | X | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Medium | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | | Viewing Distance | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP5 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | IMG_4647 | 34,45.9963 | 150,0.7073 | 646.9 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | [✓ Restricted] | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | | X | |
| Effect on Scenic Quality of View | | | X | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Low-Medium | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | Low | | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP6 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | IMG_4661 | 34,45.9299 | 150,0.6473 | 633.7 |
| | IMG_4662 | 34,45.9299 | 150,0.6473 | 633.7 |
| | | | | |
| | | | | |
|  | | |  | |
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | | X | |
| Effect on Scenic Quality of View | | | X | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Medium | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| | | | | |
|---|---|---|---|---|
| View Place or Viewer Sensitivity | | | | |
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| Receiver ID: VP7 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
|---|---|---|---|---|
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road adjacent C3 | IMG_4648 | 34,45.9248 | 150,0.6282 | 647.7 |
| | | | | |
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|---|---|---|---|---|
| [✓ Expansive] | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | | X | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity (N/A) | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| Receiver ID: VP8 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
|---|---|---|---|---|
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road adjacent R8, C2 | IMG_4649 | 34,45.5981 | 150,0.3415 | 630.3 |
|  | IMG_4650 | 34,45.5948 | 150,0.3385 | 626.2 |
|  |  |  |  |  |
|  |  |  |  |  |

|  |  |  |  |  |
|---|---|---|---|---|
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors |  | Ratings |  |  |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
|  | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* |  |  |  |  |
| Effect On Visual Character of View |  | X |  |  |
| Effect on Scenic Quality of View |  | X |  |  |
| *Variable factors* |  |  |  |  |
| Effect On View Composition |  | X |  |  |
| Effect of Relative Viewing Level |  | X |  |  |
| Effect of Viewing Period |  | X |  |  |
| Effect of Viewing Distance |  |  | X |  |
| View Loss or Blocking Effect |  | X |  |  |
| Overall Extent of Visual Effect |  |  | Low |  |
| *Weighting factors* |  |  |  |  |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
|  | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity |  | X |  |  |
| Compatibility with mining/industrial features |  | X |  |  |
| Compatibility with Urban/ Natural Features |  | X |  |  |
| Overall Extent of Visual Impact |  |  | Low |  |

| View Place or Viewer Sensitivity |  |  |  |  |
|---|---|---|---|---|
|  |  | L | M | H |
| Public Domain | Roads |  | X |  |
|  | Lookouts |  |  |  |
|  | Reserves |  |  |  |
| Private Domain | Residence |  |  |  |
|  |  | >3000m | 500-3000m | <500m |
|  |  | Viewing Distance |  |  |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP9 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | IMG_4651 | 34,45.3339 | 150,0.1557 | 633.2 |
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| | | | | |
|---|---|---|---|---|
| Expansive | [✓ Restricted] | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Low | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | Low | | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| Receiver ID: VP10 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
|---|---|---|---|---|
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| | IMG_4658 | 34,45.3417 | 150,0.1765 | 648.5 |
| | | | | |
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| | | | | |
|---|---|---|---|---|
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Low | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | Low | | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP12 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Marulan South Road | IMG_4655 | 34,44.6874 | 149,59.6631 | 645.1 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | Panoramic | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | | Low | |

| | | | | |
|---|---|---|---|---|
| | | View Place or Viewer Sensitivity | | |
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP14 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Jerrara Road | IMG_4471 | 34,44.0751 | 149,58.7341 | 664.2 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Low | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | Low | | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP15 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Jerrara Road | IMG_4472 | 34,44.8859 | 149,58.5826 | 671.3 |
| | | | | |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Expansive | Restricted | Panoramic | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| | | | | |
|---|---|---|---|---|
| View Place or Viewer Sensitivity | | | | |
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| Receiver ID: VP16 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
|---|---|---|---|---|
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Jerrara Road near Oak Valley Road | IMG_4474 | 34,46.383 | 149,57.8652 | 636.5 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| **Overall Extent of Visual Effect** | | **Negligible** | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| **Overall Extent of Visual Impact** | | **Low** | | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| Receiver ID: VP17 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
|---|---|---|---|---|
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Jerrara Road near Oak Valley Road | IMG_4475 | 34,46.5503 | 149,57.7869 | 655 |
| | | | | |
| | | | | |
| | | | | |

| Expansive | Restricted | Panoramic | Focal | Feature |
|---|---|---|---|---|

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Negligible | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | X | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | | Viewing Distance | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP18 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Glynmar Road adjacent to R10 | IMG_4476 | 34,46.2216 | 149,59.1682 | 670.6 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Low | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | Low | | |

| | | | | |
|---|---|---|---|---|
| View Place or Viewer Sensitivity | | | | |
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP19 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Glynmar Road | IMG_4477 | 34,46.0473 | 149,59.2004 | 674.7 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| **Overall Extent of Visual Effect** | | | **Negligible** | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| **Overall Extent of Visual Impact** | | | **Low** | |

| | | | | |
|---|---|---|---|---|
| View Place or Viewer Sensitivity | | | | |
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| Receiver ID: VP20 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
|---|---|---|---|---|
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| The Lookdown Lookout Morton NP | RLA_9946 | 34,47.9164 | 150,1.1372 | 557.4 |
|  | IMG_4485 | 34,47.9164 | 150,1.1372 | 557.4 |
|  | IMG_4489 | 34,47.9164 | 150,1.1372 | 557.4 |
|  | IMG_4607 | 34,47.9164 | 150,1.1372 | 557.4 |
|  |  |  |  |  |
| Expansive | Restricted | Panoramic | Focal | [✓ Feature] |

| Assessment and weighting factors |  | Ratings |  |  |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
|  | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* |  |  |  |  |
| Effect On Visual Character of View |  |  | X |  |
| Effect on Scenic Quality of View |  |  | X |  |
| *Variable factors* |  |  |  |  |
| Effect On View Composition |  | X |  |  |
| Effect of Relative Viewing Level |  |  | X |  |
| Effect of Viewing Period |  |  |  | X |
| Effect of Viewing Distance |  | X |  |  |
| View Loss or Blocking Effect |  | X |  |  |
| Overall Extent of Visual Effect |  |  | Medium |  |
| *Weighting factors* |  |  |  |  |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
|  | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity |  |  |  | X (initial stages) |
| Compatibility with mining/industrial features |  | X |  |  |
| Compatibility with Urban/ Natural Features |  |  | X |  |
| Overall Extent of Visual Impact |  |  | Medium (For whole Project) |  |

| View Place or Viewer Sensitivity |  |  |  |  |
|---|---|---|---|---|
|  |  | L | M | H |
| Public Domain | Roads |  |  |  |
|  | Lookouts |  | X |  |
|  | Reserves |  |  |  |
| Private Domain | Residence |  |  |  |
|  |  | >3000m | 500-3000m | <500m |
|  |  |  | Viewing Distance |  |

## View Place Documentation Sheets

| Receiver ID: VP21 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
|---|---|---|---|---|
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Long Point track Morton NP | RLA_9924 | 34,45.9529 | 150,3.0573 | 634.1 |
| | RLA_9922 | 34,45.9595 | 150,3.0652 | 646.5 |
| | | | | |
| | | | | |

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|---|---|---|---|---|
| 🟩 Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | | X | |
| Effect on Scenic Quality of View | | | X | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | | | X |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| **Overall Extent of Visual Effect** | | | **Medium** | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | | X | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| **Overall Extent of Visual Impact** | | | **Medium (for whole Project)** | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | | X | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | | Viewing Distance | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP22 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Long Point Lookout | IMG_4453 | 150,3.2231 | 150,3.2231 | 624.7 |
| | IMG_4454 | 34,45.8797 | 150,3.2149 | 624.9 |
| | | | | |
| | | | | |
|  | | |  | |
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Negligible | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | Low | | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | | X | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP23 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Long Point Road adjacent B7 and R17 | IMG_4463 | 34,45.5123 | 150,3.4385 | 632.8 |
| | IMG_4464 | 34,45.4271 | 150,3.5599 | 625 |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Expansive | [✓ Restricted] | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Negligible | | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | Low | | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP24 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Long Point Road adjacent R15, R16 | IMG_4465 | 34,45.1974 | 150,3.565 | 622.4 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | | X | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | X | | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | X | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | | Viewing Distance | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: R5 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| 359 Glynmar Road | IMG_4624 | 34,45.0843 | 149,59.823 | 658 |
| | IMG_4625 | 34,45.0871 | 149,59.8296 | 639.7 |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | | X | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| **Overall Extent of Visual Effect** | | | **Low-Medium** | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| **Overall Extent of Visual Impact** | | | **Low** | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | X | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: VP25 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| Badgerys Lookout | RLA_9922 | 34,46.3778 | 150,6.0531 | 591 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | | X | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | Low | | |
| ***Weighting factors*** | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | Low | | |

| | | | | |
|---|---|---|---|---|
| View Place or Viewer Sensitivity | | | | |
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | X | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: R10 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| 290 Glynmar Road | IMG_4638 | 34,46.2284 | 149,59.3644 | 662.7 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | | X | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | X | |
| | | >3000m | 500-3000m | <500m |
| | | | Viewing Distance | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: R14 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| 387 Long Point Road | IMG_4468 | 34,45.0618 | 150,3.6452 | 631.4 |
| | | | | |
| | | | | |
| | | | | |
|  | | | | |
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | | X | |
| Effect of Viewing Period | | | X | |
| Effect of Viewing Distance | | X | | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | X | |
| | | >3000m | 500-3000m | <500m |
| | | | Viewing Distance | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: C2 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| 408 Marulan South Road | Boral30Mar161 | 34,76.214 | 150,0.0492 | 637.1 |
| Commercial receiver | | | | |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Expansive | Restricted | [✓ Panoramic] | Focal | Feature |

| | | | | |
|---|---|---|---|---|
| Assessment and weighting factors | | Ratings | | |
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | | X | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| | | | | |
|---|---|---|---|---|
| View Place or Viewer Sensitivity (Not applicable to Commercial Receiver) | | | | |
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Potential Residence | | X | |
| | | >3000m | 500-3000m | <500m |
| | | | Viewing Distance | |

## View Place Documentation Sheets

| | | | | |
|---|---|---|---|---|
| Receiver ID: C3 | R=Residence | C=Commercial | B=Boral owned | VP=Public View |
| Address/Location | Image No. | LATITUDE | LONGITUDE | ELEVATION (M) |
| 452 Marulan South Road | IMG_4620 | 34,45.9358 | 150,0.487 | 626.7 |
| | | | | |
| | | | | |
| | | | | |

| | | | | |
|---|---|---|---|---|
| Expansive | Restricted | Panoramic | Focal | Feature |

| Assessment and weighting factors | | Ratings | | |
|---|---|---|---|---|
| Assessment Factor where effects increase as ratings increase | Assessment | Low | Medium | High |
| | Visual Effect | (Low Effect) | (Medium effect) | (High effect) |
| *Base-line factors* | | | | |
| Effect On Visual Character of View | | X | | |
| Effect on Scenic Quality of View | | X | | |
| *Variable factors* | | | | |
| Effect On View Composition | | X | | |
| Effect of Relative Viewing Level | | X | | |
| Effect of Viewing Period | | X | | |
| Effect of Viewing Distance | | | X | |
| View Loss or Blocking Effect | | X | | |
| Overall Extent of Visual Effect | | | Low | |
| *Weighting factors* | | | | |
| Weighting Factor where impacts decrease as ratings increase | Assessment | High | Medium | Low |
| | Visual Impact | (Low Impact) | (Medium impact) | (High impact) |
| Physical Absorption Capacity | | X | | |
| Compatibility with mining/industrial features | | X | | |
| Compatibility with Urban/ Natural Features | | | X | |
| Overall Extent of Visual Impact | | | Low | |

| View Place or Viewer Sensitivity (Not applicable to Commercial Receiver) | | | | |
|---|---|---|---|---|
| | | L | M | H |
| Public Domain | Roads | | | |
| | Lookouts | | | |
| | Reserves | | | |
| Private Domain | Residence | | | |
| | | >3000m | 500-3000m | <500m |
| | | Viewing Distance | | |

## Summary Curriculum Vitae: Dr Richard Lamb

### Summary

- Qualifications
  - Bachelor of Science - First Class Honours, University of New England in 1969
  - Doctor of Philosophy, University of New England in 1975

- Employment history
  - Tutor and teaching fellow – University of New England School of Botany 1969-1974
  - Lecturer, Ecology and environmental biology, School of Life Sciences, NSW Institute of Technology (UTS) 1975-1979
  - Senior lecturer in Landscape Architecture, Architecture and Heritage Conservation in the Faculty of Architecture, Design and Planning at the University of Sydney 1980-2009
  - Director of Master of Heritage Conservation Program, University of Sydney, 1998-2006
  - Principal and Director, Richard Lamb and Associates,1989-2017

- Teaching and research experience
  - visual perception and cognition
  - aesthetic assessment and landscape assessment
  - interpretation of heritage items and places
  - cultural transformations of environments
  - conservation methods and practices

- Academic supervision
  - Undergraduate honours, dissertations and research reports
  - Master and PhD candidates: heritage conservation and environment/behaviour studies

- Professional capability
  - Consultant specialising in visual and heritage impacts assessment
  - 30 year's experinence in teaching and research in environmental impact, heritage and visual impact assessment.
  - Provides professional services, expert advice and landscape and aesthetic assessments in many different contexts
  - Specialist in documentation and analysis of view loss and view sharing
  - Provides expert advice, testimony and evidence to the Land and Environment Court of NSW on visual contentions in various classes of litigation.
  - Secondary specialisation in matters of landscape heritage, heritage impacts and heritage view studies
  - Appearances in over 250 Land and Environment Court of New South Wales cases, submissions to Commissions of Inquiry and the principal consultant for over 1000 individual consultancies concerning view loss, view sharing, visual impacts and landscape heritage

A full CV can be viewed on the Richard Lamb and Associates website at www.richardlamb.com.au

# Appendix T

## Traffic assessment

## VOLUME 7

FINAL

# TRAFFIC IMPACT ASSESSMENT

# FOR

# CONTINUED OPERATIONS

# OF

# MARULAN SOUTH LIMESTONE MINE

## MARULAN SOUTH ROAD
## MARULAN SOUTH

Ref. 14099r Rev 5 AC

5 March 2019

Prepared By

TRANSPORT & URBAN PLANNING PTY LTD
Traffic Engineering, Transport Planning
Road Safety & Project Management Consultants
5/90 Toronto Parade
P.O. Box 533
SUTHERLAND NSW 2232
Tel: (02) 9545-1411
Fax: (02) 9545-1556
Email: terry@transurbanplan.com.au

# EXECUTIVE SUMMARY

1. *This report documents the assessment of the road transport and traffic impacts of the continued operation of Boral's Limestone Mine at Marulan South.*

2. *The majority of the product produced by the Limestone Mine is transported to market via rail and this will continue in the future with the Project.*

3. *Boral currently transports around 330,000tpa of limestone and clay shale by road from the mine via Marulan South Road to the Hume Highway where it then travels either north or south along the Hume Highway. Boral's truck fleet, which transports the Product, includes truck and dog combinations as well as a small number of B-doubles.*

4. *Up to an additional 120,000tpa is transported from the mine to the Aglime Fertiliser facility which is located approximately 1km south west of the entrance to the mine, along Marulan South Road.*

5. *This existing road transportation will continue under the Project. Boral proposes to transport an additional 120,000tpa of limestone and clay shale as well as 150,000tpa of aggregate/sand products from the Peppertree Quarry via Marulan South Road and the Hume Highway.*

6. *The despatch of 150,000tpa of aggregate/sand product from Peppertree along with 50,000tpa of aggregate/sand from the Limestone Mine will be managed through stockpiles in the proposed Road Sales Stockpile Area. The additional 70,000tpa of limestone and clay shale will be transported directly out of the mine.*

7. *Overall, the Project seeks to transport up to 600,000tpa between the mine and the Hume Highway, along Marulan South Road, as well as tup to 120,000tpa of lime product to the Aglime Fertiliser facility.*

8. *Boral currently transport 500,000tpa of manufactured limestone sand to Peppertree Quarry via a dedicated internal haul road that crosses Marulan South Road east of the rail level crossing and the main vehicle truck entry to the Limestone Mine. Boral are proposing to increase this by up to 500,000tpa resulting in an additional four one way truck loads per hour (i.e. 8 additional truck trips with the return movement). These vehicles will cross Marulan South Road. Traffic volumes using this section of Marulan South Road are relatively low (i.e. less than 40 two way vph) and the impact of the additional trucks at the intersection will be relatively small and satisfactory traffic conditions will be maintained.*

9. *Boral is proposing to realign a section of Marulan South Road to accommodate the northwards extension of the existing Western Overburden Emplacement and will widen the road pavement of Marulan South Road in the narrower sections to meet Goulburn Mulwaree Council's DCP requirements. These upgrade works will be designed and constructed byBoral to Council's specifications and road standards. In addition, a new intersection and associated works in Marulan South Road adjacent to the Road Sales Stockpile Area is proposed and will be constructed by Boral.*

10. *The Project will result in a small increase in heavy vehicle trips in the order of 2-3 heavy vehicle loads per hour (total of 4-6 two way trips) on an average day using the Marulan South Road access to the Hume Highway.*

11. *The assessment of the traffic impacts of the additional product truck movements on the adjoining road network and intersections has concluded that the impacts would be relatively minor and there will be minimal changes to the Level of Service and vehicle delays on the road network, including at all key intersections.*

12. *The Project is not expected to have any negative impacts on the other road users and or on road safety. As noted above, Boral is proposing upgrades to Marulan South Road as part of the Project. These upgrade works will take into consideration the need for and location of the school bus stopping and turning. In addition, Boral has a Traffic Safety Management Plan for operations at the mine site and holds Safety Toolbox discussions on a regular basis with employees regarding the safe use of Marulan South Road. All Boral drivers are trained to the nationally recognised Certificate III (Transport and Distribution) Qualification. All drivers, including subcontractor drivers travelling to and from the mine along Marulan South Road will be trained on protocols for the interaction with school buses and minimising traffic noise, particularly during night time periods.*

13. *The construction impacts associated with the road upgrading works will be managed through separate Construction Traffic Management Plans which will be prepared with full consultation with Goulburn Mulwaree Council, following approval of the Project.*

# CONTENTS

## ILLUSTRATIONS

## REFERENCES

**APPENDICES**

# 1.0 INTRODUCTION

## 1.1 Overview

Boral Cement Limited (Boral) owns and operates the Marulan South Limestone Mine (the mine). It is a long standing open cut mine that has produced up to 3.38 million tonnes of limestone based products per year for the cement, steel, agricultural, construction and commercial markets.

Boral also owns the adjacent Peppertree Quarry which is a hard rock operation that produces aggregate and sand products. **Figure 1** shows the location of the mine and quarry operations.

The mine is a strategically important asset for Boral, as it supplies the main ingredient for the manufacture of cement at Boral's Berrima Cement Works. This is also a strategically important operation for Sydney based consumers of these products as this represents around 60% of the cement sold in NSW and feeds into more than 30% of concrete sold in Sydney.

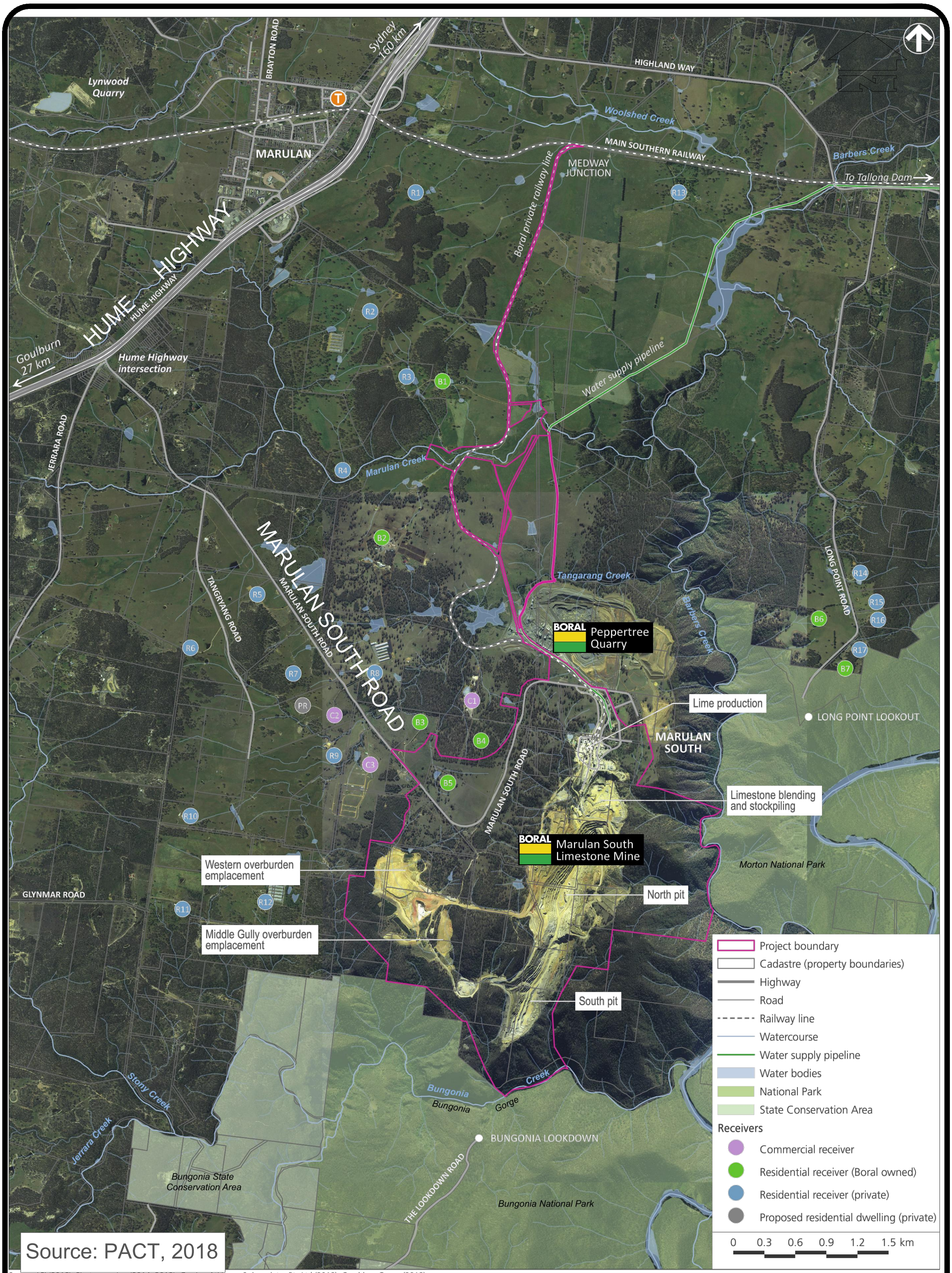
The mine operates under Consolidated Mining Lease No. 16 (CML 16), Mining Lease No. 1716, Environment Protection Licence (EPL) 944 and a combination of development consents issued by Goulburn Mulwaree Council and continuing use rights.

Due to changes between the *Mining Act 1992* and the *Environmental Planning & Assessment Act 1979* (EP&A Act), when mining moves beyond the area covered by the current Mining Operations Plan, a development consent under the EP&A Act will need to be in place.

An Environmental Impact Statement has been prepared by Element Environment Pty Ltd on behalf of Boral for submission to the Department of Planning and Environment to satisfy the provisions of Part 4 of the EP&A Act. Boral is seeking approval for continued operations at the site through a development application for a State Significant Development including a 30 year mine plan, associated overburden Emplacement Areas and a mine water supply dam (hereafter referred to as 'the Project').

## 1.2 Authority Requirements

The Project's Secretary's Environmental Assessment Requirements (SEAR's) for traffic and road transport are summarised in Table 1.1, together with where each requirement is addressed in this report or elsewhere in the EIS documentation.



Source: PACT, 2018

Source: LPI (2018), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

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**5/90 Toronto Parade, Sutherland NSW 2232**
**Phone 02 9545 1411 Fax 02 9545 1556**
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# FIGURE 1

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS

# SITE LOCATION

JOB NO.14099 R 13/08/18

## TABLE 1.1 Traffic and road transport SEAR's

| STAKEHOLDER | EIS REQUIREMENT<br>Traffic and Road Transport | COMMENT |
|---|---|---|
| Department of Environment and Planning | (i) Accurate predictions of the road and rail traffic generated by the development;<br>(ii) An assessment of the likely transport impacts of the development on the capacity, condition, safety and efficiency of the local and State road and rail network; and<br>(iii) A detailed description of the measures that would be implemented to maintain and/or improve the capacity, efficiency and safety of the road and rail networks in the surrounding area over the life of the development, having regard to Transport NSW's and Goulburn Mulwaree Council's requirements. | (i) See Section 5 for road traffic predictions<br>(ii) See Section 5<br>(iii) See Section 5 |
| Transport for NSW (TfNSW) | (i) Detail existing daily and peak hour vehicle movements on the road network located adjacent to the proposed development;<br>(ii) Estimate daily and peak hour traffic generated from the proposed mine expansion (including vehicle type and the likely arrival and departure times) during construction and operation;<br>(iii) Detail origin and destination of vehicle movements and haulage routes;<br>(iv) Assessment and details of traffic, transport and safety impacts on intersection along the Hume Highway during construction and operation and how these impacts will be mitigated;<br>(v) Detail delivery, servicing and loading arrangements for the proposed mine expansion;<br>(vi) Detail emergency vehicle access arrangement;<br>(vii) Include an assessment for the access of Higher Productivity Vehicle movements to the mine (at a minimum PBS 2B (combinations at Higher Mass Limits) in terms of ability to access the mine and surrounding roads, impact on road infrastructure (bridges and pavement) and potential increased road safety risks; | (i) See Section 4 and 5.1<br>(ii) See Section 5.2 and 5.1<br>(iii) See Section 3.5 and Figure 3<br>(iv) See Section 5<br>(v) See Section 5<br>(vi) See Section 5.14<br>(vii) See Section 5.12 |

| | | |
|---|---|---|
| | (viii) Include a description and plans of any road upgrades required for the expansion; and<br>(ix) Include detailed plans of the proposed layout of the internal road network and parking on site in accordance with the relevant Australian standards.<br>*Planning Documents*<br>(x) The proposal needs to assess the proposal against the relevant provisions of the applicable environmental planning instruments and policies including:<br>• NSW Long Term Transport Master Plan<br>• Southern Regional Transport Plan<br>*Guidelines*<br>(xi) The proponent needs to review the following documentation for information and requirements and address any relevant issues:<br>• Guide to Traffic Generating Developments (RMS)<br>• Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development<br>• Austroads Guide to Road Design<br>*Consultation*<br>(xii) During the preparation of the EIS, the proponent needs to consult with the following transport agencies:<br>• Roads and Maritime Services<br>• Transport for NSW | (viii) See Section 5.3<br>(ix) Details of the proposed new intersection in Marulan South Road at the proposed Road Sales Stockpile Area are contained in Section 5.3, 5.43 and Figure 10. See Section 5.13 regarding internal road network and parking<br>(x) See whole of document and Section 5.14.<br>(xi) Documents have been reviewed and referenced as required during the preparation of this traffic impact assessment report.<br>(xii) Boral has consulted with these stakeholders. Refer to consultation details in the EIS. |
| Goulburn Mulwaree Council | (i) The report indicates the project will not generate significant increased volume of finished products transported by road. Council request that an EIS includes specific estimated volumes, and the proposed management of potential road impacts should the rail link be unable to be accessed or used for any period of time.<br>(ii) An updated assessment of Marulan Road South as a B-double route is required. It should be noted that the current Goulburn Mulwaree Section 94 Development Contributions Plan 2009 states that a "pavement shall have a minimum remaining life of 10 years". The haulage route along Marulan South Road shall be investigated for this standard and rectified where deficient, noting that the minimum standard | (i) See Sections 5.1 to 5.6.<br>Boral do not propose to transport by road any additional product other than identified in the Project, in the event that the rail line is unable to be accessed or used for any period of time.<br>(ii) See Section 5.12.<br>Boral will undertake and construct all upgrade works in Marulan South Road which will include any pavement strengthening. This can be a condition of consent. |

| | | |
|---|---|---|
| | specific in the DCP involves a 7 metre sealed carriageway plus 1m shoulders (0.5m of which are sealed) each side.<br>(iii) Marulan South Road is to be realigned and constructed in accordance with Council's Standards for Engineering Works 2013.<br>(iv) Council requires details of the proposed annual verification method in relation to the actual loads using Marulan South Road.<br>(v) In accordance with Council's Section 94 Development Plan 2009, a contribution shall be made for the heavy vehicle movements. It is noted that the current (2014/15) rate is $0.0456 per tonne per kilometre, which shall be applied to the length along Marulan South Road. | (iii) All improvement works in Marulan South Road will be designed and constructed to Council's standards and specifications.<br>(iv) Boral will provide Council with a summary of their road weighbridge data on an annual basis.<br>(v) See Section 5.7. |

## 1.3 Structure of this Report

Structure of Report

This report has been prepared to assess the traffic impacts associated with the proposed continued operations of the mine and will inform the preparation of the Environmental Impact Statement (EIS).

The assessment has been undertaken in accordance with the requirements of Roads and Traffic Authority's now Roads & Maritime Services (RMS) *Guide to Traffic Generating Developments October 2002*.

Other technical standards/publications referenced in this assessment include:

- Austroads Guide to Road Design and RMS supplements.
- Austroads Guide to Traffic Management and RMS supplements.
- Austroads Guide to Traffic Management Part 12. Traffic Impacts of Developments.
- Goulburn Mulwaree Council Development Control Plan (DCP) 2009
- Goulburn Mulwaree Council's Section 94 Development Contributions Plan 2009 Amendment No. 2.

Other publications reviewed as part of the preparation of this assessment include NSW Long Term Transport Master Plan and the Southern Regional Transport Plan.

The remaining sections of this report address the following;

- Section 2 – provides an overview of the existing operations at the mine;
- Section 3 – describes the Project;
- Section 4 – examines the existing traffic conditions on the road network;
- Section 5 – evaluates the traffic impacts of the proposed continued operations of the mine including any cumulative impacts; and
- Section 6 – presents conclusions

Traffic Assessment

The traffic assessment commenced in 2014 but there was a delay in finalising the project and hence the EIS and the lodgement of the application.

The traffic assessment uses base traffic volumes in Marulan South Road as well as intersection volumes at the Hume Highway / Marulan South Road interchange intersections which were collected in June and November 2014. The assessment also uses road crash statistics for Marulan South Road for the three year period between 1st July 2011 to 30th June 2014.

This data is still relevant for 2019 as there has been no material change to the land uses in Marulan South Road including the Limestone Mine and Peppertree Quarry between 2014 and 2019 that would have altered traffic conditions in Marulan South Road.

With regard to the traffic volumes and traffic modelling undertaken for the Hume Highway / Marulan Road South interchange intersections, this modelling examined future 2025 traffic conditions with cumulative impacts of all known approved developments using future 2025 traffic volumes plus the additional volumes from the project. Therefore, the analysis for this intersection is representative of the future traffic conditions.

# 2.0 EXISTING MINING OPERATIONS

## 2.1 Existing Mining Operations

The mine is sited on a high grade limestone resource. Subject to market demand the mine has typically produced 3 to 3.38 million tonnes of limestone and 120,000 to 200,000 tonnes of shale per annum.

The mine currently produces a range of limestone products for internal and external customers in the Southern Highlands/Tablelands, the Illawarra and Metropolitan Sydney markets for use primarily in cement and lime manufacture, steel making, agriculture and other commercial uses. Products produced at the mine are despatched by road and rail, with the majority despatched by rail.

Historically limestone mining was focused on the approximately 200-300 m wide Eastern Limestone and was split between a North Pit and a South Pit. A limestone wall (referred to by the mine as the ‘centre ridge’) rising almost to the original land surface, divided the two pits. The North and South Pits were recently joined in 2016/2017 by mining the centre ridge to form a single contiguous pit, approximately 2 km in length. However, the North Pit/South Pit nomenclature remains important as current mining operation locations continue to be reported with respect to one or other of the old pits.
Limestone and shale are extracted using open-cut hard rock drill and blast techniques. Material is loaded using front end loaders and hauled either to stockpiles or the processing plant using haul trucks. Oversized material is stockpiled and reduced in size using a hydraulic hammer attached to an excavator.

Limestone processing facilities including primary and secondary crushing, screening, conveying and stockpiling plant and equipment are in the northern end of the North Pit. Kiln stone grade limestone is also processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment. Overburden from stripping operations is emplaced in the Western Overburden Emplacement, west of the open cut pits.

The current operations are 24 hour, 7 days per week with personnel employed on a series of 8, 10 and 12 hour shifts to cover the different operational aspects of the mine. Blasting is restricted to daylight hours and on weekdays, excluding public holidays.

## 2.2 Employment

A total of 191 full time personnel are currently employed in connection with the mine, including lime manufacturing, administration and logistics. This includes 118 personnel on-site and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and Greystanes that would otherwise not be employed if it weren’t for the Limestone Mine at Marulan.

The majority of personnel employed on-site reside in the local Marulan and surrounding Goulburn Mulwaree district.

Total employees on site on weekdays number approximately 91 people who arrive by car and or by the staff bus. Employees on weekends number 18 on Saturday and 12 on Sunday.

# 3.0 PROJECT

## 3.1 Mining Operations

Boral proposes to continue mining limestone from the mine at a rate of up to 4 million tonnes per annum (mtpa) for a period of up to 30 years. This represents an increase in extraction rate from historic levels (peak of 3.38 mtpa) due to forecast increased demand from the construction industry. Shale will continue to be extracted at a rate of up to 200,000 tonnes per annum (tpa).

The proposed 30 year mine plan accesses approximately 120 million tonnes of limestone down to a depth of 335 m AHD. The mine footprint focuses on an expansion of the North Pit westwards to mine the Middle Limestone and to mine deeper into the Eastern Limestone. As the Middle Limestone lies approximately 70 m to 150 m west of the Eastern Limestone, the 30 year mine plan avoids mining where practical the interburden between these two limestone units thereby creating a smaller second, north-south oriented West Pit with a ridge remaining between. The North Pit will also be expanded southwards, encompassing part of the South Pit, leaving the remainder of the South Pit for overburden emplacement and a visual barrier.

In addition to mining approximately 5 million tonnes of shale, the extraction of the limestone requires the removal of approximately 108 million tonnes of overburden over the 30 year period. This material will be emplaced within existing and proposed overburden Emplacement Areas.

Limestone will continue to be mined using drilling and blasting methods. Shale will continue to be mined by excavator/front end loader. Limestone, shale and overburden will be transported to the primary crusher, stockpile areas and overburden emplacements respectively, using the load and haul fleet of trucks.
Products produced at the mine will continue to be despatched by road and rail, with the majority despatched by rail.

The limestone sand plant, produces a crushed and air classified limestone sand for use in concrete. The mine currently produces 500,000 tpa for Peppertree Quarry and propose to increase production of manufactured sand to approximately 1 million tpa.

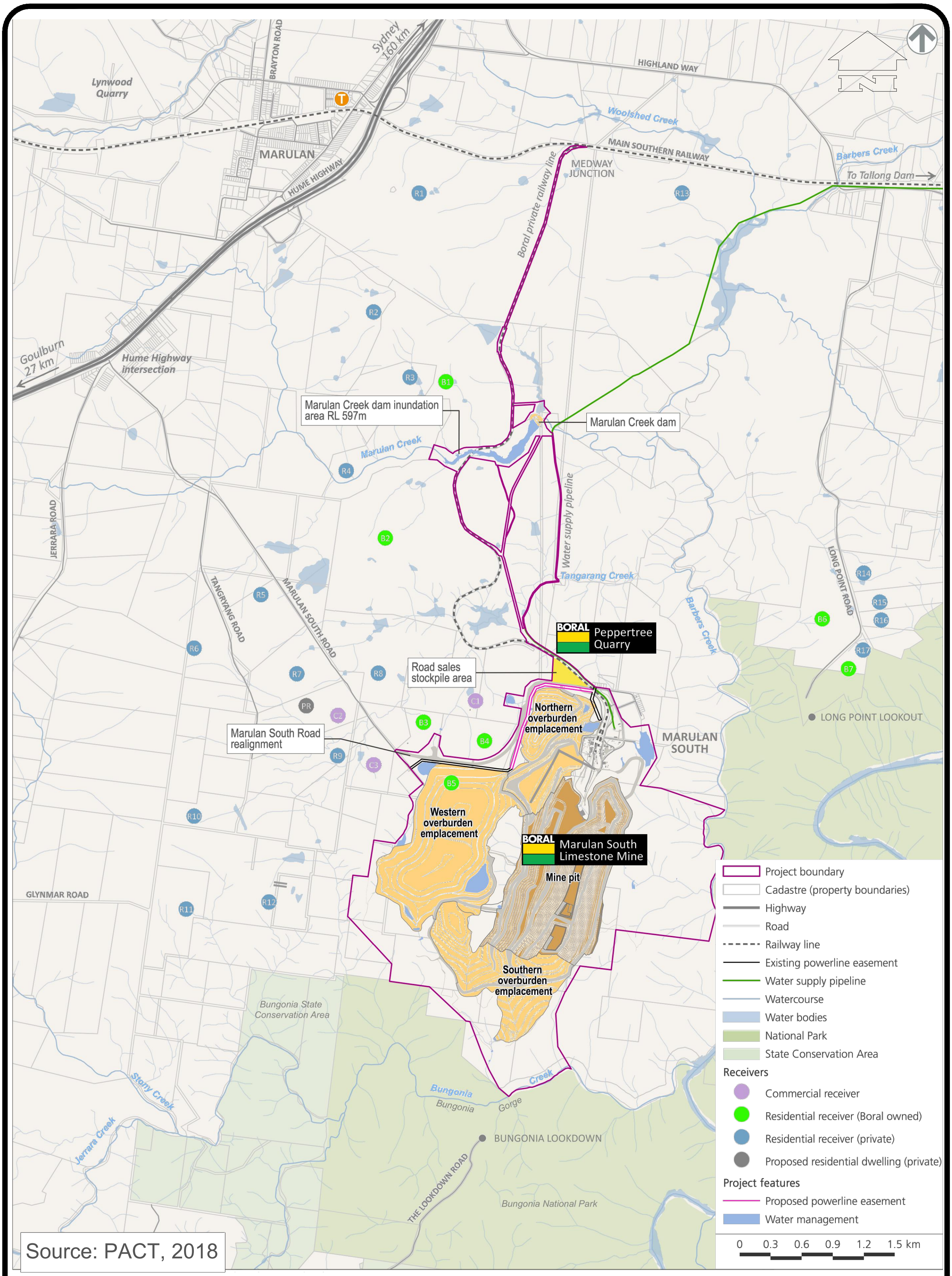
Boral's adjoining Peppertree Quarry currently has approval to emplace some of its overburden in the South Pit mine void. As the South Pit is required for the emplacement of over 30 million tonnes of overburden from the mine after the removal of accessible limestone, Boral proposes to emplace up to 15 million tonnes of overburden from Peppertree Quarry within the Northern Overburden Emplacement.

**Figure 2** shows the Project's Definition and Area.

## 3.2 Processing

The existing facilities for processing limestone will continue to be utilised to produce a series of graded and blended limestone products that are despatched from site for use primarily in cement manufacture, steel making, commercial and agricultural applications. Limestone processing facilities include primary and secondary crushing, screening, conveying and stockpiling plant and equipment located north-west of the North Pit and extending to the tertiary crushing, screening, bin storage and despatch (rail and road) systems that form part of the main processing facilities.

Kiln stone grade limestone will also continue to be processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment.



Source: PACT, 2018

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# FIGURE 2

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS

# THE PROJECT

JOB NO.14099 R 13/08/18

Processing infrastructure and the reclaim and stockpile area at the northern end of the North Pit will be relocated during the life of the 30 year pit to enable full development of the mine plan. The timing and location of this is presented in the EIS.
Shale and white clay will not be processed and will be stockpiled directly from the pit, ready for dispatch by road to the Berrima and Maldon cement operations.

## 3.3 Rail

No changes are proposed to the existing rail infrastructure. A 1.2 km long passing line was constructed at Medway Junction during construction of the Peppertree Quarry, which will also be used by the mine to enhance access to the Main Southern Railway.

## 3.4 Road

Road access from the mine to the Hume Highway is via Marulan South Road. **Figure 3** shows the transport route to and from the Hume Highway.

The proposed Western Overburden Emplacement extends northwards over Marulan South Road. Boral propose to realign a section of Marulan South Road, to accommodate the northern portion of the proposed Western Overburden Emplacement. **Figure 4** shows the proposed realignment in concept form**.**

As part of the proposal, all public roads within the former village of Marulan South as well as the section of Marulan South Road between Boral's operations and the entrance to the agricultural lime manufacturing facility will be deproclaimed.

## 3.5 Transport

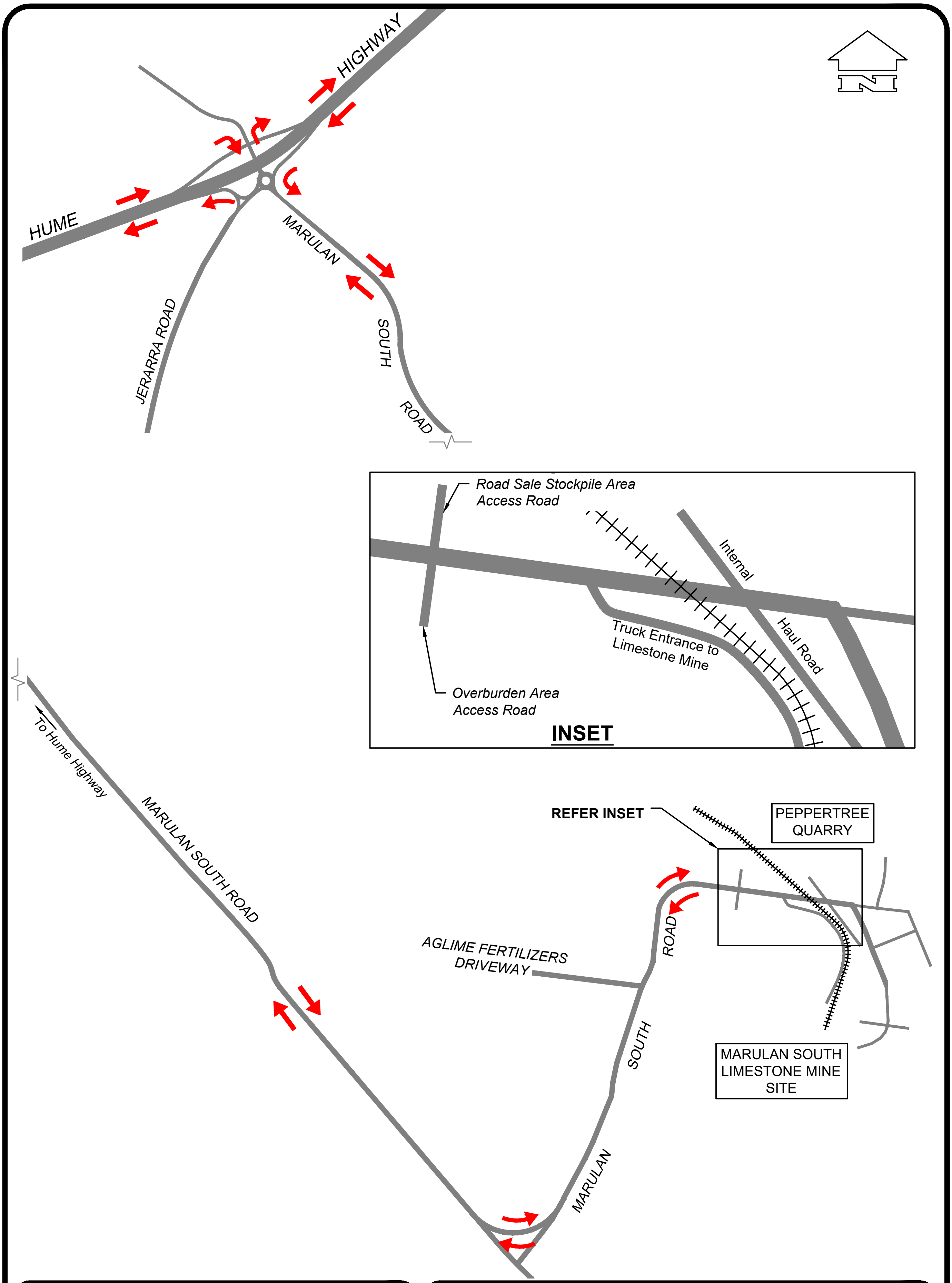
The majority of limestone products will continue to be transported to customers by rail for cement, steel, commercial and agricultural uses. Boral seeks no limitation on the volume of products transported by rail.

Manufactured sand will continue to be transported by truck along a dedicated internal road, across Marulan South Road and into Peppertree Quarry for blending and dispatch by rail.

Agricultural lime, quick lime and fine limestone products will continue to be transported by powder tanker, bulk bags on trucks or open tipper trucks along Marulan South Road.
Shale, limestone aggregates, sand and tertiary crushed products will be transported by predominantly truck and dog along Marulan South Road.

The adjoining Peppertree Quarry is currently approved to transport all products by rail. Boral will seek to transport approximately 150,000 tpa of Peppertree Quarry's products from the mine to customers via Marulan South Road. This could be achieved by back loading to a new shared road sales product stockpile area by the trucks carrying the limestone sand to Peppertree Quarry. A new shared road sales product stockpile area is proposed on the northern side of Marulan South Road, immediately west of the mine and Peppertree Quarry entrances. This shared finished product stockpile area, includes a weighbridge and wheel wash and will service both the mine and Peppertree Quarry.

In total, Boral is seeking to transport up to 600,000 tpa of limestone and hard rock products along Marulan South Road to the Hume Highway, as well as 120,000 tpa of limestone products to the agricultural lime manufacturing facility.



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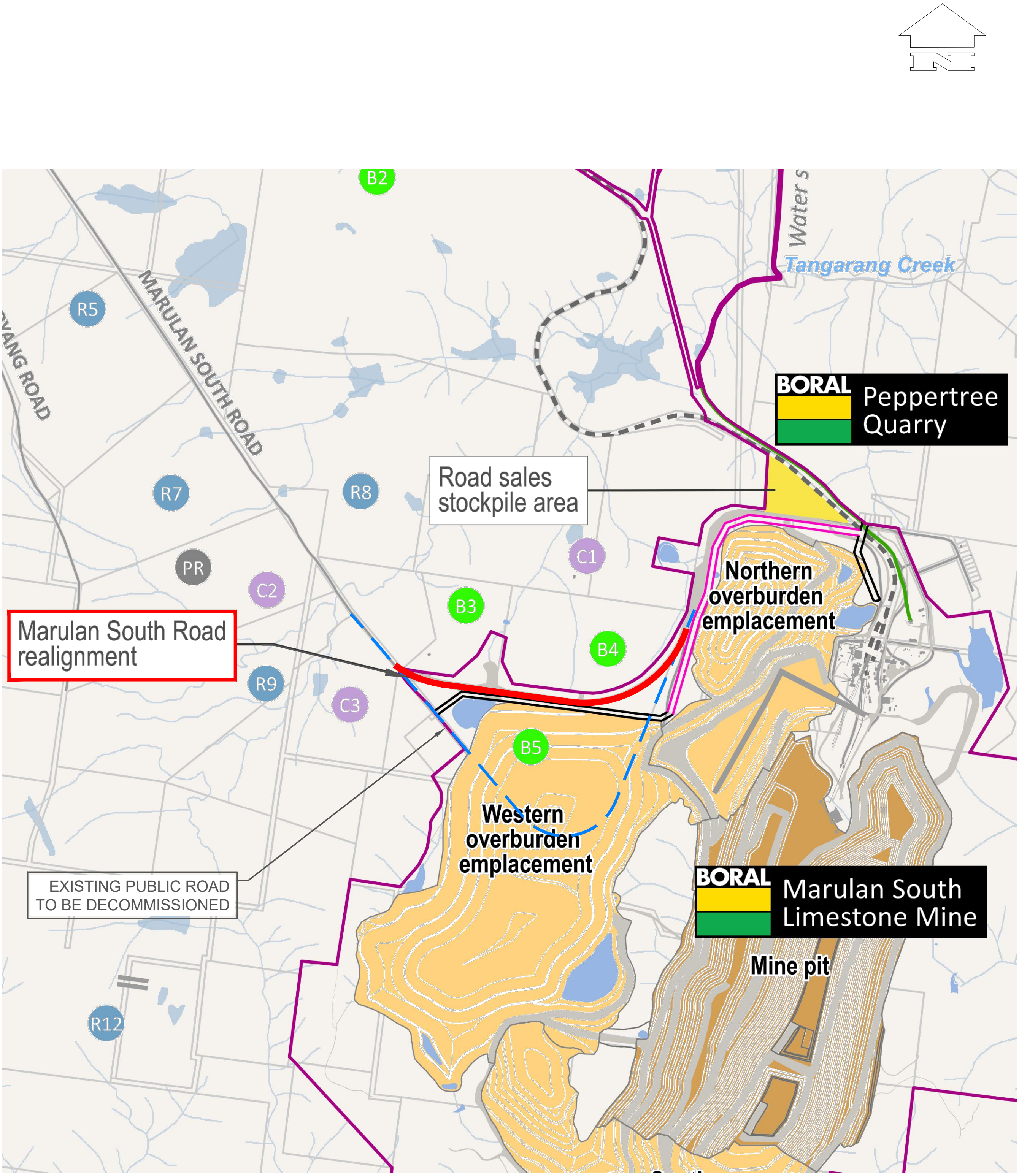
# FIGURE 3

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS

## ROAD TRANSPORT ROUTES

JOB NO.14099 R 13/08/18



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## FIGURE 4

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS
**CONCEPT PLAN**
**PROPOSED REALIGNMENT - MARULAN SOUTH RD**

JOB NO.14099 R 13/08/18

## 3.6 Power

Power supply to the mine is via a high voltage power line that commences at a sub-station on the southern side of Marulan South Road, immediately west of the Project boundary. A section of this power line will be relocated to accommodate the proposed Northern Overburden Emplacement.

# 4.0 EXISTING TRAFFIC CONDITIONS

## 4.1 Principal Road Network

The principal road network that provides access to Marulan South Limestone Mine includes Marulan South Road and the Hume Highway.

## 4.2 Description of Existing Roads

### 4.2.1 Marulan South Road

Marulan South Road connects the Hume Highway and the mine. The overall distance is approximately 8.1km between the Hume Highway intersection and the rail line level crossing at Marulan South.

The road is constructed as a 2 lane rural road (one travel lane in each direction) with centreline marking, edge lines, guideposts/reflectors and warning signs.

The speed limit along Marulan South Road is predominantly 80km/h except at/near the Hume Highway intersection and at the mine where it is 60km/h.

Marulan South Road services a number of rural properties along its length including the mine, Peppertree Quarry and the Aglime Fertiliser facility, which is located to the west of the mine. A school bus service uses Marulan South Road in the mornings and afternoons on school days.

The section of Marulan South Road between the Hume Highway and approximately 6km to the south east has a horizontal alignment which consists of straight sections interspersed with gentle curves constructed through moderately rolling terrain. This section of Marulan South Road generally has a 6.3 metre wide sealed pavement with gravel/grass shoulders of variable width.

The horizontal alignment changes at chainage 6km with a sweeping left hand curve. Marulan South Road then travels in a north easterly direction for approximately 1.5km and then in an easterly direction for another 600 metres before it reaches the rail line level crossing in Marulan South. This section of the road has a mixture of newer and older sealed pavement with road widths of 6.9 metres in the older section and up to 7.3 metres in the newer sections with sealed shoulders 0.3 to 1.0 metres wide, plus gravel shoulders. In 2013/2014, Boral funded heavy patching of eight damaged sections of Marulan South towards the end of the construction period of the Peppertree quarry plant.

Intersections along Marulan South Road include:

- Hume Highway Grade Separated Interchange intersection which provides access to Marulan South Road and Jerrara Road, as well as to Holcim's Lynwood Quarry which is north of the Hume Highway.

- Marulan Creek Road/Tangarang Road which are unsealed gravel roads and form a minor cross section intersection with Marulan South Road under priority control. This intersection has basic left (BAL) and basic right (BAR) turn treatments in Marulan South Road. The available sight distance is satisfactory to/from the northern approach (190 metres) and limited (150 metres) to/from the southern approach due to a curve.

- The Aglime Fertiliser facility access road forms a channelised T junction intersection under priority control. This intersection provides modified AUL (i.e. auxiliary left turn treatment) and a modified short CHR (i.e. right turn treatment) in Marulan South Road.

The available sight distance at this intersection is 200 metres to the south and 160 metres to the north.

Within the 60km/h speed zone of Marulan South Road in Marulan South, there are several roads that provide access to various facilities of the mine and Peppertree Quarry. These access roads form T and cross junction intersections with Marulan South Road. All the vehicles using these roads and intersections in this section of Marulan South Road are generated by the mine and Peppertree Quarry.

### 4.2.2 Hume Highway

The Hume Highway is a high standard 4 lane divided road with dual carriageways. It is the main road corridor between Sydney and Melbourne, as well as servicing those towns/communities in south western NSW, and the ACT.

In the Marulan area the Hume Highway provides 2 through lanes in each direction plus additional turning and/or diverging/merging lanes at intersections for vehicles entering or leaving the Highway.

The speed limit on this section of the Hume Highway is 110km/h. The Hume Highway has a high level of traffic management with wide shoulders, delineation and signage.

The principal intersections along the Hume Highway between Marulan and Marulan South include:

- A grade separated interchange at the northern end of Marulan that provides the main access to/from the township including access to George Street; and

- A grade separated interchange at Old Marulan that provides access to Marulan South Road and Jerrara Road as well as to Holcim’s Lynwood Quarry. This interchange includes a roundabout at the southbound ramps and a conventional cross junction intersection at the northbound ramps. The speed limit operating at the these intersections is 60km/h

Available sight distance at the Old Marulan Interchange intersections is considered to be satisfactory and meets Austroads requirements for the posted speed limits and the estimated operating vehicle speeds, using the interchange. The interchange also has lighting on the approaches, exits and intersections.

## 4.3 Existing Traffic Conditions on the Road Network

### 4.3.1 Existing Traffic Volumes

Traffic counts were undertaken as part of this assessment to establish current traffic volumes using the road network.

This included daily volume and vehicle classification counts on Marulan South Road at several locations. In addition, intersection volume and turning counts were undertaken during the weekday AM, business hours and PM peak hour periods at the Old Marulan Interchange intersection with Marulan South Road/Jerrara Road and the northbound and southbound on/off ramp of the Hume Highway.

The intersection counts were undertaken on Wednesday 11 June 2014. The classification counts were undertaken between 12 and 19 November 2014. Whilst these counts were undertaken in 2014 the volumes are considered to be representative of 2019 traffic conditions as there has been no material change to the land uses in Marulan South Road and hence the traffic volumes using the road.

The count locations are shown in **Figure 5** together with a summary of the daily volume and vehicle classifications using Marulan South Road at the count locations.

### 4.3.2 Daily and Hourly Volumes

Tables 4.1 and 4.2 shows the daily volumes including heavy vehicles using Marulan South Road on a typical weekday and per day, south of the Hume Highway (Table 4.1) and west of the mine (Table 4.2).

Table 4.1 shows that weekday (5 day average) and daily (7 day average) two way traffic volumes on Marulan South Road, south of Hume Highway are 666 vehicles per day (vpd) and 544vpd, respectively. Heavy vehicles (Austroad Class 3-12) number 203vpd on a weekday and 154vpd per day representing 30.5% and 28.3% of total vehicles on weekdays and per day respectively.

Table 4.2 shows that two way weekday (5 day average) and daily (7 day average) traffic volumes are lower in Marulan South Road, just west of the Limestone Mine. Two way weekday volumes are 538vpd and two way daily traffic volumes are 421vpd. Heavy vehicles (Austroad Class 3-12) number 190vpd on a weekday and 143vpd per day representing 35.3% and 34.0% of total vehicles on weekdays and per day respectively.

**TABLE 4.1**

**MARULAN SOUTH ROAD, SOUTH OF HUME HIGHWAY**
**5 DAY AVERAGE AND 7 DAY AVERAGE**
**TRAFFIC VOLUMES AND VEHICLE CLASSIFICATION**

| Direction of Travel | 5 Day Average (Weekday) | | | 7 Day Average (ADT) | | |
|---|---|---|---|---|---|---|
| | Light[1] | Heavy[2] | Total | Light[1] | Heavy[2] | Total |
| South* | 234 | 99 | 333 | 196 | 75 | 271 |
| North° | 229 | 104 | 333 | 194 | 79 | 273 |
| Total | 463 | 203 | 666 | 390 | 154 | 544 |
| Proportion of Total | 69.5% | 30.5% | 100.0% | 66.2% | 28.3% | 100.0% |

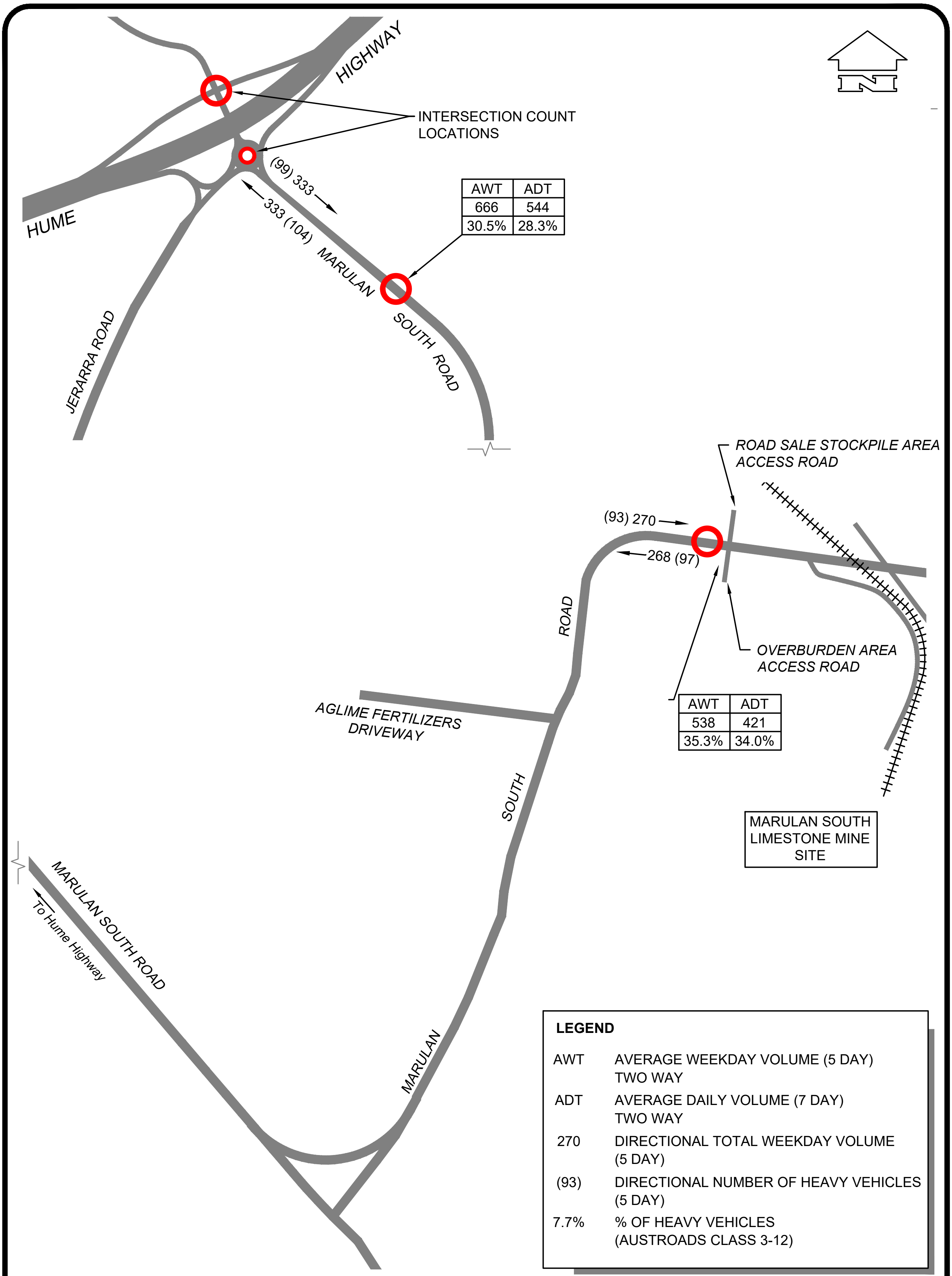
*Source: Traffic Counts undertaken 12-19 November 2014*
*[1] Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes*
*[2] Heavy Vehicles – Austroads 3-12 vehicle classifications*
**Towards the Mine*
*°Away from the Mine*

**TABLE 4.2**

**MARULAN SOUTH ROAD, WEST OF THE MINE**
**5 DAY AVERAGE AND 7 DAY AVERAGE**
**TRAFFIC VOLUMES AND VEHICLE CLASSIFICATION**

| Direction of Travel | 5 Day Average (Weekday) | | | 7 Day Average (ADT) | | |
|---|---|---|---|---|---|---|
| | Light[1] | Heavy[2] | Total | Light[1] | Heavy[2] | Total |
| East* | 177 | 93 | 270 | 141 | 69 | 210 |
| West° | 171 | 97 | 268 | 137 | 74 | 211 |
| Total | 348 | 190 | 538 | 278 | 143 | 421 |
| Proportion of Total | 64.7% | 35.3% | 100.0% | 66.0% | 34.0% | 100.0% |

*Source: Traffic Counts undertaken 12-19 November 2014*
*[1] Light Vehicles – Austroads 1 and 2 vehicle classification and motorbikes*
*[2] Heavy Vehicles – Austroads 3-12 vehicle classifications*
**Towards the Mine*
*°Away from the Mine*



| AWT | ADT |
|---|---|
| 666 | 544 |
| 30.5% | 28.3% |

| AWT | ADT |
|---|---|
| 538 | 421 |
| 35.3% | 34.0% |

**LEGEND**

| | |
|---|---|
| AWT | AVERAGE WEEKDAY VOLUME (5 DAY) TWO WAY |
| ADT | AVERAGE DAILY VOLUME (7 DAY) TWO WAY |
| 270 | DIRECTIONAL TOTAL WEEKDAY VOLUME (5 DAY) |
| (93) | DIRECTIONAL NUMBER OF HEAVY VEHICLES (5 DAY) |
| 7.7% | % OF HEAVY VEHICLES (AUSTROADS CLASS 3-12) |

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# FIGURE 5

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS

**EXISTING DAILY TRAFFIC VOLUMES & VEHICLE CLASSIFICATION**

JOB NO.14099 R 13/08/18

Tables 4.3 and 4.4 show the hourly volumes on Marulan South Road at the same locations for a weekday (5 day average) and per day (7 day average).

The highest hourly volumes occur on a weekday between 6am – 8am, just south of the Hume Highway (Table 4.3). At this time, two way traffic volumes are in the order of 67-70 vehicles per hour (vph). The next highest periods are between 3pm – 4pm and 5pm – 6pm where two way vehicles are in the order of 55 – 58vpd.

At other times between 5am and 8pm two way traffic volumes are in the order of 25 – 46vph.

Weekday hourly volumes on Marulan South Road, just west of the mine are slightly lower than the volumes recorded south of the Hume Highway. The maximum two way volumes are 59 – 65vph in the 6am – 8am period, 44 – 46vph in the 3pm – 6pm period and 15 – 33vph at other times between 5am and 8pm.

**TABLE 4.3**

**HOURLY TRAFFIC VOLUMES IN MARULAN SOUTH ROAD, SOUTH OF HUME HIGHWAY FOR AVERAGE WEEKDAY AND AVERAGE DAY**

| Time | 5 Day Average | | | 7 Day Average | | |
|---|---|---|---|---|---|---|
| | South* | Northº | Total | South* | Northº | Total |
| Midnight – 1am | 1 | 1 | 2 | 1 | 0 | 1 |
| 1am-2am | 1 | 1 | 2 | 1 | 1 | 2 |
| 2am-3am | 1 | 0 | 1 | 1 | 0 | 1 |
| 3am-4am | 1 | 2 | 3 | 1 | 2 | 3 |
| 4am-5am | 6 | 1 | 7 | 4 | 0 | 4 |
| 5am-6am | 30 | 6 | 36 | 24 | 5 | 29 |
| 6am-7am | 58 | 9 | 67 | 44 | 7 | 51 |
| 7am-8am | 52 | 18 | 70 | 42 | 16 | 58 |
| 8am-9am | 25 | 21 | 46 | 19 | 17 | 36 |
| 9am-10am | 17 | 19 | 36 | 14 | 16 | 30 |
| 10am-11am | 17 | 16 | 33 | 15 | 14 | 29 |
| 11am-12 noon | 16 | 18 | 34 | 15 | 15 | 30 |
| 12 noon-1pm | 17 | 18 | 35 | 14 | 15 | 29 |
| 1pm-2pm | 16 | 21 | 37 | 13 | 18 | 31 |
| 2pm-3pm | 14 | 19 | 33 | 12 | 17 | 29 |
| 3pm-4pm | 12 | 46 | 58 | 10 | 37 | 47 |
| 4pm-5pm | 11 | 31 | 42 | 10 | 24 | 34 |
| 5pm-6pm | 12 | 43 | 55 | 9 | 33 | 42 |
| 6pm-7pm | 9 | 15 | 24 | 7 | 12 | 19 |
| 7pm-8pm | 10 | 15 | 25 | 10 | 13 | 23 |
| 8pm-9pm | 3 | 8 | 11 | 3 | 8 | 11 |
| 9pm-10pm | 2 | 3 | 5 | 2 | 3 | 5 |
| 10pm-11pm | 2 | 2 | 4 | 2 | 1 | 3 |
| 11pm-Midnight | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Traffic Counts undertaken 12-19 November 2014*
**Direction of Travel – towards the Mine*
*ºDirection of Travel – away from the Mine*

### TABLE 4.4

### HOURLY TRAFFIC VOLUMES IN MARULAN SOUTH ROAD, WEST OF THE MINE FOR AVERAGE WEEKDAY AND AVERAGE DAY

| Time | 5 Day Average | | | 7 Day Average | | |
|---|---|---|---|---|---|---|
| | East* | Westº | Total | East* | Westº | Total |
| Midnight – 1am | 0 | 0 | 0 | 0 | 0 | 0 |
| 1am-2am | 1 | 1 | 2 | 0 | 1 | 1 |
| 2am-3am | 1 | 1 | 2 | 1 | 0 | 1 |
| 3am-4am | 1 | 2 | 3 | 1 | 2 | 3 |
| 4am-5am | 4 | 1 | 5 | 3 | 0 | 3 |
| 5am-6am | 28 | 4 | 32 | 22 | 3 | 25 |
| 6am-7am | 53 | 6 | 59 | 40 | 5 | 45 |
| 7am-8am | 50 | 15 | 65 | 40 | 13 | 53 |
| 8am-9am | 19 | 14 | 33 | 14 | 11 | 25 |
| 9am-10am | 17 | 16 | 33 | 13 | 12 | 25 |
| 10am-11am | 13 | 15 | 28 | 11 | 12 | 23 |
| 11am-12 noon | 12 | 15 | 27 | 9 | 11 | 20 |
| 12 noon-1pm | 13 | 14 | 27 | 10 | 11 | 21 |
| 1pm-2pm | 12 | 16 | 28 | 9 | 11 | 20 |
| 2pm-3pm | 10 | 13 | 23 | 8 | 12 | 20 |
| 3pm-4pm | 7 | 39 | 46 | 6 | 30 | 36 |
| 4pm-5pm | 5 | 23 | 28 | 4 | 18 | 22 |
| 5pm-6pm | 7 | 37 | 44 | 5 | 27 | 32 |
| 6pm-7pm | 5 | 10 | 15 | 4 | 8 | 12 |
| 7pm-8pm | 9 | 14 | 23 | 9 | 11 | 20 |
| 8pm-9pm | 2 | 7 | 9 | 2 | 7 | 9 |
| 9pm-10pm | 1 | 3 | 4 | 1 | 2 | 3 |
| 10pm-11pm | 1 | 1 | 2 | 0 | 1 | 1 |
| 11pm-Midnight | 0 | 0 | 0 | 0 | 0 | 0 |

*Source: Traffic Counts undertaken 12-19 November 2014*
**Direction of Travel – towards the Mine*
*ºDirection of Travel – away from the Mine*

### 4.3.3 Hume Highway Interchange Marulan South Road/Jerrara Road Intersection

**Figures 6** and **7** show the AM and PM peak hour volumes for the above interchange intersection.

The on/off ramps to/from the Hume Highway form two intersections including a roundabout intersection and a cross junction intersection connected by a bridge structure over the Hume Highway.

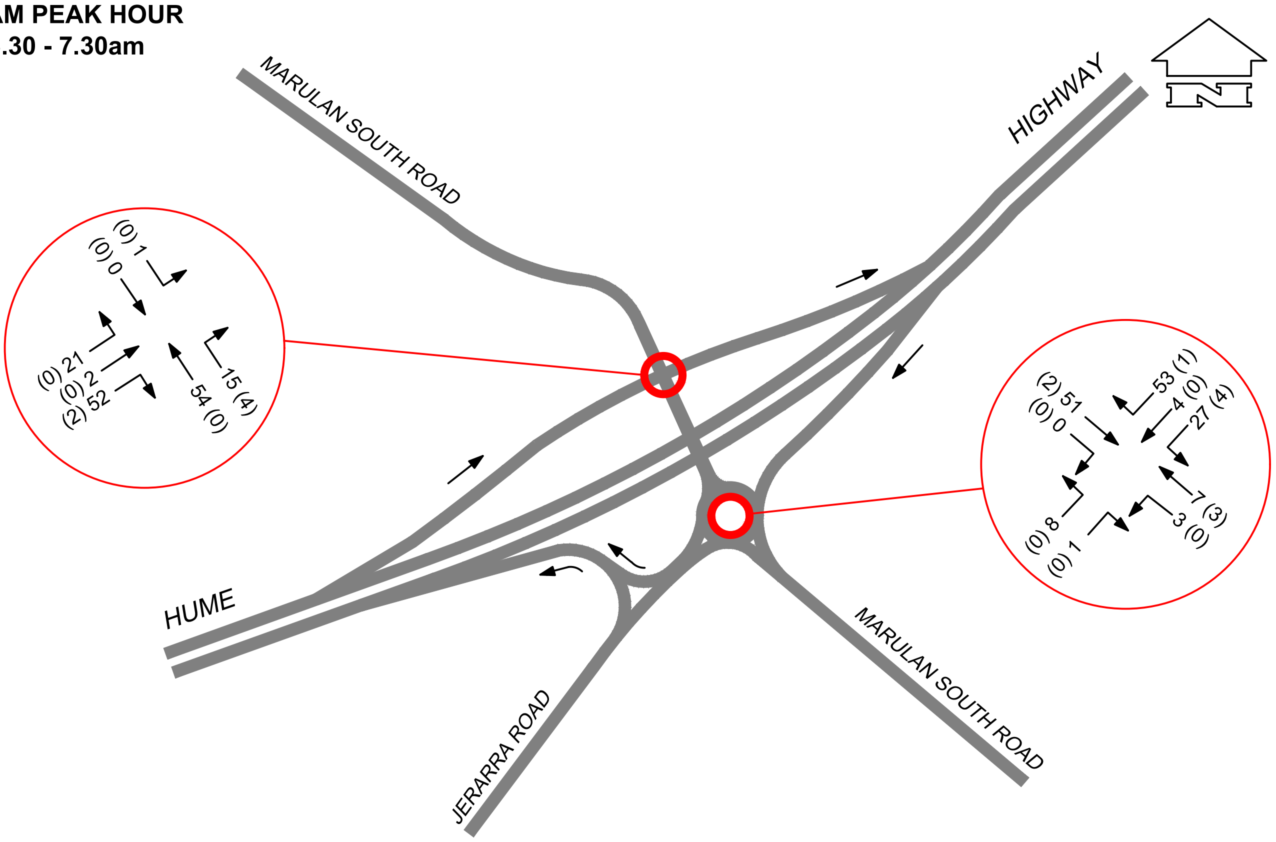
The AM peak hour at the interchange intersection occurred between 6.30am – 7.30am while the PM peak hour occurred between 4.30pm and 5.30pm.

Some 154 vph and 145 vph used the roundabout and cross junction intersection in the AM peak hour (6.30am – 7.30am) and 120 vph and 108 vph used the intersections in the PM peak hour.

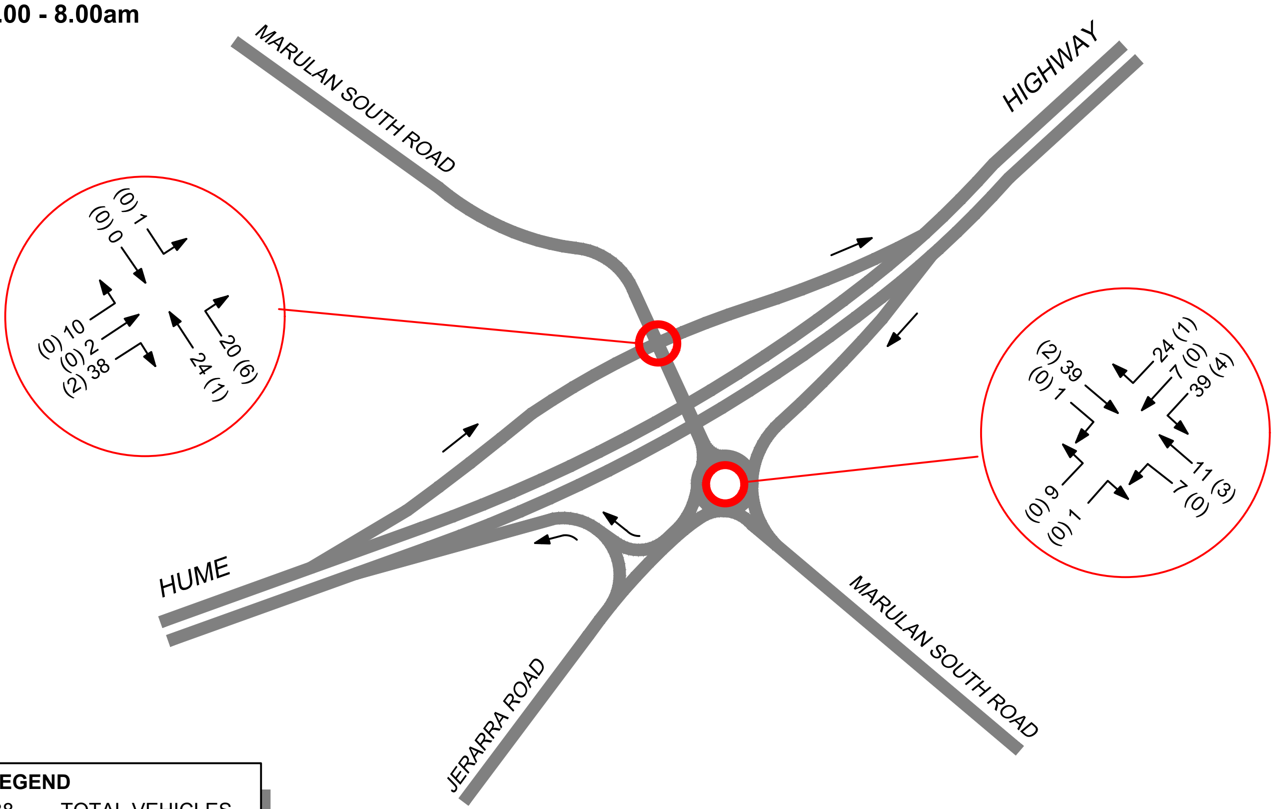
These volumes are relatively low peak hour intersection traffic volumes and are consistent with other intersections in rural areas.

Deceleration and Acceleration lanes are provided in the northbound and southbound directions of the Hume Highway to safely facilitate vehicles exiting and entering the Hume Highway to and from the interchange.

**AM PEAK HOUR**
**6.30 - 7.30am**



**AM PEAK HOUR**
**7.00 - 8.00am**



**LEGEND**

| | |
|---|---|
| 38 | TOTAL VEHICLES |
| (2) | HEAVY VEHICLES |

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# FIGURE 6

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS

**EXISTING WEEKDAY AM PEAK HOUR TRAFFIC VOLUMES AT HUME HIGHWAY INTERCHANGE INTERSECTIONS**

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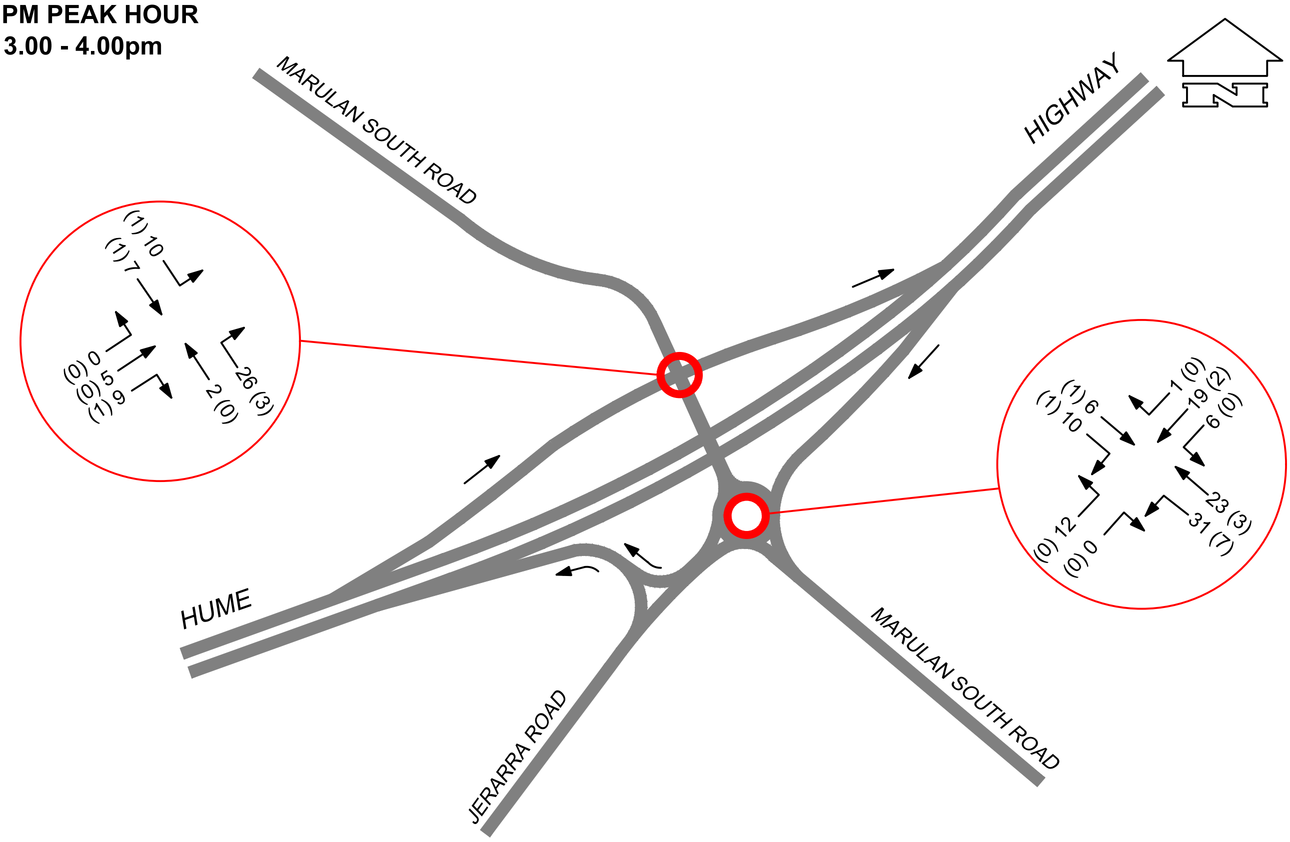
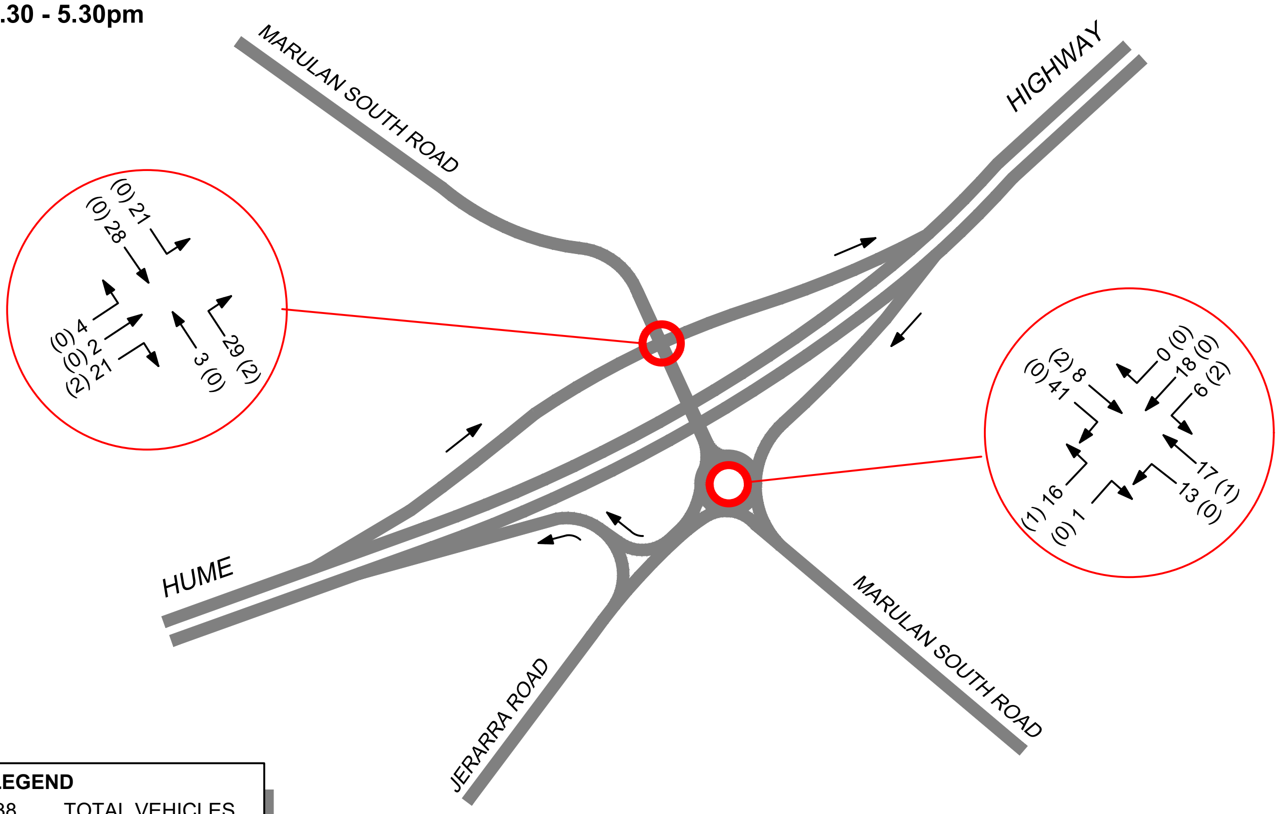
**PM PEAK HOUR**
**3.00 - 4.00pm**



**PM PEAK HOUR**
**4.30 - 5.30pm**



**LEGEND**

| | |
|---|---|
| 38 | TOTAL VEHICLES |
| (2) | HEAVY VEHICLES |

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# FIGURE 7

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS

**EXISTING WEEKDAY PM PEAK HOUR TRAFFIC VOLUMES AT HUME HIGHWAY INTERCHANGE INTERSECTIONS**

JOB NO.14099 R 13/08/18

Also shown on **Figures 6** and **7** are the traffic volumes using the interchange intersections between the 7.00am – 8.00am period and the 3.00pm – 4.00pm period. These periods coincide with the peak hours for traffic using Marulan South Road.

## 4.4 Road Safety

Road crash statistics for Marulan South Road were obtained from the RMS for the 3 year period between 1 July 2011 and 30 June 2014.

During this period there was one (1) run off the road crash, which occurred in foggy conditions on the sweeping curve located 6kms from the Hume Highway. This crash involved one (1) vehicle and was a non-injury crash.

This section of Marulan South Road is proposed to be realigned as part of the Project.

# 5.0 ASSESSMENT OF IMPACTS OF PROJECT

## 5.1 Existing Traffic Generation of Mine and Peppertree Quarry

### 5.1.1 Vehicle Trips in Marulan South Road, West of the Mine

Based on the November 2014 traffic counts, the existing traffic generation of Boral's Marulan South operations (the mine and Peppertree Quarry) is a total of 538 two way vehicle trips (i.e. 270 in/268 out) on a weekday. Heavy vehicles account for 190 two way trips.

When averaged over a full week which includes Saturday and Sunday, the traffic generation is 421 two way vehicle trips per day (210 in/211 out) including 144 two way heavy vehicle trips. Saturday and Sunday have lower overall traffic volumes when compared to weekdays. As weekdays have higher traffic generation, the traffic volumes for weekdays have been used in this traffic assessment.

Table 5.1 below shows the breakdown of the major vehicle classifications generated by the combined mine and Peppertree Quarry operations on a typical weekday.

The breakdown of the heavy vehicles comprises:

- 56 two way trips by rigid trucks; and
- 134 two way trips by articulated trucks.

**TABLE 5.1**

**COMBINED EXISTING TRAFFIC GENERATION OF MARULAN SOUTH LIMESTONE MINE AND PEPPERTREE QUARRY ON A WEEKDAY**

| Two Way Volumes[i] | | | |
|---|---|---|---|
| **Light Vehicles** | **Rigid Trucks (Austroad Class 3-5)** | **Articulated Trucks (Austroad Class 6-12)** | **Total Vehicles** |
| 348 | 56 | 134 | 538 |

*1Vehicle trips to and from the mine and Peppertree Quarry travelling to and from the Aglime Fertiliser Facility and the Hume Highway*

Light vehicle trips on a weekday includes employee and visitor trips to and from the mine and Peppertree Quarry. A staff bus also transports employees to and from the mine each day, which typically would be recorded as a rigid truck in the counts.

Heavy vehicles generated by the mine include articulated truck and trailers, tankers and rigid trucks that transport some of the limestone product and fuel, as well as other articulated and rigid trucks associated with maintenance of the mine equipment by Boral or external contractors. A small number of tankers transporting limestone product are B-Doubles.

On an average weekday the mine generates some 60 heavy vehicle loads (120 two way trips) transporting product along Marulan South Road.

A portion of these, around 14 heavy vehicle loads on weekdays (28 two way trips) travel to the Aglime Fertiliser facility, which is approximately one (1) km south west of the mine entrance, via Marulan South Road.

Fuel and general deliveries to the mine account for up to an average of 12 heavy vehicle trips to the mine (24 two way trips) per day.

The remainder of the heavy vehicles include contractor maintenance vehicles to the mine, as well as fuel, general deliveries and maintenance contractors associated with Peppertree Quarry.

Peppertree Quarry does not transport finished product by road. However, it does generate a number of heavy vehicle trips as outlined above.

Heavy vehicle trips generated by the mine associated with product transport travel via Marulan South Road to the Hume Highway where 70% travel to and from the north and 30% travel to and from the south.

Based on Boral's weighbridge records, heavy vehicle transport to and from the mine occurs 24 hours per day with the majority of trips occurring between 4am and 11pm.

Approximately 92% of heavy vehicle trips occurred on weekdays and 8% on weekends.

Table 5.2 shows the breakdown of two-way vehicle trips using Marulan South Road (ie. external trips) generated by Marulan South Limestone Mine and Peppertree Quarry on a typical weekday.

**TABLE 5.2**

**BREAKDWN OF TWO-WAY TRIPS ON A WEEKDAY GENERATED BY MARULAN SOUTH LIMESTONE MINE AND PEPPERTREE QUARRY USING MARULAN SOUTH ROAD**

| Two Way Traffic Volumes | | | |
|---|---|---|---|
| | **Light Vehicles** | **Heavy Vehicles (Austroad Class 3-12)** | **Total Vehicles** |
| Marulan South Limestone Mine | 278 | 150 | 428 |
| Peppertree Quarry | 70 | 40 | 110 |
| **Combined Total** | **348** | **190** | **538** |

*1Vehicle trips to and from the mine and Peppertree Quarry travelling to and from the Aglime Fertiliser Facility and the Hume Highway*

### 5.1.2 Internal Trips

Boral also transport up to 500,000tpa of limestone sand, between the mine and Peppertree Quarry. This product is transported via a dedicated internal haul road that crosses Marulan South Road, east of the railway level crossing and east of the main vehicle truck entrance to the mine. This generates 16,667 truck loads per year (i.e. 33,333 truck trips with the return trip).

## 5.2 Traffic Generation of Project in Operational Phase

The Limestone Mine will continue to operate 24 hours per day and 365 days per year.

Most of the mine's product along with the aggregate/sand produced by Peppertree Quarry will continue to be despatched by rail.

The mine will continue to generate daily light vehicle trips associated with employees and visitors, as well as daily heavy vehicle trips associated with product transport by road, fuel and other supplies and maintenance.

Light vehicle trips are expected to remain at similar levels to existing for the foreseeable future.

Product trucks (articulated truck and dog combination, tankers and rigid trucks) will continue to transport around 330,000tpa of limestone and clay shale products to the Hume Highway via Marulan South Road, as well as the existing 120,000tpa of lime transported to the nearby Aglime facility, which is located one (1) km west of the mine, along Marulan South Road.

Boral proposes to transport an additional 120,000tpa of limestone and clay shale products to the Hume Highway via Marulan South Road using the same vehicle fleet. This will generate an additional 4,086 loads (8,172 trips with return trip) per year, based on loads between 27 to 30 tonnes.

Boral also proposes to transport by articulated truck and dog trailer vehicles an additional 150,000tpa of aggregate and sand produced by the Peppertree Quarry by road to the Hume Highway via Marulan South Road. This will generate an additional 5,000 loads per year (10,000 trips with return trip) based on average loads of 30 tonne. As noted above, these additional trucks will travel via Marulan South Road to the Hume Highway.

The section of Marulan South Road adjacent the mine and Peppertree Quarry entrances will experience crossing by heavy vehicles associated with the use of the proposed new Road Sales Stockpile Area and the hauling of overburden from Peppertree Quarry to the Northern Overburden Emplacement Area.

The mine will also continue to transport limestone sand across Marulan South Road to Peppertree Quarry for dispatch by rail, using the dedicated internal haul road, east of the rail line and level crossing. Boral proposed to increase this to 1,000,000tpa which is the equivalent of 16,667 truck loads per year (i.e. 33,333 truck trips with return trip).

Boral may seek to purchase and close the public roads in Marulan South up to the entrance to the Aglime Fertiliser facility. **Figure 8** shows the sections of public roads that may be purchased and closed.

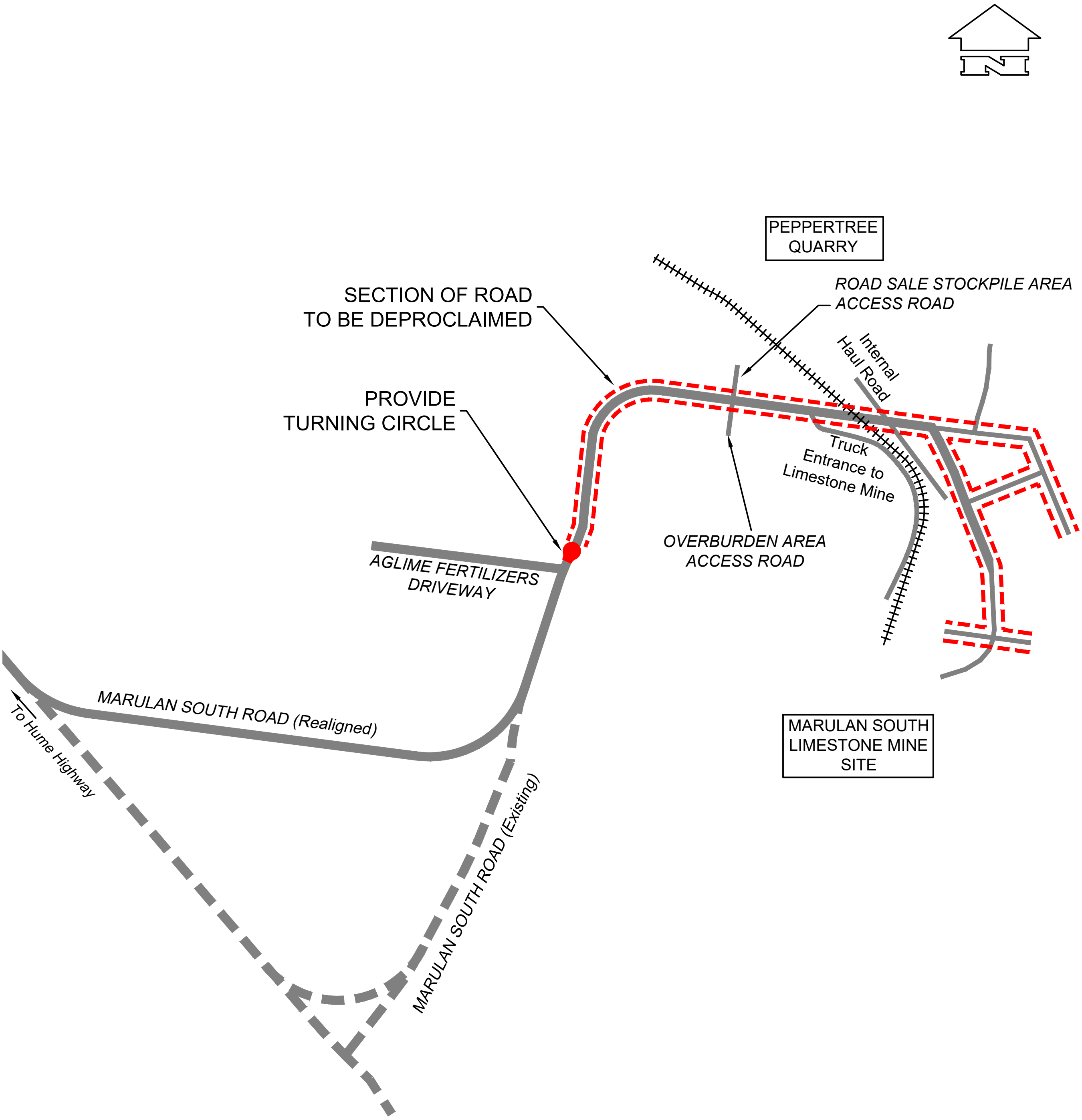
However, for the purposes of this traffic assessment, it has been assumed that no public roads will be closed. Therefore the additional traffic generation associated with the proposed new Road Sales Stockpile Area, the additional limestone product, the hauling of overburden from Peppertree Quarry to the Northern Overburden Emplacement on the mine site, and the additional internal truck trips associated with the increased hauling of limestone sand between the Limestone Mine and Peppertree Quarry, has been considered in detail as part of this traffic assessment.

## 5.3 Proposed Road Improvements/Changes

The proposed road improvement and changes associated with the Project includes:

- The realignment of the section of Marulan South Road, near the proposed northern extension of the Western Overburden Emplacement Area.

- The upgrading of the narrower sections of Marulan South Road that remain a public road to accommodate Goulburn Mulwaree Council's DCP minimum standard of a 7 metre wide sealed carriageway plus 1 metre shoulders (0.5 metres of which are



**LEGEND**

╌╌ DENOTES ROAD SECTION TO BE DEPROCLAIMED

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# FIGURE 8

MARULAN SOUTH LIMESTONE MINE
CONTINUED OPERATONS

## SECTION OF MARULAN SOUTH ROAD TO BE DEPROCLAIMED

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sealed) each side. As part of these upgrade works provision for school bus stopping and turning will be considered.

- A new cross junction intersection in Marulan South Road at the Road Sales Stockpile Area and associated improvement works.

Proposed Realignment of Marulan South Road

**Figure 4** shows the location of the proposed realignment in Marulan South Road.

The section of Marulan South Road to be realigned to accommodate the northern extension of the Western Overburden Emplacement will be designed for an 80km/h design speed and to Council's standards and specifications. The road will be designed and constructed with a 7.0 metre wide sealed road pavement, plus 0.5 sealed shoulders on each side as part of 1.0 metre wide shoulders. The road will be constructed on land owned by Boral and the realigned section of road including the road corridor will be transferred to Council as a public road as part of a land swap agreement between Council and Boral.

Proposed New Intersection on Marulan South Road at Road Sales Stockpile Area

**Figure 9** shows the proposed intersection layout for the intersection of the Road Sales Stockpile Area access road and the Northern Overburden Emplacement Area access road with Marulan South Road.

This will be a new cross junction intersection in Marulan South Road located some 310 metres west of the rail level crossing near the entrance to the mine and 175 metres west of the truck access road to the mine.

The intersection will be located at/near the change of the speed limit between 60km/h and 80km/h. If this section of Marulan South Road is to remain a public road, then it is recommended that the 60km/h speed limit that applies in the old Marulan South village, be extended 200 metres to the west, so that the new intersection is located in the 60km/h speed limit area.

The intersection will be designed with suitable geometry including wider road pavement on Marulan South Road to cater for the wider trucks (CAT740) that will transport the overburden from Peppertree Quarry to the mine's Northern Overburden Emplacement.

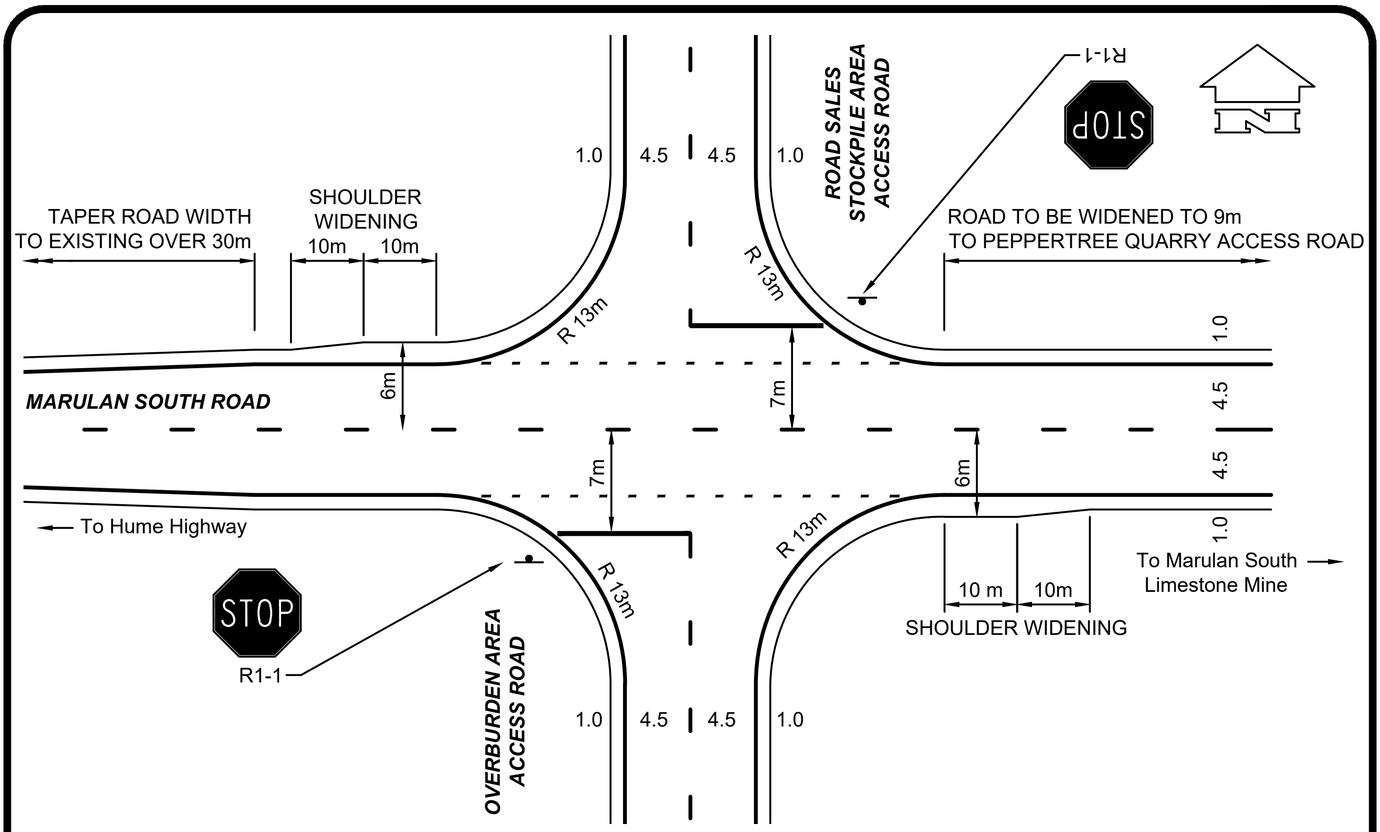
Trucks hauling overburden from the Peppertree Quarry pit to the mine, will travel along one of two routes:

(i) Along Marulan South Road to and from the east with the overburden trucks turning left into the Northern Overburden Emplacement Area access road and right out of the Overburden Emplacement access road.

(ii) From the Road Sales Stockpile Area access road into the Northern Overburden Emplacement access road and vice versa as a cross movement across Marulan South Road.

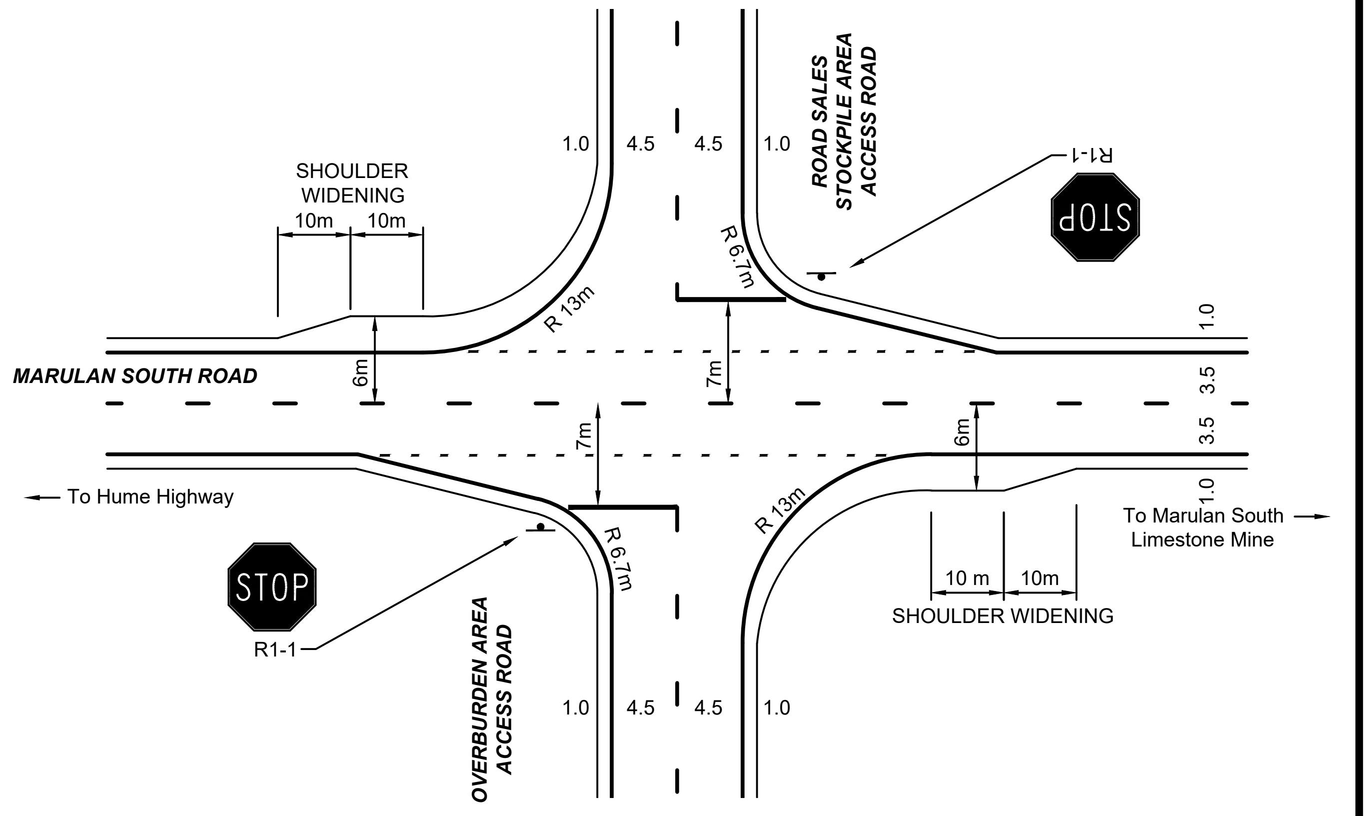
The aggregate/sand from Peppertree Quarry, to be stockpiled in the Road Sales Stockpile Area, will be transported along internal roads within the Peppertree Quarry site, to the north of the stockpile area.

The aggregate/sand from the mine, to be stockpiled in the Road Sales Stockpile Area, will be transported via the section of Marulan South Road east of the proposed intersection.



**SCENARIO 1**

MARULAN SOUTH ROAD WIDENED TO 9m
FROM INTERSECTION TO PEPPERTREE QUARRY ACCESS ROAD



**SCENARIO 2**

MARULAN SOUTH ROAD TO REMAIN 7m WIDE

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# FIGURE 9

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATONS

**CONCEPT LAYOUT OF PROPOSED INTERSECTION OF MARULAN SOUTH RD, ROAD SALES STOCKPILE AREA ACCESS ROAD & OVERBURDEN AREA ACCESS ROAD**

JOB NO.14099 R 13/08/18

Those product trucks delivering the aggregate/sand products to customers will arrive and depart from the west along Marulan South Road.

Future Intersection Treatment Option of Traffic Signals for Marulan South Road at Road Sales Stockpile Area

In the event that the section of Marulan South Road from the Aglime facility's driveway eastwards, becomes a private road under the control of Boral (i.e. deproclaimed/deregistered as a public road), Boral may decide to provide traffic signal control of the intersection to ensure safety is maximised for vehicles using the intersection and its workforce.

The design volumes indicate that single lane approaches and departures would be sufficient to cater for the estimated vehicles using the intersection. Also a simple two phase operation with Marulan South Road operating in one phase (i.e. A phase) and the Haul Road/Overburden access road operating the second phase (i.e. B phase) would safely accommodate vehicle movements at the intersection.

The traffic signals being located on private roads could either be vehicle activated (i.e. have detectors in each approach) or operate as fixed time, with pre-set phase times and the type of operation could be determined at design stage.

As noted above, single lane approach and departures would be adequate. The intersection layout would be determined by the size of the vehicles using the intersection and their turning requirement.

No pedestrian crossing facilities would be required.

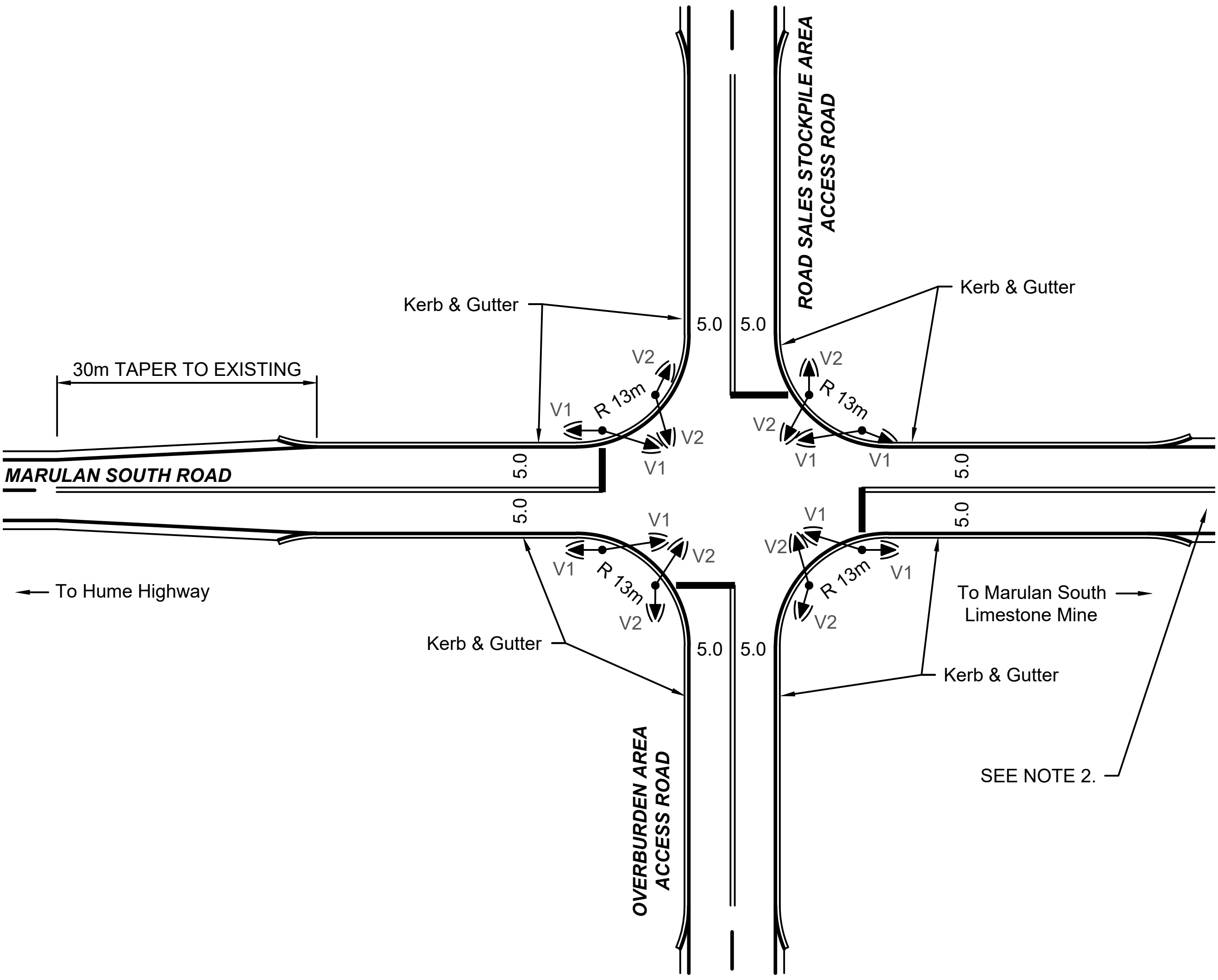
A concept layout for the intersection under traffic signal control is shown in **Figure 10**. This layout would suit the second Peppertree Quarry overburden haul route option outlined above, where the haul trucks cross Marulan South Road from the Road Sales Stockpile Area access road to the Northern Overburden Emplacement access road and vice versa. However, the intersection could also cater for the first Peppertree Quarry overburden haul route option, where the haul trucks use Marulan South Road east of the intersection and turn left into and right out of the Northern Overburden Emplacement access road.

## 5.4 Assessment of the Project's Traffic Impacts on the Road Network

### 5.4.1 Impacts on Marulan South Road and the Hume Highway

The additional traffic generated by the Project will be the 5,000 truckloads per year (10,000 return trips) associated with the 150,000 tpa of aggregate/sand from Peppertree Quarry, to be stored at the new Road Sales Stockpile Area, plus 4,086 truck loads per year (8,172 return trips) associated with the 120,000tpa of limestone products.

Currently 92% of all product transported by road from the mine occurs on weekdays with the remainder on weekends. Adopting the same proportion as this for the additional 9,086 truckloads per year of additional limestone products and the aggregate/sand product from the new Road Sales Stockpile Area, amounts to an additional 34 one way heavy vehicle trips per day (i.e. 68 two way trips per day with return trips) on an average weekday. This calculation assumes 8,360 of the loads are despatched on a weekday and 726 loads on weekends per year.



**NOTES**:

1. Kerb & gutter to be provided for 30m on all legs of intersection.

2. Marulan South Road to be widened to 9m east of intersection and existing vehicle access to Peppertree Quarry if overburden haul trucks use this section of Marulan South Road (ie Scenario 1).

3. Mast arm posts may be required for primary lanterns subject to height of trucks.

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## FIGURE 10

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATONS

**CONCEPT LAYOUT OF PROPOSED INTERSECTION OF MARULAN SOUTH RD, ROAD SALES STOCKPILE AREA ACCESS ROAD & OVERBURDEN AREA ACCESS ROAD FOR TRAFFIC SIGNALS**

JOB NO.14099 R 13/08/18

On a peak or busy day up to 58 additional one way heavy vehicle trips could be generated (i.e. 116 two way trips per day with return trip).

These trucks will travel along Marulan South Road to the Hume Highway, where some 53% will travel to/from the north and 47% to/from the south.

While Boral seeks approval to continue to transport product from the mine and Road Sales Stockpile Area, by road over a 24 hour period, for the purpose of this assessment and to take into account the worst case operating scenario, it is assumed that the transport of the additional products will occur over a 12 hour period generally between 6.00am and 6.00pm.

The additional hourly heavy vehicle volumes associated with the Project using the road network are calculated to be:

- 2-3 one way heavy vehicle trips per hour (4-6 two way trips) in an average hour on an average day; and
- 5 one way heavy vehicle trips per hour (10 two way trips) during a busy hour on a busy day.

Tables 4.3 and 4.4 shows the weekday hourly traffic volumes using Marulan South Road, south of the Hume Highway (Table 4.3) and just west of the mine (Table 4.4) on a weekday. The existing two way hourly volumes between 6am and 6pm and on a weekday range between:

- 33-70vph south of the Hume Highway; and
- 23-65vph west of the mine.

The additional 4-6 two way heavy vehicle trips per hour during an average hour and up to 10 two way heavy vehicle trips per hour during a busy hour would have a relatively small impact on existing traffic conditions in Marulan South Road in terms of level of service and or vehicle delay. There will be no change to vehicle delay at the minor intersections along Marulan South Road due to the Project.

Similarly in the Hume Highway 2-3 heavy vehicles travelling to/from the north (4-6 two way trips) and 2-3 heavy vehicles travelling to/from the south (4-6 two way trips) during the busy hour would also have a very small impact on the traffic conditions in the Highway and traffic conditions in the Hume Highway will remain satisfactory.

Tables 5.3 and 5.4 show the increase in two way traffic volumes generated by the Project that will use Marulan South Road to travel towards the Hume Highway on an average weekday and during an average and busy hour.

The volumes shown in Table 5.3 and 5.4 do not include existing and proposed internal vehicle trips between the Limestone Mine and Peppertree Quarry.

## TABLE 5.3

## COMPARISON OF TWO WAY TRIPS ON AN AVERAGE WEEKDAY GENERATED BY MARULAN SOUTH LIMESTONE MINE USING MARULAN SOUTH ROAD WITH AND WITHOUT THE PROJECT

| Two Way Traffic Volumes[1] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Existing** | | | **Increase with the Project** | | **Total Volumes with the Project** | | |
| | **Light Vehicles** | **Heavy Vehicles (Austroad Class 3-12)** | **Total** | **Light Vehicles** | **Heavy Vehicles (Austroads Class 3-12)** | **Light Vehicles** | **Heavy Vehicles Austroad Class 3-12)** | **Total** |
| **Marulan South Limestone Mine** | 278 | 150 | 428 | - | +68 | 278 | 218 | 496 |
| **Peppertree Quarry** | 70 | 40 | 110 | - | - | 70 | 40 | 110 |
| **Combined Total** | **348** | **190** | **538** | **-** | **+68** | **348** | **258** | **606** |

*1Vehicle trips to and from the mine and Peppertree Quarry travelling to and from the Aglime Fertiliser Facility and the Hume Highway*

## TABLE 5.4

## COMPARISON OF TWO WAY HOURLY HEAVY VEHICLE VOLUMES ON A WEEKDAY GENERATED BY MARULAN SOUTH LIMESTONE MINE USING MARULAN SOUTH ROAD WITH THE PROJECT

| **Two Way Volumes[1]** | | |
|---|---|---|
| **Average Hour** | | |
| Existing Heavy Vehicle Trips | Increase in Average Hour | Total Heavy Vehicle Volumes |
| 8-10 | +4-6 | 12-16 |
| | | |
| **Busy Hour** | | |
| Existing Heavy Vehicle Trips | Increase in Busy Hour | Total Heavy Vehicle Volumes |
| 8-10 | +10 | 18-20 |

*1Vehicle trips to and from the mine and Peppertree Quarry travelling to and from the Aglime Fertiliser Facility and the Hume Highway*

### 5.4.2 Cumulative Impact on the Hume Highway Interchange Intersections

Short Term Impact including Approved Other Projects

To examine the impacts of the Project's increased traffic volumes on the intersections at the Hume Highway Interchange, traffic modelling has been undertaken using the SIDRA software package.

The modelling has been undertaken for peak hour periods in the AM and PM hour periods, adopting the existing traffic volumes using the interchange intersections, together with the additional heavy vehicles generated by the Project, in an hour.

To ensure that the cumulative impacts are assessed, the existing volumes or base case for the AM and PM peak hours also includes the maximum hourly truck volumes of the recently approved expansion of Gunlake Quarry to produce and transport 2 million tonnes of product per year. This expansion could generate 29 trucks per hour returning to the Quarry that will U turn at the interchange with arrivals from the north and departures to the north.

For the Project, a busy hour of 5 additional one way heavy vehicle trips (10 two way trips) has been adopted in the traffic modelling. **Figure 11** shows the number of heavy vehicle trips generated by the Project on the local road network during a busy hour.

SIDRA assesses the operational performance of intersections under traffic signal, roundabout or sign control. The best criteria for assessing intersections controlled by roundabout or sign control are Level of Service (LS), Degree of Saturation (DS) and Average Vehicle Delay (AVD). Table 5.5 shows the Level of Service Criteria for intersections as presented in the RMS (formerly RTA) Guide to Traffic Generating Developments.

For intersections controlled by roundabouts and Give Way/Stop signs, the Level of Service of the intersection is determined by the movement with the highest average vehicle delay and not the average vehicle delay for all vehicles using the intersection.

RMS Guidelines indicate that a Level of Service D operation, or better (i.e. A, B, C or D) is the desirable design criteria for intersections.

**TABLE 5.5**

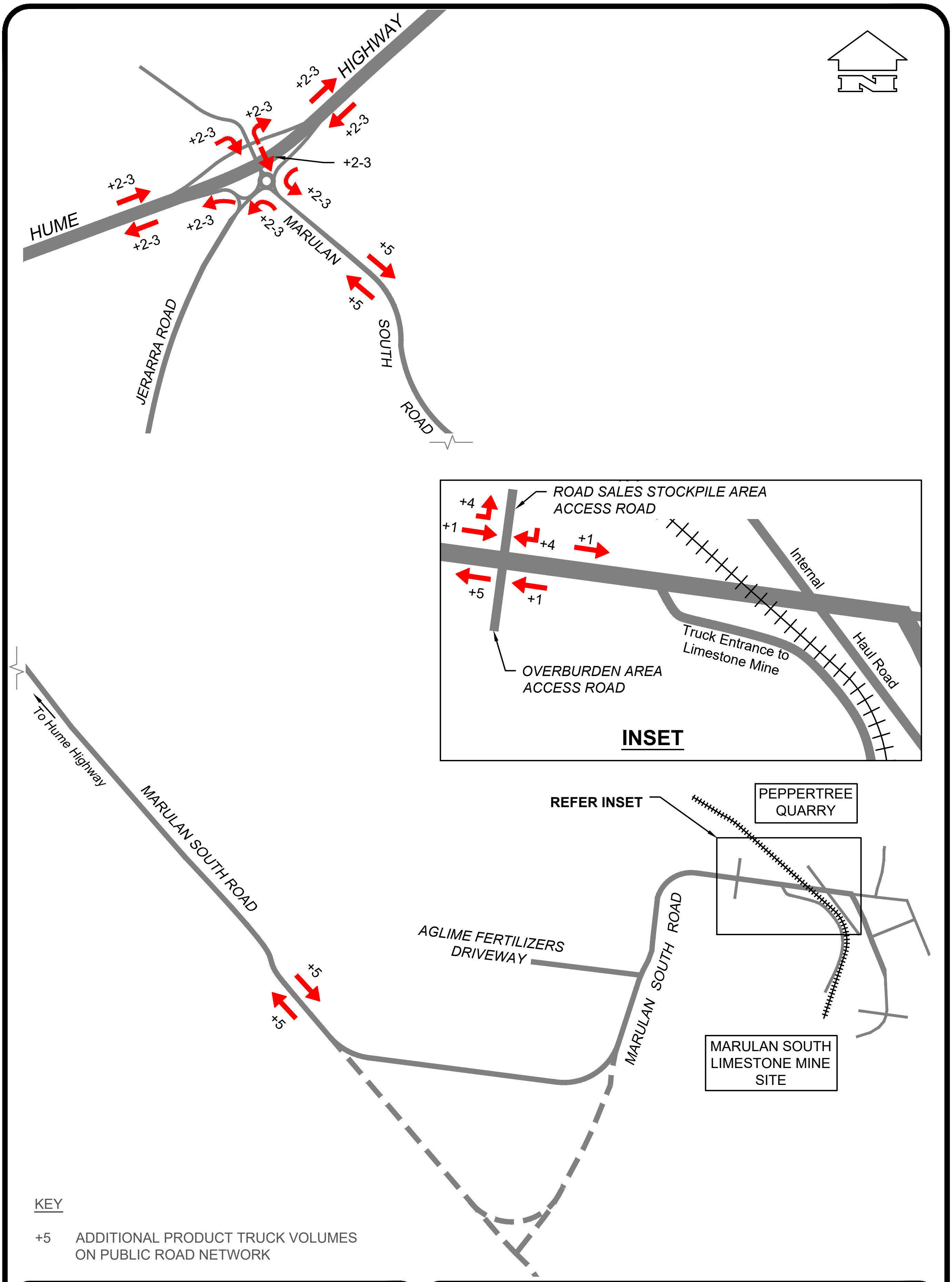
**LEVEL OF SERVICE CRITERIA FOR INTERSECTIONS**

| Level of Service | Average Delay per Vehicle (secs/veh) | Traffic Signals, Roundabout | Give Way & Stop Signs |
|---|---|---|---|
| A | <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 will cause excessive delays. Roundabouts require other control mode | At capacity, requires other control mode |
| F | >70 | Intersection is oversaturated | Oversaturated, requires other control mode |

*Source: Table 4.1 RTA Guide to Traffic Generating Developments October 2002*

Tables 5.6 and 5.7 show the traffic modelling results for the Hume Highway Interchange intersections, during the AM and PM peak hour periods.

The traffic modelling shows that the interchange intersections will continue to operate with a very good operation in terms of capacity with a Level of Service A operation and low vehicle delays during a busy hour, with the Project in place.



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**MANAGEMENT CONSULTANTS**
**5/90 Toronto Parade, Sutherland NSW 2232**
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# FIGURE 11

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS

## ADDITIONAL PRODUCT TRUCK VOLUMES ON ROAD NETWORK DURING A BUSY HOUR

JOB NO.14099 R 13/08/18

## TABLE 5.6

## SIDRA RESULTS FOR HUME HIGHWAY WESTBOUND RAMPS/MARULAN SOUTH ROAD/JERRARA ROAD INTERSECTION FOR THE CUMULATIVE EXISTING CONDITIONS AND WITH THE PROJECT DURING A BUSY HOUR IN THE AM AND PM PEAK HOURS.

**AM PEAK HOUR**

| Movement | Existing | | | | With Project | | | |
|---|---|---|---|---|---|---|---|---|
| | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** |
| **South: Marulan South Road** | | | | | | | | |
| Left | 0.010 | 4.1 | A | 0.3 | 0.021 | 4.6 | A | 0.9 |
| Through | 0.010 | 4.5 | A | 0.3 | 0.021 | 4.8 | A | 0.9 |
| **East: Westbound Off Ramp** | | | | | | | | |
| Left | 0.082 | 4.2 | A | 2.3 | 0.115 | 4.2 | A | 4.1 |
| Through | 0.082 | 4.2 | A | 2.3 | 0.115 | 4.2 | A | 4.1 |
| Right | 0.082 | 8.9 | A | 2.3 | 0.115 | 9.1 | A | 4.1 |
| **North: Marulan South Road** | | | | | | | | |
| Through | 0.034 | 4.1 | A | 0.8 | 0.036 | 4.1 | A | 0.9 |
| Right | 0.034 | 8.7 | A | 0.8 | 0.036 | 8.7 | A | 0.9 |
| **West: Jerrara Road** | | | | | | | | |
| Left | 0.007 | 4.1 | A | 0.2 | 0.007 | 4.2 | A | 0.2 |
| Right | 0.007 | 8.9 | A | 0.2 | 0.007 | 8.9 | A | 0.2 |
| **All Vehicles** | **0.082** | **6.0** | **A** | **2.3** | **0.115** | **6.3** | **A** | **4.1** |

**PM PEAK HOUR**

| Movement | Existing | | | | With Project | | | |
|---|---|---|---|---|---|---|---|---|
| | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** |
| **South: Marulan South Road** | | | | | | | | |
| Left | 0.025 | 4.1 | A | 0.6 | 0.035 | 4.4 | A | 1.0 |
| Through | 0.025 | 4.3 | A | 0.6 | 0.035 | 4.5 | A | 1.0 |
| **East: Westbound Off Ramp** | | | | | | | | |
| Left | 0.036 | 4.3 | A | 1.2 | 0.071 | 4.4 | A | 3.2 |
| Through | 0.036 | 4.2 | A | 1.2 | 0.071 | 4.2 | A | 3.2 |
| Right | 0.036 | 9.4 | A | 1.2 | 0.071 | 9.5 | A | 3.2 |
| **North: Marulan South Road** | | | | | | | | |
| Through | 0.031 | 4.3 | A | 0.7 | 0.034 | 4.4 | A | 0.9 |
| Right | 0.031 | 8.7 | A | 0.7 | 0.034 | 8.7 | A | 0.9 |
| **West: Jerrara Road** | | | | | | | | |
| Left | 0.014 | 4.1 | A | 0.3 | 0.014 | 4.2 | A | 0.3 |
| Right | 0.014 | 8.8 | A | 0.3 | 0.014 | 8.8 | A | 0.3 |
| **All Vehicles** | **0.036** | **6.0** | **A** | **1.2** | **0.039** | **6.5** | **A** | **3.2** |

| | | |
|---|---|---|
| *Where:* | *DS* | *Degree of Saturation* |
| | *AVD* | *Average Vehicle Delay in seconds* |
| | *LS* | *Level of Service* |
| | *95%tile Queue Length* | *95%tile Back of Queue Length in metres* |

## TABLE 5.7

## SIDRA RESULTS FOR HUME HIGHWAY EASTBOUND RAMPS / MARULAN SOUTH ROAD INTERSECTION FOR THE CUMULATIVE EXISTING CONDITIONS AND WITH THE PROJECT DURING A BUSY HOUR IN THE AM AND PM PEAK HOURS.

**AM PEAK HOUR**

| Movement | Existing | | | | With Project | | | |
|---|---|---|---|---|---|---|---|---|
| | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** |
| **South: Marulan South Road** | | | | | | | | |
| Through | 0.052 | 0 | A | 2.1 | 0.088 | 0 | A | 5.8 |
| Right | 0.052 | 6.2 | A | 2.1 | 0.088 | 6.4 | A | 5.8 |
| **North: Marulan South Road** | | | | | | | | |
| Left | 0.001 | 5.5 | A | 0 | 0.001 | 5.5 | A | 0 |
| Through | 0.001 | 0 | A | 0 | 0.001 | 0.0 | A | 0 |
| **West: East Off Ramp** | | | | | | | | |
| Left | 0.072 | 5.8 | A | 2.2 | 0.080 | 5.8 | A | 2.5 |
| Through | 0.072 | 4.9 | A | 2.2 | 0.080 | 5.1 | A | 2.5 |
| Right | 0.072 | 6.1 | A | 2.2 | 0.080 | 6.4 | A | 2.5 |
| **All Vehicles** | **0.072** | **3.9** | **A** | **2.2** | **0.080** | **4.4** | **A** | **5.8** |

**PM PEAK HOUR**

| Movement | Existing | | | | With Project | | | |
|---|---|---|---|---|---|---|---|---|
| | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** | **DS** | **AVD (secs)** | **LS** | **95% Queue Length (m)** |
| **South: Marulan South Road** | | | | | | | | |
| Through | 0.032 | 0.2 | A | 1.6 | 0.063 | 0.4 | A | 4.2 |
| Right | 0.032 | 6.1 | A | 1.6 | 0.063 | 6.5 | A | 4.2 |
| **North: Marulan South Road** | | | | | | | | |
| Left | 0.025 | 5.5 | A | 0 | 0.025 | 5.5 | A | 0 |
| Through | 0.025 | 0 | A | 0 | 0.025 | 0 | A | 0 |
| **West: East Off Ramp** | | | | | | | | |
| Left | 0.028 | 5.6 | A | 0.9 | 0.034 | 5.6 | A | 1.1 |
| Through | 0.028 | 4.9 | A | 0.9 | 0.034 | 5.1 | A | 1.1 |
| Right | 0.028 | 6.0 | A | 0.9 | 0.034 | 6.4 | A | 1.1 |
| **All Vehicles** | **0.032** | **4.3** | **A** | **1.6** | **0.036** | **4.9** | **A** | **4.2** |

| | | |
|---|---|---|
| *Where:* | *DS* | *Degree of Saturation* |
| | *AVD* | *Average Vehicle Delay in seconds* |
| | *LS* | *Level of Service* |
| | *95%tile Queue Length* | *95%tile Back of Queue Length in metres* |

### Future 2025 Operation and Impact

As noted above, Gunlake Pty Ltd received approval to produce and transport 2 million tpa of saleable product from their quarry.

The Transport Assessment (Appendix J) of the Gunlake Quarry Extension Project EIS prepared by EMM Consulting modelled the future 2025 operation of the Hume Highway intersections using the projected 2025 AM and PM peak hour volumes with the additional traffic from the now approved Gunlake proposal. The EMM modelling concluded that the

Hume Highway Interchange intersections would continue to operate at a good level of service equivalent to a level of service A operation in both future peaks.

Transport and Urban Planning Pty Ltd has adopted future 2025 traffic volume projections for the AM and PM peak hours as contained in the EMM Transport Assessment and modelled the Hume Highway interchange intersections with the additional vehicles from Boral's Marulan SSD Project.

The Transport and Urban Planning Pty Ltd modelling confirms that the interchange intersections would continue to operate at a level of service A operation, which represents a good operation in terms of capacity and low vehicle delays, in 2025 with the additional heavy vehicles from the Project, as well as from the Gunlake approval.

Tables 5.8 and 5.9 show the modelling results for 2025 with the Project and Gunlake.

## TABLE 5.8

## SIDRA RESULTS FOR HUME HIGHWAY WESTBOUND RAMPS/MARULAN SOUTH ROAD/JERRARA ROAD INTERSECTION FOR THE CUMULATIVE 2025 CONDITIONS AND WITH THE PROJECT DURING A BUSY HOUR IN THE AM AND PM PEAK HOURS.

**AM PEAK HOUR**

| Movement | Cumulative 2025 with Project | | | |
|---|---|---|---|---|
| | DS | AVD (secs) | LS | 95% Queue Length (m) |
| **South: Marulan South Road** | | | | |
| Left | 0.042 | 4.6 | A | 1.5 |
| Through | 0.042 | 4.5 | A | 1.5 |
| **East: Westbound Off Ramp** | | | | |
| Left | 0.086 | 4.3 | A | 4.0 |
| Through | 0.086 | 4.1 | A | 4.0 |
| Right | 0.086 | 9.1 | A | 4.0 |
| **North: Marulan South Road** | | | | |
| Through | 0.020 | 4.3 | A | 0.8 |
| Right | 0.020 | 9.2 | A | 0.8 |
| **West: Jerrara Road** | | | | |
| Left | 0.018 | 4.2 | A | 0.4 |
| Right | 0.018 | 8.9 | A | 0.4 |
| **All Vehicles** | **0.086** | **5.9** | **A** | **4.0** |

**PM PEAK HOUR**

| Movement | Cumulative 2025 with Project | | | |
|---|---|---|---|---|
| | DS | AVD (secs) | LS | 95% Queue Length (m) |
| **South: Marulan South Road** | | | | |
| Left | 0.042 | 4.4 | A | 1.2 |
| Through | 0.042 | 4.5 | A | 1.2 |
| **East: Westbound Off Ramp** | | | | |
| Left | 0.094 | 4.6 | A | 4.4 |
| Through | 0.094 | 4.2 | A | 4.4 |
| Right | 0.094 | 9.5 | A | 4.4 |
| **North: Marulan South Road** | | | | |
| Through | 0.045 | 4.4 | A | 1.2 |
| Right | 0.045 | 8.7 | A | 1.2 |
| **West: Jerrara Road** | | | | |
| Left | 0.018 | 4.2 | A | 0.4 |
| Right | 0.018 | 8.9 | A | 0.4 |
| **All Vehicles** | **0.094** | **6.7** | **A** | **4.4** |

| *Where:* | | |
|---|---|---|
| | *DS* | *Degree of Saturation* |
| | *AVD* | *Average Vehicle Delay in seconds* |
| | *LS* | *Level of Service* |
| | *95%tile Queue Length* | *95%tile Back of Queue Length in metres* |

## TABLE 5.9

## SIDRA RESULTS FOR HUME HIGHWAY EASTBOUND RAMPS / MARULAN SOUTH ROAD INTERSECTION FOR THE CUMULATIVE 2025 CONDITIONS AND WITH THE PROJECT DURING A BUSY HOUR IN THE AM AND PM PEAK HOURS.

**AM PEAK HOUR**

| Movement | Cumulative 2025 with Project | | | |
|---|---|---|---|---|
| | DS | AVD (secs) | LS | 95% Queue Length (m) |
| **South: Marulan South Road** | | | | |
| Through | 0.083 | 0 | A | 5.4 |
| Right | 0.083 | 6.2 | A | 5.4 |
| **North: Marulan South Road** | | | | |
| Left | 0.011 | 6.0 | A | 0 |
| Through | 0.011 | 0 | A | 0 |
| **West: East Off Ramp** | | | | |
| Left | 0.034 | 5.7 | A | 1.5 |
| Through | 0.034 | 5.2 | A | 1.5 |
| Right | 0.034 | 7.0 | A | 1.5 |
| **All Vehicles** | **0.083** | **5.2** | **A** | **5.4** |

**PM PEAK HOUR**

| Movement | Cumulative 2025 with Project | | | |
|---|---|---|---|---|
| | DS | AVD (secs) | LS | 95% Queue Length (m) |
| **South: Marulan South Road** | | | | |
| Through | 0.069 | 0.5 | A | 4.4 |
| Right | 0.069 | 6.6 | A | 4.4 |
| **North: Marulan South Road** | | | | |
| Left | 0.038 | 5.7 | A | 0 |
| Through | 0.038 | 0 | A | 0 |
| **West: East Off Ramp** | | | | |
| Left | 0.045 | 5.6 | A | 1.6 |
| Through | 0.045 | 5.3 | A | 1.6 |
| Right | 0.045 | 6.6 | A | 1.6 |
| **All Vehicles** | **0.069** | **4.7** | **A** | **4.4** |

*Where:*

| | | |
|---|---|---|
| *Where:* | *DS* | *Degree of Saturation* |
| | *AVD* | *Average Vehicle Delay in seconds* |
| | *LS* | *Level of Service* |
| | *95%tile Queue Length* | *95%tile Back of Queue Length in metres* |

### 5.4.3 Proposed Marulan South/Road Sales Stockpile Area Access Road/Northern Overburden Emplacement Access Road Intersection

The traffic volumes using this intersection will consist of:

(i) The existing traffic generated by the mine and Peppertree Quarry travelling between the sites and the Hume Highway;

(ii) Boral's internal heavy vehicle movements generated by the hauling of overburden from Peppertree Quarry to the mine's proposed Northern Overburden Emplacement and also the delivering of aggregate/sand from the mine to the Road Sales Stockpile Area; and

(iii) The heavy vehicles that will transport the aggregate/sand products from the mine and the Road Sales Stockpile Area to customers.

As previously noted, up to 4 one way heavy vehicle trips per hour (8 two way trips) could be generated by the Road Sales Stockpile Area in the busy hour along Marulan South Road.

Peppertree Quarry's development approval allows for overburden hauling and emplacement 7 days a week and 12 hours per day between 7am to 7pm. Adopting this and the traffic generation for the proposal for a busy hour on a busy day as outlined in Section 5.4.1, the maximum hourly truck movements associated with these internal heavy vehicle trips would be:

- 2 trucks per hour delivering aggregate/sand from the Limestone Mine to the Road Sales Stockpile Area plus the return trips;
- 28 trucks per hour hauling overburden from Peppertree Quarry to the proposed Northern Overburden Emplacement, plus the return trip.

In addition to this, one (1) additional truck per hour, plus the return trip would be generated by the mine.

**Figure 12** shows the additional internal traffic generated by the above truck movements for the following two overburden hauling scenarios:

1. The overburden trucks travelling along Marulan South Road to and from Peppertree Quarry to the east;
2. The overburden trucks travelling along internal Peppertree Quarry haul roads, crossing Marulan South Road using the Road Sales Stockpile Area access road and Northern Overburden Emplacement access road and vice versa.

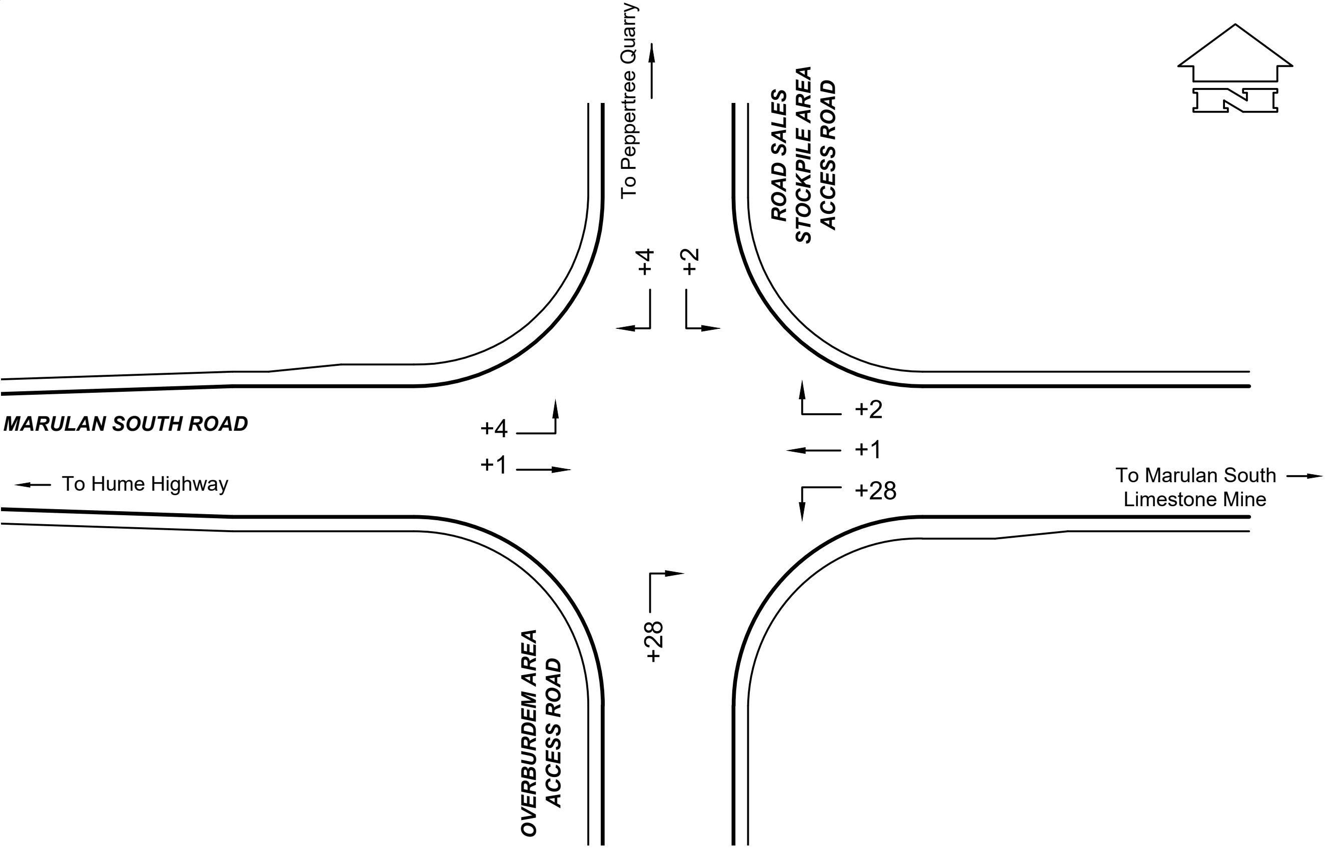
**Figure 13** shows the additional traffic generated by the Project for the above operating scenarios combined with the existing maximum peak hour traffic that occurs in Marulan South Road in the weekday AM and PM periods.

Austroads Guide to Road Design – Part 4A Un-signalised and Signalised intersections provides guidance on the warrants for turn treatments on a major road at un-signalised intersections. Figure 4.9 of the above document (included in Appendix 1) shows that an auxiliary lane for right or left turn movements is only required for an intersection where the design speed is less than 100km/h and the major road through volume either in the same direction or the opposing direction is equal to or greater than 250vph.

The overall approach volumes using Marulan South Road in each direction are significantly less than this threshold of 250vph and therefore the provision of auxiliary lanes in Marulan South Road to cater for turning movements at the proposed intersection is not warranted.

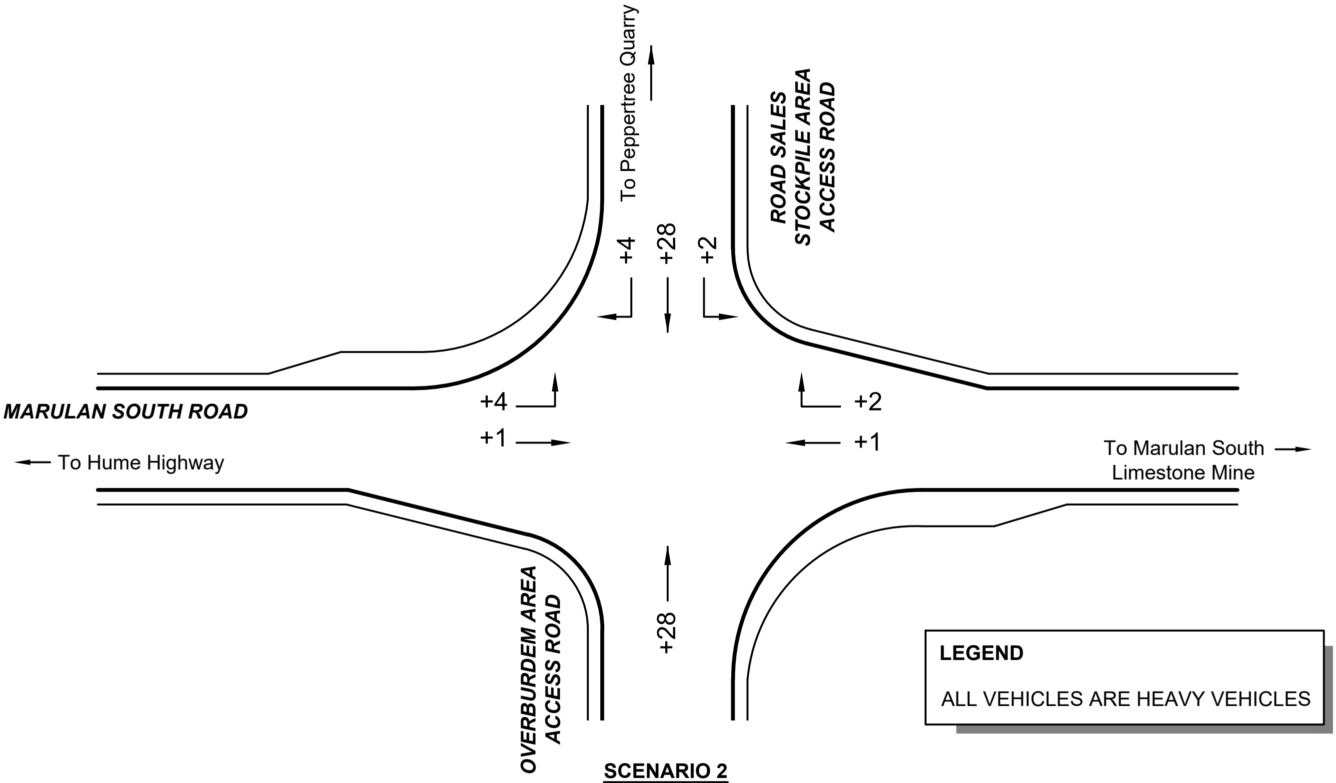
To examine the likely delays at the proposed intersection, SIDRA traffic modelling has been undertaken using the traffic volumes shown in **Figure 13.**

The modelling has assumed single lane approaches for each leg of the intersection based on a wider lane width to cater for the oversize vehicles. Stop sign control has been provided on the Northern Overburden Emplacement access road and Road Sales



**SCENARIO 1**

MARULAN SOUTH ROAD WIDENED TO 9m
FROM INTERSECTION TO PEPPERTREE QUARRY ACCESS ROAD



**LEGEND**

ALL VEHICLES ARE HEAVY VEHICLES

**SCENARIO 2**

MARULAN SOUTH ROAD TO REMAIN 7m WIDE

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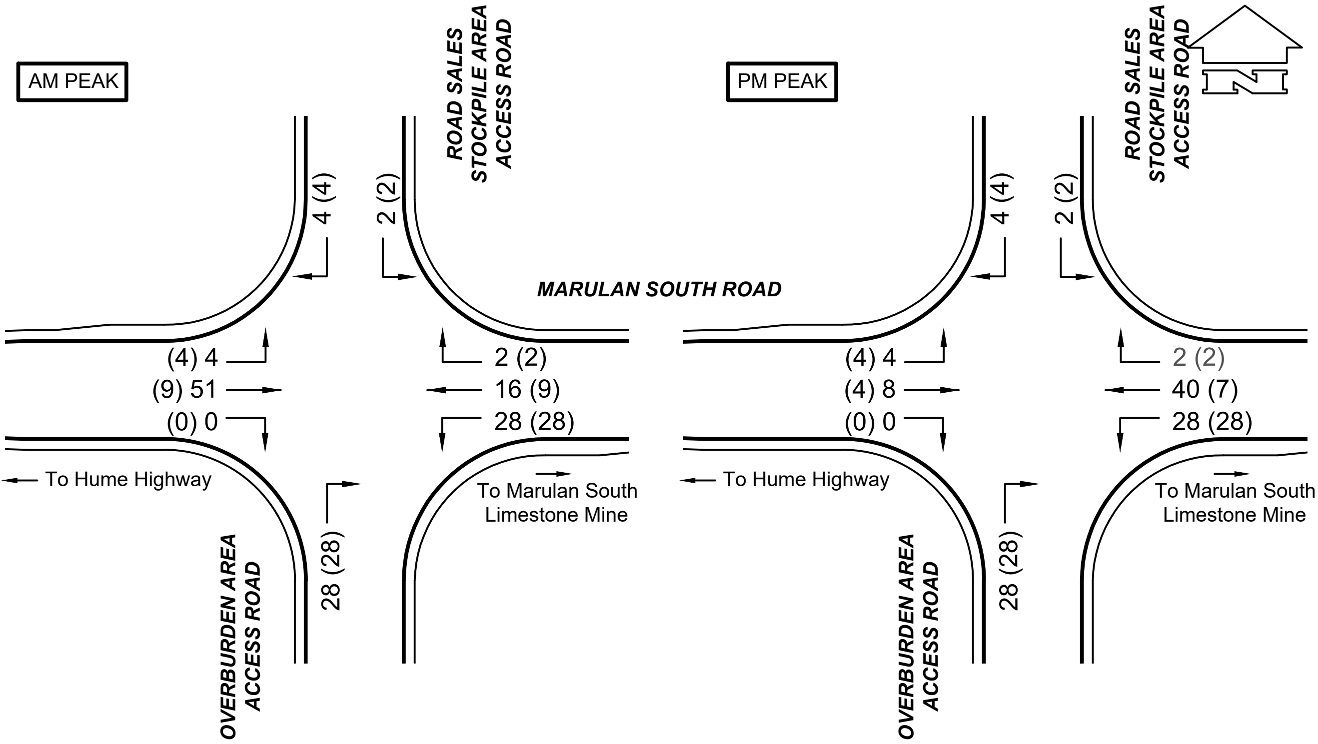
# FIGURE 12

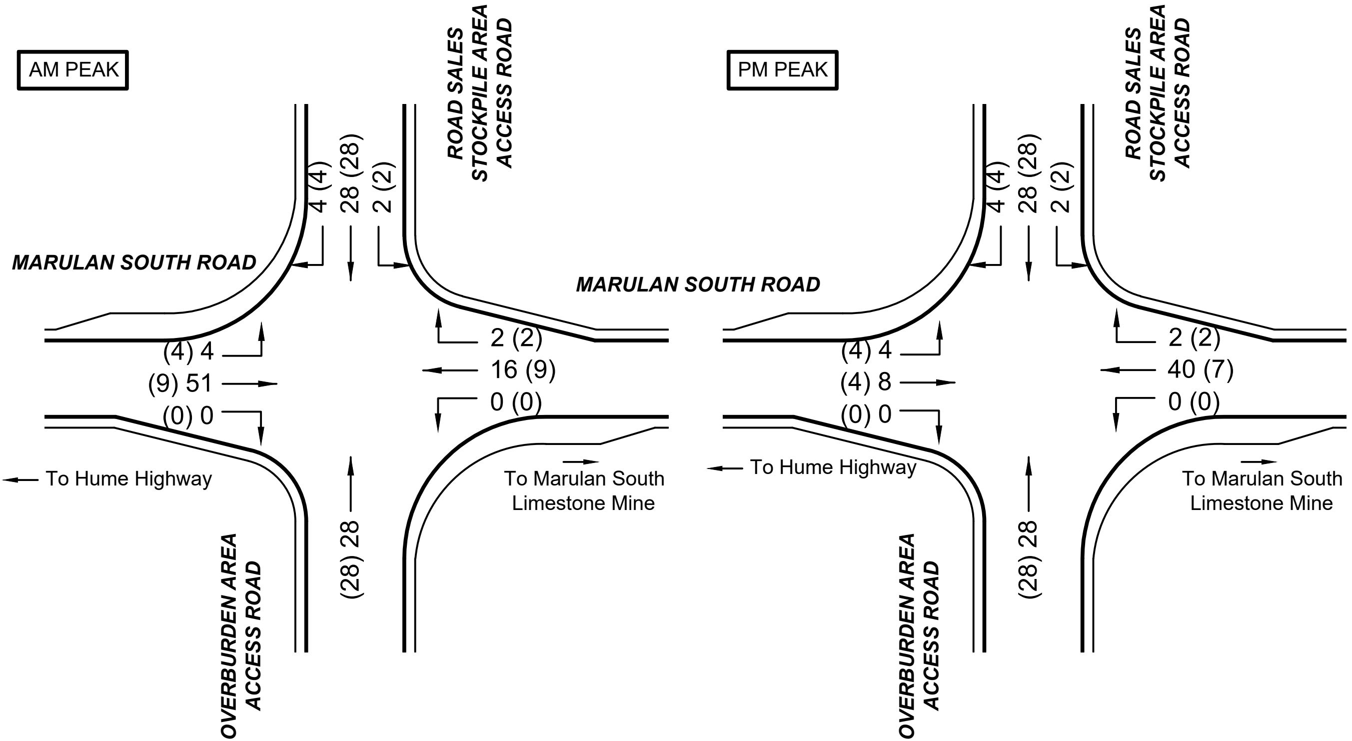
MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATONS

**ADDITIONAL HOURLY TRUCK MOVEMENTS**
**AT INTERSECTION OF MARULAN SOUTH RD, ROAD SALES STOCKPILE AREA ACCESS RD & OVERBURDEN AREA ACCESS RD**

JOB NO.14099 R 13/08/18



**SCENARIO 1**
MARULAN SOUTH ROAD WIDENED TO 9m
FROM INTERSECTION TO PEPPERTREE QUARRY ACCESS ROAD



**SCENARIO 2**
MARULAN SOUTH ROAD TO REMAIN 7m WIDE

**LEGEND**

| | |
|---|---|
| 4 | TOTAL VEHICLES |
| (4) | HEAVY VEHICLES |

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# FIGURE 13

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATONS

**FUTURE PEAK HOUR TRAFFIC VOLUMES**
**AT INTERSECTION OF MARULAN SOUTH RD, ROAD SALES STOCKPILE AREA ACCESS ROAD & OVERBURDEN AREA ACCESS ROAD**

JOB NO.14099 R 13/08/18

Stockpile Area access road and increased (larger) gap acceptance times due to the proportion of heavy vehicles using the intersection.

The results of the modelling are shown in Table 5.10 and show that the intersection would have a good operation in both peak hours for both scenarios.

For Scenario 1, with the overburden trucks travelling to and from the east along Marulan South Road, the intersection would operate at a Level of Service A with low delays to all movements. Vehicle delays for the minor access roads controlled by the Stop sign were around 12 seconds or less per vehicle indicating relatively low delays.

For Scenario 2, with the overburden trucks crossing over Marulan South Road and using both the Road Sales Stockpile Area and Northern Overburden Emplacement Area access roads, the intersection will also operate at a Level of Service A (good operation) with low vehicle delays for all movements at the intersection. Vehicle delays for minor access roads controlled by the Stop signs would be around 12-13 seconds per vehicle.

**TABLE 5.10**

**SIDRA MODELLING RESULTS FOR INTERSECTION OF MARULAN SOUTH ROAD/ROAD SALES STOCKPILE AREA ACCESS ROAD/ NORTHERN OVERBURDEN EMPLACEMENT ACCESS ROAD IN AM AND PM PEAK HOURS WITH STOP SIGN CONTROL**

| | Scenario 1 | | Scenario 2 | |
|---|---|---|---|---|
| | AM | PM | AM | PM |
| LS | A | A | A | A |
| HMD (sec) | 12.2 | 11.3 | 13.1 | 12.1 |
| DS | 0.097 | 0.092 | 0.107 | 0.100 |

*Where: LS – Level of Service*
*HMD – Highest Vehicle Delay in seconds for Priority Controlled Movements*
*DS – Degree of saturation*

*Scenario 1 – Overburden trucks use Marulan South Road east of intersection*
*Scenario 2 – Overburden trucks use New Haul Road*

Geometric Considerations

In terms of sight distance, the intersection will be designed to comply with Austroad requirements. Available sight distance to and from the intersection along Marulan South Road will be a minimum of 200 metres to the west (i.e. to the curve) and 250 metres to the east.

Austroad's Safe Intersection Sight Distance for a design speed of 60km/h is 113 to 121 metres depending on a 2.0 second or a 2.5 second reaction time.

Therefore the intersection will have satisfactory sight distance.

As noted previously, it is recommended that the existing 60km/h speed limit in the vicinity of the mine entrance and old Marulan South village be extended and relocated 200 metres to the west in Marulan South Road, if the intersection is constructed and operational while this section of Marulan South Road remains a public road. If purchased and closed and under Boral's control, the speed limit would be reduced to 60km/h.

### 5.4.4 Future Intersection Treatment Option of Traffic Signals for Marulan South Road at Road Sales Stockpile Area

As noted in Section 5.4.3 Boral may consider future traffic signals at the proposed Road Sales Stockpile Area intersection in the event that Marulan South Road, east of the Aglime Facility driveway, is deproclaimed/deregistered as a public road.

To examine the operation of the intersection under traffic signal control, SIDRA traffic modelling has been undertaken using the future AM and PM traffic volumes shown for Design Scenarios 1 and 2 as shown on **Figure 13**. A cycle length of 45 seconds was adopted, together with fixed phase times for each phase, due to the number of heavy vehicles.

The results of the modelling are shown in Table 5.11 and indicate that the intersection would operate at a good Level of Service (Level of Service A operation) under traffic signal control with average vehicle delays in the order of 11.6 seconds to 13.5 seconds per vehicle for both Scenario 1 and Scenario 2. The low degree of saturation (DS) for both modelled scenarios, indicates that the intersection has plenty of spare capacity.

Therefore, future traffic signal control is a suitable option for the traffic management at this intersection, if Marulan South Road becomes a private road, to the east of the Aglime Facility driveway.

**TABLE 5.11**

**SIDRA MODELLING RESULTS FOR INTERSECTION OF MARULAN SOUTH ROAD/ROAD SALES STOCKPILE AREA ACCESS ROAD/NORTHERN OVERBURDEN EMPLACEMENT ACCESS ROAD IN AM AND PM PEAK HOURS WITH TRAFFIC SIGNAL CONTROL**

| | Scenario 1 | | Scenario 2 | |
|---|---|---|---|---|
| | AM | PM | AM | PM |
| LS | A | A | A | A |
| AVD (sec) | 12.9 | 13.5 | 11.6 | 11.9 |
| DS | 0.104 | 0.125 | 0.104 | 0.104 |

*Where: LS – Level of Service*
*AVD – Average Vehicle Delay in seconds for all vehicles using intersection*
*DS – Degree of saturation*

*Scenario 1 – Overburden trucks travel along Marulan South Road east of intersection*
*Scenario 2 – Overburden trucks cross Marulan South Road at the proposed intersection*

### 5.4.5 The Impacts of the Additional Limestone Sand Transported to Peppertree Quarry

A total of 16,667 truck loads per year (33,333 truck trips with return trip) associated with transporting limestone sand between the mine and Peppertree Quarry will cross Marulan South Road using the dedicated internal haul roads. This intersection is located east of the rail line level crossing in Marulan South Road and east of the main vehicle truck entrance to the mine. Based on 12 hours of transport between 7am and 7pm, the total truck movements per hour would average 8 truck loads (i.e. 16 truck trips with return trip). The average increase over the existing truck loads per hour is 4 truck loads per hour (i.e. 8 truck trips with return trip).

Marulan South Road, at this intersection, carries relatively low traffic volumes (i.e. less than 40 two way vph) as the intersection is approximately 175 metres east of the main vehicle truck entrance to the mine.

As the site distance in Marulan South Road at the internal haul road intersection is good and traffic volumes that will use the intersection are low, vehicle delays at the intersection will also be low. The traffic conditions at this intersection will remain satisfactory and similar to existing conditions at the intersection, with the additional trucks.

### 5.4.6 Summary

In summary, the Project will have very minor impacts and these will not adversely affect the Level of Service and or vehicle delay at existing intersections on the road network or at the intersection proposed for use by Boral's Marulan South operations for hauling of overburden and transport of finished products.

## 5.5 Construction Impacts

There will be additional traffic impacts associated with the construction of the road improvements including:

(i) Proposed realignment of Marulan South Road, to the north of the proposed Western Overburden Emplacement Area;

(ii) The upgrading (widening) of the narrower sections of Marulan South Road, between the mine and the Hume Highway interchange to Council's DCP standard; and

(iii) The construction of the new intersection on Marulan South Road at the Road Sales Stockpile Area.

Other construction activities associated with the proposed continuation of operations at the mine include:

(iv) Realignment of a section of the high voltage powerline that currently traverses the proposed location of the Northern Overburden Emplacement;
(v) Construction of the Marulan Creek Dam; and
(vi) Relocation and reconfiguration of the stockpile reclaim area.

Although the majority of these construction activities will involve heavy vehicle movements within the mine site and will use construction materials produced at the mine or Peppertree Quarry, some materials and equipment will need to be brought from off site and would contribute to additional heavy vehicle movements along Marulan South Road for a limited time during each construction project

Potentially up to 40 additional inbound and outbound vehicle trips (i.e. total of 80 trips) could occur on some days associated with the above works associated with either the upgrade/realignment of Marulan South Road or other on-site construction activities associated with the continuation of mining. These will consist of light vehicle trips associated with additional construction workers, as well as heavy vehicle trips associated with the delivery of materials and equipment.

Following approval of the Project, Construction Traffic Management Plans will be prepared in consultation with Goulburn Mulwaree Council to manage the impacts associated with these construction works.

## 5.6 Impact on Other Road Users and Road Safety

The Project is not expected to result in any negative impacts to other road users, including school buses. School buses use Marulan South Road in the morning and afternoon periods on school days.

Upgrades to Marulan South Road will be undertaken during the continued operations of the mine, including widening of the narrower sections to Council's DCP standard, and the realignment of a section of Marulan Road South to the north of the proposed Western Overburden Emplacement Area. These works will improve the standard of the existing road. As part of these upgrade works, provision for school bus stopping and turning will be considered. In addition, future driver training will include protocols for the interaction with school buses (refer to Section 5.11).

On the wider road network, traffic generated by the mine join and depart the Hume Highway (which is a high standard road) via the existing grade separated interchange intersection and travel north and south via the Highway. This interchange has substantial additional capacity and permits all vehicles to enter and exit the Highway safely.

The actual increase in product trucks from the Project is small in real terms (i.e. 2-3 heavy vehicles trips in each direction resulting in a total of 4-6 two way heavy vehicle trips per hour on average) and these additional trucks will have minimal impacts on levels of service and vehicle delay in Marulan South Road at the Hume Highway.

Potential traffic impacts during road works associated with the Project, will be managed in accordance with Construction Traffic Management Plans.

In concluding, the Project is expected to have negligible negative impacts on other road users and road safety on the road network.

## 5.7 Road Maintenance

Boral is currently paying a contribution to Council for road maintenance and will continue to do so with the Project in place.

It is noted in the SEARS that Council has requested a pavement condition survey be undertaken on Marulan South Road. Boral suggests that this can be a condition of consent as part of the design of the upgrade works which will be undertaken by Boral.

## 5.8 Oversize and Higher Mass Limit Vehicles

The Project, which is the continued operation of the mine will use the same type of vehicles and equipment currently used at the mine.

Any deliveries of equipment using oversize or higher mass limit vehicles will be in accordance with the National Heavy Vehicle Regulator (NHVR) requirements and permit system.

## 5.9 Marulan South Road Realignment and Upgrading of Marulan South Road

Boral will fund the design and construction of the realignment of Marulan South Road. **Figure 4** shows the location of the proposed realignment in Marulan South Road.

This section of Marulan South Road will be realigned to accommodate the northern extension of the Western Overburden Emplacement. The road will be designed for an 80km/h design speed and to Council's standards and specifications. The road will be designed and constructed with a 7.0 metre wide sealed road pavement, plus 0.5 sealed shoulders on each side as part of 1.0 metre wide shoulders. The road will be constructed on land owned by Boral and the realigned section of road including the road corridor will be transferred to Council as a public road as part of a land swap agreement between Council and Boral.

Boral have held initial discussions with Council concerning the road realignment.

The proposed realigned section can be largely constructed with minimal disruption to Marulan South Road and traffic using the road.

In addition, Boral will fund the upgrade of the narrower sections of Marulan South Road in accordance with the DCP requirements.

## 5.10 Deregistration of Portion of Marulan South Road

Boral is also proposing to deregister (deproclaim) the section of Marulan South Road between the vehicle entrance to the Aglime Facility and the Limestone Mine, including all the village roads at Marulan South.

**Figure 8** shows the section of Marulan South Road proposed to be deproclaimed.

Suitable turning and other required traffic management changes will be provided adjacent the entrance of the Aglime Facility at the end of the public road section. Boral has held initial discussions with Council concerning this matter and will continue these discussions until an agreement is reached.

## 5.11 Driver Safety Awareness and Training

Boral has a Traffic Safety Management Plan for operations at the mine site and holds safety toolbox discussions on a regular basis with employees regarding the safe use of Marulan South Road.

All Boral drivers are trained, monitored and scrutinised according to Boral Logistics training modules in line with the nationally recognised Certificate III (Transport and Distribution) qualification. These modules include driver behaviour, road rule competencies, fatigue management and chain of responsibility requirements. In addition, they are educated on Boral Logistics Safe Work Method Statements and Standard Operating Procedures pertaining to all tasks that a Boral heavy vehicle driver will have to perform in the course of their duties. Expectations and compulsory behaviours such as obeying all sign-posted rules on public roads and not driving when impaired by drugs and/or alcohol, are committed to by drivers under their employment contract, Boral's Safety Absolutes program and the various site-specific inductions that a driver will have to undergo in order to access the various sites in the course of their duties.

Drivers travelling to and from the mine will also be trained on:

- minimising traffic noise in Marulan South Road, particularly during night time periods;
- protocols for the interaction with school buses along Marulan South Road.

Subcontractor drivers, will also be required to comply with the same standards as Boral drivers through contractual obligations and will also be required to attend site-specific inductions to train subcontractor drivers on protocols for driving along Marulan South Road.

## 5.12 Assessment of Marulan South Road as a B Double Route and for Use by PBS 2B Vehicles

As part of the SEARs, Council requested the reassessment of Marulan South Road as a B Double route. In addition, Transport for NSW requested an assessment for access of higher productivity vehicle movements to the mine at a minimum PBS 2B (combinations at higher mass limits), in terms of ability to access the mine and surrounding roads, impact on road infrastructure, bridges and pavement and potential road safety risk.

The RMS restricted vehicle map for NSW which is contained on their website, shows that Marulan South Road is an approved B-double route for use by B-double vehicles up to 25-26 metres in length except during the 7.30–9.00am and 3.30–5.00pm periods on school days.

Currently a small number of B-double tankers, 22 metres and 24 metres long access the mine. These vehicles travel to Queensland and Victoria from the mine. Travel conditions along Marulan South Road between the Hume Highway and the mine, are suitable for use by these vehicles and the most recent road crash statistics indicate that road safety along the route is satisfactory.

The maximum length vehicle that can be accommodated on the existing weighbridge at the mine is 24 metres and for this reason Boral has no plans to change its current vehicle fleet which transports products to and from the mine.

As noted in earlier sections of this report, upgrades to Marulan South Road will be undertaken as part of the Project by way of:

- The realignment of the section of Marulan South Road to accommodate the proposed Western Overburden Emplacement Area;

- The upgrading of the narrower sections of Marulan Road South to Council's DCP standard with pavement strengthening, where required.

These improvement works will be designed and constructed to Council's standards and specifications to accommodate B-doubles.

## 5.13 Internal Roads and Parking

Other than the proposed new intersection in Marulan South Road at the Road Sales Stockpile Area there will be no changes to the internal roads within the mine (other than the proposed unsealed in-pit and out of pit haul routes), or to the parking areas used by employees/contractors and other visitors coming to the mine. The mine accommodates parking in a number of existing areas within the mine and no changes are proposed to the existing parking arrangements.

The existing arrangements are considered to comply with the current Australian Standards.

## 5.14 Emergency Vehicle Access

Emergency vehicle access to the Limestone Mine is via Marulan South Road which is a public road.

In the event of an emergency, Boral will provide a sentry at the gate to the mine to direct emergency services to the affected area.

## 5.15 NSW Long Term Transport Master Plan and Southern Regional Transport Plan

The NSW Long Term Transport Master Plan identifies a range of actions for the southern region to address the challenges and meet the transport planning objectives for the region.

The Southern Regional Transport Plan has developed actions around the three key themes of:

1. providing better transport services;
2. ensuring effective regulation; and
3. improving transport infrastructure over the short, medium and long term.

The Project will improve the road infrastructure in Marulan South Road and is therefore consistent with objectives and actions of these NSW transport plans.

# 6.0 CONCLUSIONS

This report documents the assessment of the road transport and traffic impacts of the continued operation of Boral's limestone mine at Marulan South, which involves the production and transportation of 4 million tpa of limestone products and 150,000tpa of Peppertree Quarry products.

The majority of the product produced by the mine is transported to market via rail and this will continue in the future with the Project.

Boral currently transports around 330,000tpa of limestone and clay shale by road from the mine via Marulan South Road to the Hume Highway where it then travels either north or south along the Hume Highway. An additional 120,000tpa is transported from the mine to the Aglime Fertiliser facility which is located approximately 1km south west of the entrance to the mine, along Marulan South Road. Boral's truck fleet, which transports limestone products, includes truck and dog combinations as well as a small number of B-doubles.

This existing road transportation will continue under the Project. Boral proposes to transport an additional 120,000tpa of limestone and clay shale as well as 150,000tpa of aggregate/sand products from the Peppertree Quarry via Marulan South Road and the Hume Highway.

The despatch of 150,000tpa of aggregate/sand product from Peppertree Quarry along with 50,000tpa of aggregate/sand from the Limestone Mine will be managed through stockpiles in the proposed Road Sales Stockpile Area. The additional 70,000tpa of limestone and clay shale will be transported directly out of the mine.

Overall, the Project seeks to transport up to 600,000tpa between the mine and the Hume Highway, along Marulan South Road, as well as the 120,000tpa of lime product to the Aglime Fertiliser facility.

Boral is also proposing to increase the amount of limestone sand transported between the mine and Peppertree Quarry by 500,000tpa to 1 million tpa. This product will be transported via dedicated internal haul road and will cross Marulan South Road, east of the rail line and level crossing and the main vehicle truck entrance to the mine. The increase represents 4 additional truck loads per hour (i.e. 8 truck trips with return trip). The impact of these additional truck movements will be minimal.

Boral is proposing to realign a section of Marulan South Road to accommodate the extension of the Western Overburden Emplacement, as well as widening the pavement of Marulan South Road in the narrower sections to meet Goulburn Mulwaree Council's DCP requirements. These upgrade works will be designed and constructed to Council's standards and specification. In addition, a new intersection and associated works in Marulan South Road adjacent the Road Sales Stockpile Area is proposed and will be constructed by Boral. The need for and design of this new intersection, will be dependent on whether Boral have completed the process of de-registration of Marulan South Road eastwards from the entrance to the Aglime Fertiliser manufacturing facility.

The Project will result in a small increase in heavy vehicle trips in the order of 2-3 heavy vehicle loads per hour (total of 4-6 two way trips) on an average day using Marulan South Road and the Hume Highway.

The assessment of the traffic impacts of the additional product truck movements on the adjoining road network and intersections has found that the impacts would be relatively minor and there will be minimal changes to the Level of Service and vehicle delays on the road network, including at all key intersections.

The Project is not expected to have any negative impacts on the other road users and or on road safety. As noted above, Boral is proposing upgrades to Marulan South Road as part of the Project. These upgrade works will take into consideration the need for and location of school bus stopping and turning.

In addition, Boral has a Traffic Safety Management Plan for operations at the mine site and holds safety toolbox discussions on a regular basis with employees regarding the safe use of Marulan South Road. *All Boral drivers are trained to the nationally recognised Certificate III (Transport and Distribution) Qualification. All drivers, including subcontractor drivers travelling to and from the mine along Marulan South Road will be trained on protocols for the interaction with school buses and minimising traffic noise, particularly during night time periods.*

The construction impacts associated with the road upgrading works and other on-site construction works associated with continued operations, will be managed through separate Construction Traffic Management Plans which will be prepared with full consultation with Goulburn Mulwaree Council, following approval of the Project.

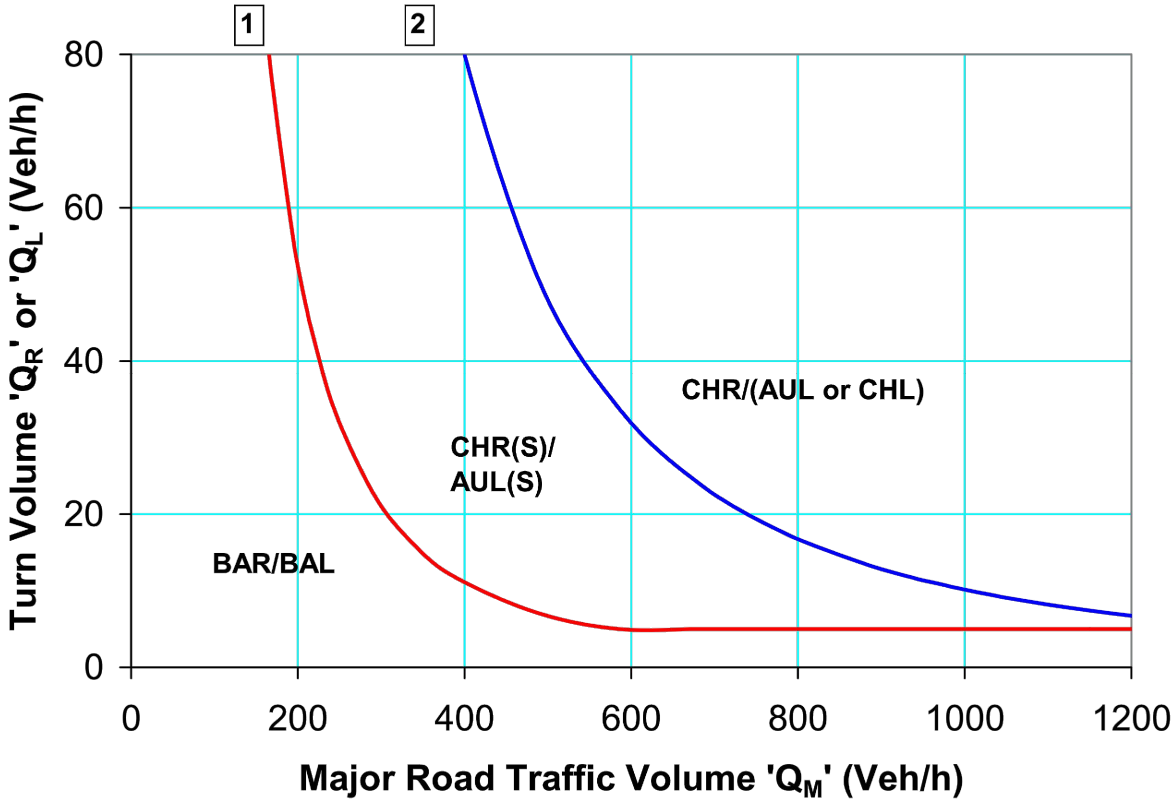
# REFERENCES

1. Austroads Guide to Road Design
2. Austroads Guide to Road Safety – Version 1 December 2010
3. Austroads Guide to Traffic Management including Part 12. Traffic Impacts of Development.
4. RTA (now RMS) Austroads Guide Supplements – Austroads Guide to Traffic Management – January 2011
5. RTA (now RMS) Supplement to Austroads Guide to Road Design Parts 1-5, 6 and 8
6. RMS Supplements to Austroads Guide to Road Safety
7. RMS Southern Region – Crash Statistics for 1 July 2011 to 30 June 2014
8. RTA (now RMS) Guide to Traffic Generating Developments October 2002
9. Goulburn Mulwaree Council Development Control Plan
10. Goulburn Mulwaree Council Section 94 Development Contributions Plan 2009 Amendment No. 2
11. NSW Long Term Transport Master Plan and Southern Regional Transport Plan

# APPENDICES

1. Austroads Warrants for Turn Treatments on the Major Road at Unsignalised Intersections

2. SIDRA Traffic Modelling Results



Design Speed < 100 km/h

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**TRAFFIC, TRANSPORT & PROJECT**
**MANAGEMENT CONSULTANTS**
**5/90 Toronto Parade, Sutherland NSW 2232**
**Phone 02 9545 1411 Fax 02 9545 1556**
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# APPENDIX 1

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATONS

## WARRANTS FOR TURN TREATMENTS ON THE MAJOR ROAD AT UNSIGNALISED INTERSECTIONS

JOB NO.14099 R 13/08/18

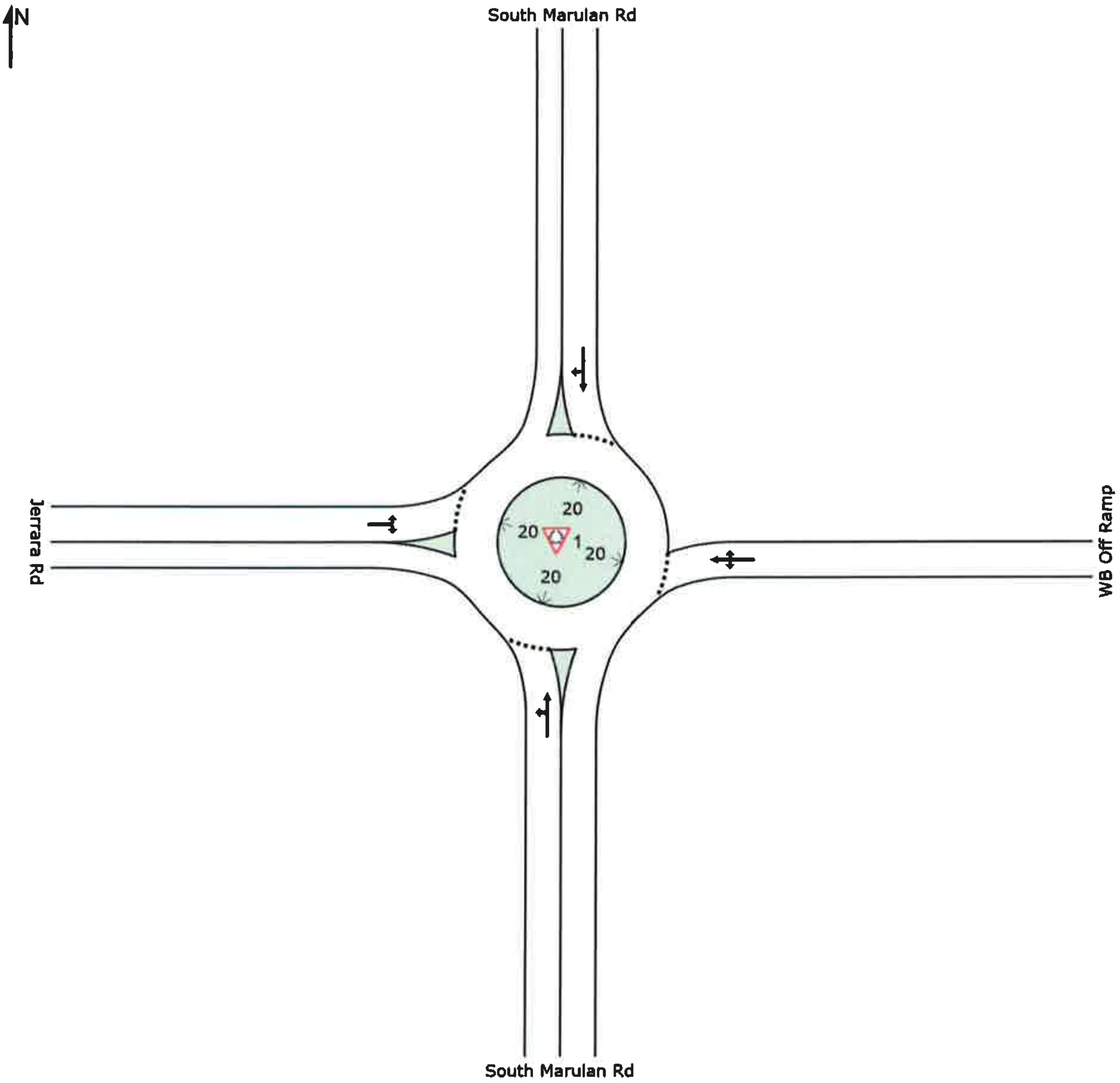
# APPENDIX 2

# SIDRA Results

# SITE LAYOUT

## ▽ Site: 1 [WB Ramps/SM Rd/J Rd- 2015 AM ]

2015 AM
Roundabout



Organisation: TRANSPORT AND URBAN PLANNING | Created: Monday, 13 August 2018 12:06:01 PM
Project: C:\Users\Terry\Documents\14099 South Marulan.sip7

# MOVEMENT SUMMARY

## Site: 1 [WB Ramps/SM Rd/J Rd- 2015 AM ]

2015 AM
Roundabout

**Movement Performance - Vehicles**

| Mov | OD | Demand Flows | | Deg. | Average | Level of | 95% Back of Queue | | Prop. | Effective | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Mov | Total | HV | Satn | Delay | Service | Vehicles | Distance | Queued | Stop Rate | Speed |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: South Marulan Rd | | | | | | | | | | | |
| 1 | L2 | 3 | 0.0 | 0.010 | 4.1 | LOS A | 0.0 | 0.3 | 0.15 | 0.42 | 54.8 |
| 2 | T1 | 7 | 43.0 | 0.010 | 4.5 | LOS A | 0.0 | 0.3 | 0.15 | 0.42 | 55.1 |
| Approach | | 11 | 30.1 | 0.010 | 4.4 | LOS A | 0.0 | 0.3 | 0.15 | 0.42 | 55.0 |
| East: WB Off Ramp | | | | | | | | | | | |
| 4 | L2 | 28 | 15.0 | 0.082 | 4.2 | LOS A | 0.3 | 2.3 | 0.12 | 0.58 | 52.3 |
| 5 | T1 | 4 | 0.0 | 0.082 | 4.2 | LOS A | 0.3 | 2.3 | 0.12 | 0.58 | 54.0 |
| 6 | R2 | 64 | 18.0 | 0.082 | 8.9 | LOS A | 0.3 | 2.3 | 0.12 | 0.58 | 53.3 |
| Approach | | 97 | 16.3 | 0.082 | 7.3 | LOS A | 0.3 | 2.3 | 0.12 | 0.58 | 53.0 |
| North: South Marulan Rd | | | | | | | | | | | |
| 8 | T1 | 54 | 4.0 | 0.034 | 4.1 | LOS A | 0.1 | 0.8 | 0.01 | 0.41 | 56.7 |
| 9 | R2 | 1 | 0.0 | 0.034 | 8.7 | LOS A | 0.1 | 0.8 | 0.01 | 0.41 | 56.7 |
| Approach | | 55 | 3.9 | 0.034 | 4.2 | LOS A | 0.1 | 0.8 | 0.01 | 0.41 | 56.7 |
| West: Jerrara Rd | | | | | | | | | | | |
| 10 | L2 | 8 | 0.0 | 0.007 | 4.1 | LOS A | 0.0 | 0.2 | 0.14 | 0.49 | 54.6 |
| 12 | R2 | 1 | 0.0 | 0.007 | 8.9 | LOS A | 0.0 | 0.2 | 0.14 | 0.49 | 55.9 |
| Approach | | 9 | 0.0 | 0.007 | 4.7 | LOS A | 0.0 | 0.2 | 0.14 | 0.49 | 54.7 |
| All Vehicles | | 172 | 12.3 | 0.082 | 6.0 | LOS A | 0.3 | 2.3 | 0.09 | 0.51 | 54.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 1 [WB Ramps/SM Rd/J Rd- 2015 PM ]

2015 PM
Roundabout

**Movement Performance - Vehicles**

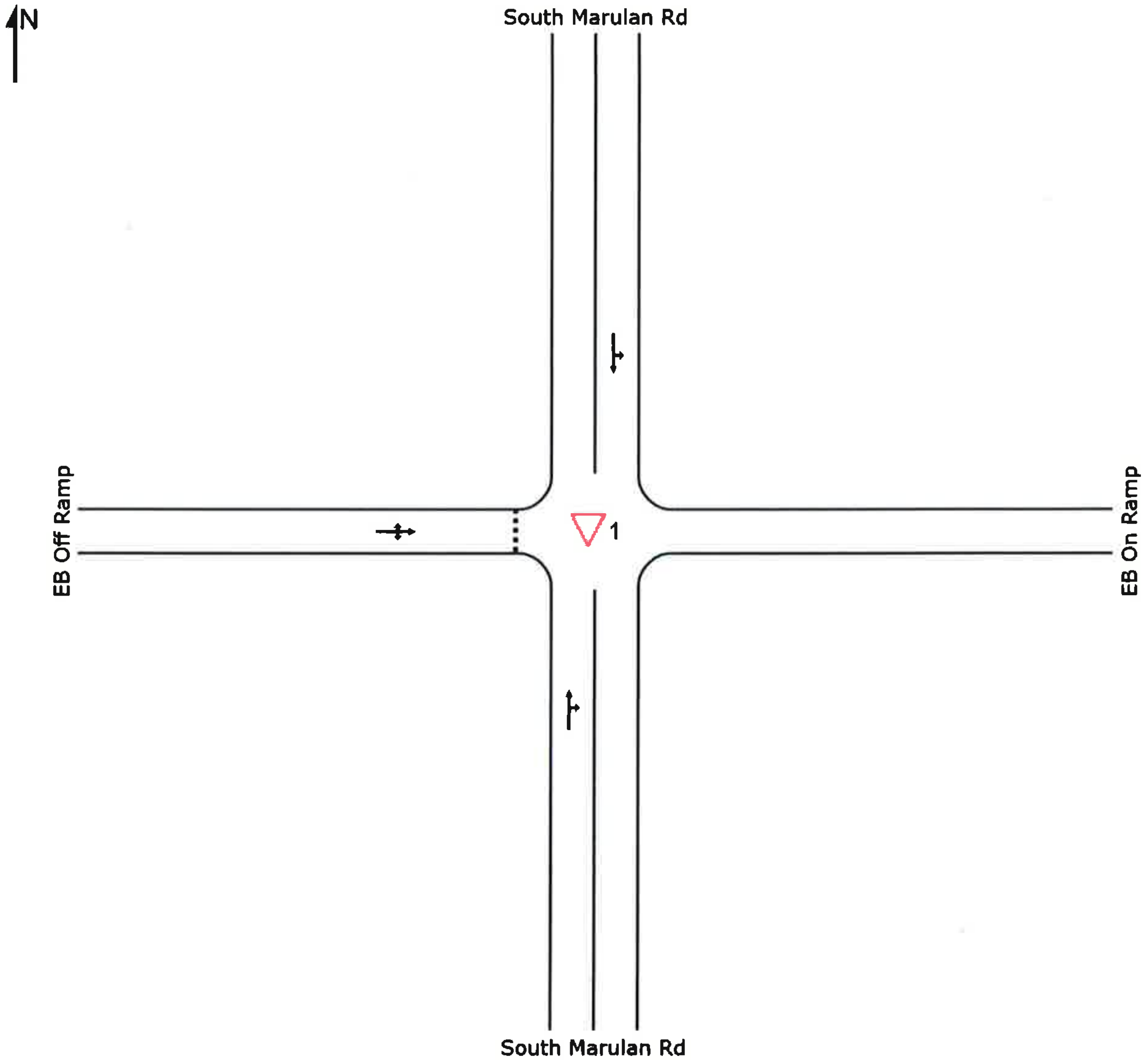
| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Deg Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: South Marulan Rd | | | | | | | | | | | |
| 1 | L2 | 14 | 0.0 | 0.025 | 4.1 | LOS A | 0.1 | 0.6 | 0.14 | 0.43 | 54.9 |
| 2 | T1 | 18 | 6.0 | 0.025 | 4.3 | LOS A | 0.1 | 0.6 | 0.14 | 0.43 | 56.1 |
| Approach | | 32 | 3.4 | 0.025 | 4.2 | LOS A | 0.1 | 0.6 | 0.14 | 0.43 | 55.6 |
| East: WB Off Ramp | | | | | | | | | | | |
| 4 | L2 | 6 | 33.0 | 0.036 | 4.3 | LOS A | 0.1 | 1.2 | 0.13 | 0.48 | 53.7 |
| 5 | T1 | 19 | 0.0 | 0.036 | 4.2 | LOS A | 0.1 | 1.2 | 0.13 | 0.48 | 56.1 |
| 6 | R2 | 11 | 90.0 | 0.036 | 9.4 | LOS A | 0.1 | 1.2 | 0.13 | 0.48 | 52.4 |
| Approach | | 36 | 32.3 | 0.036 | 5.7 | LOS A | 0.1 | 1.2 | 0.13 | 0.48 | 54.5 |
| North: South Marulan Rd | | | | | | | | | | | |
| 8 | T1 | 8 | 25.0 | 0.032 | 4.3 | LOS A | 0.1 | 0.7 | 0.01 | 0.64 | 53.1 |
| 9 | R2 | 43 | 0.0 | 0.032 | 8.7 | LOS A | 0.1 | 0.7 | 0.01 | 0.64 | 53.6 |
| Approach | | 52 | 4.1 | 0.032 | 8.0 | LOS A | 0.1 | 0.7 | 0.01 | 0.64 | 53.5 |
| West: Jerrara Rd | | | | | | | | | | | |
| 10 | L2 | 17 | 7.0 | 0.014 | 4.1 | LOS A | 0.0 | 0.3 | 0.09 | 0.48 | 54.7 |
| 12 | R2 | 1 | 0.0 | 0.014 | 8.8 | LOS A | 0.0 | 0.3 | 0.09 | 0.48 | 56.3 |
| Approach | | 18 | 6.6 | 0.014 | 4.3 | LOS A | 0.0 | 0.3 | 0.09 | 0.48 | 54.8 |
| All Vehicles | | 137 | 11.6 | 0.036 | 6.0 | LOS A | 0.1 | 1.2 | 0.08 | 0.53 | 54.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## ▽ Site: 1 [EB Ramps/S M Rd- 2015 AM ]

2015 AM
Giveway / Yield (Two-Way)



# MOVEMENT SUMMARY

## ▽ Site: 1 [EB Ramps/S M Rd- 2015 AM ]

2015 AM
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Deg Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: South Marulan Rd | | | | | | | | | | | |
| 2 | T1 | 57 | 0.0 | 0.052 | 0.0 | LOS A | 0.2 | 2.1 | 0.02 | 0.18 | 59.0 |
| 3 | R2 | 25 | 54.0 | 0.052 | 6.2 | LOS A | 0.2 | 2.1 | 0.02 | 0.18 | 54.6 |
| Approach | | 82 | 16.6 | 0.052 | 1.9 | NA | 0.2 | 2.1 | 0.02 | 0.18 | 57.6 |
| North: South Marulan Rd | | | | | | | | | | | |
| 7 | L2 | 1 | 0.0 | 0.001 | 5.5 | LOS A | 0.0 | 0.0 | 0.00 | 0.30 | 55.9 |
| 8 | T1 | 1 | 0.0 | 0.001 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.30 | 57.4 |
| Approach | | 2 | 0.0 | 0.001 | 2.8 | NA | 0.0 | 0.0 | 0.00 | 0.30 | 56.6 |
| West: EB Off Ramp | | | | | | | | | | | |
| 10 | L2 | 22 | 0.0 | 0.072 | 5.8 | LOS A | 0.3 | 2.2 | 0.19 | 0.55 | 53.1 |
| 11 | T1 | 2 | 0.0 | 0.072 | 4.9 | LOS A | 0.3 | 2.2 | 0.19 | 0.55 | 53.4 |
| 12 | R2 | 55 | 4.0 | 0.072 | 6.1 | LOS A | 0.3 | 2.2 | 0.19 | 0.55 | 52.6 |
| Approach | | 79 | 2.8 | 0.072 | 5.9 | LOS A | 0.3 | 2.2 | 0.19 | 0.55 | 52.8 |
| All Vehicles | | 163 | 9.7 | 0.072 | 3.9 | NA | 0.3 | 2.2 | 0.10 | 0.36 | 55.1 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## ▽ Site: 1 [EB Ramps/S M Rd- 2015 PM ]

2015 PM
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

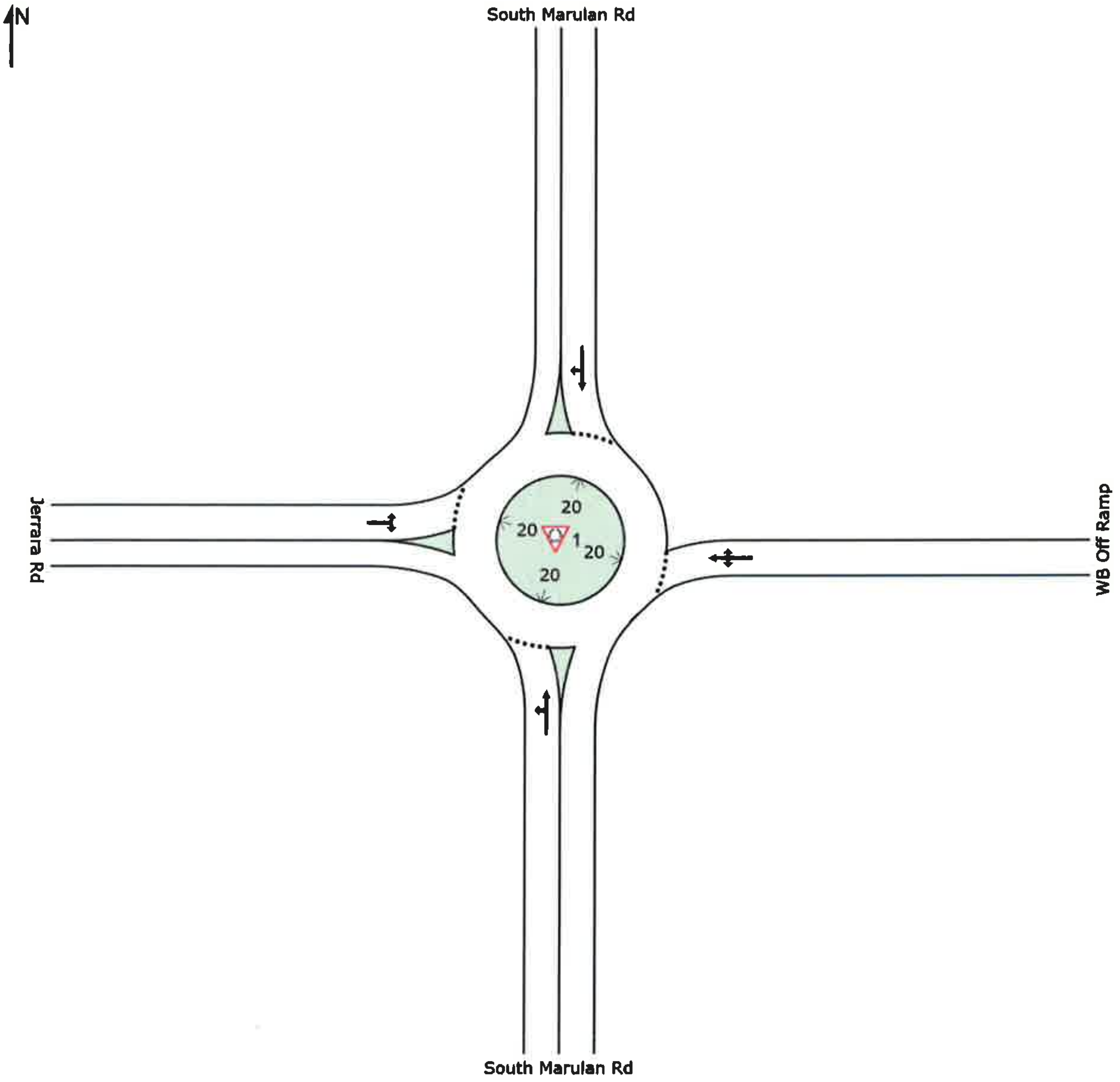
| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: South Marulan Rd | | | | | | | | | | | |
| 2 | T1 | 3 | 0.0 | 0.032 | 0.2 | LOS A | 0.1 | 1.6 | 0.16 | 0.50 | 55.0 |
| 3 | R2 | 40 | 29.0 | 0.032 | 6.1 | LOS A | 0.1 | 1.6 | 0.16 | 0.50 | 52.1 |
| Approach | | 43 | 26.9 | 0.032 | 5.7 | NA | 0.1 | 1.6 | 0.16 | 0.50 | 52.3 |
| North: South Marulan Rd | | | | | | | | | | | |
| 7 | L2 | 22 | 0.0 | 0.025 | 5.5 | LOS A | 0.0 | 0.0 | 0.00 | 0.25 | 56.2 |
| 8 | T1 | 29 | 0.0 | 0.025 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.25 | 57.7 |
| Approach | | 52 | 0.0 | 0.025 | 2.4 | NA | 0.0 | 0.0 | 0.00 | 0.25 | 57.1 |
| West: EB Off Ramp | | | | | | | | | | | |
| 10 | L2 | 4 | 0.0 | 0.028 | 5.6 | LOS A | 0.1 | 0.9 | 0.05 | 0.57 | 53.4 |
| 11 | T1 | 2 | 0.0 | 0.028 | 4.9 | LOS A | 0.1 | 0.9 | 0.05 | 0.57 | 53.7 |
| 12 | R2 | 22 | 9.5 | 0.028 | 6.0 | LOS A | 0.1 | 0.9 | 0.05 | 0.57 | 52.7 |
| Approach | | 28 | 7.4 | 0.028 | 5.9 | LOS A | 0.1 | 0.9 | 0.05 | 0.57 | 52.8 |
| All Vehicles | | 123 | 11.1 | 0.032 | 4.3 | NA | 0.1 | 1.6 | 0.07 | 0.41 | 54.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1 [WB Ramps/SM Rd/J Rd- Project 2015 AM]

2015 AM with Project
Roundabout



# MOVEMENT SUMMARY

## Site: 1 [WB Ramps/SM Rd/J Rd- Project 2015 AM]

2015 AM with Project
Roundabout

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows 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: South Marulan Rd | | | | | | | | | | | |
| 1 | L2 | 6 | 50.0 | 0.021 | 4.6 | LOS A | 0.1 | 0.9 | 0.21 | 0.44 | 53.0 |
| 2 | T1 | 11 | 60.0 | 0.021 | 4.8 | LOS A | 0.1 | 0.9 | 0.21 | 0.44 | 54.5 |
| Approach | | 17 | 56.3 | 0.021 | 4.7 | LOS A | 0.1 | 0.9 | 0.21 | 0.44 | 53.9 |
| East: WB Off Ramp | | | | | | | | | | | |
| 4 | L2 | 31 | 21.0 | 0.115 | 4.2 | LOS A | 0.4 | 4.1 | 0.14 | 0.58 | 52.1 |
| 5 | T1 | 4 | 0.0 | 0.115 | 4.2 | LOS A | 0.4 | 4.1 | 0.14 | 0.58 | 54.0 |
| 6 | R2 | 86 | 37.0 | 0.115 | 9.1 | LOS A | 0.4 | 4.1 | 0.14 | 0.58 | 52.5 |
| Approach | | 121 | 31.7 | 0.115 | 7.7 | LOS A | 0.4 | 4.1 | 0.14 | 0.58 | 52.4 |
| North: South Marulan Rd | | | | | | | | | | | |
| 8 | T1 | 56 | 8.0 | 0.036 | 4.1 | LOS A | 0.1 | 0.9 | 0.01 | 0.41 | 56.5 |
| 9 | R2 | 1 | 0.0 | 0.036 | 8.7 | LOS A | 0.1 | 0.9 | 0.01 | 0.41 | 56.7 |
| Approach | | 57 | 7.9 | 0.036 | 4.2 | LOS A | 0.1 | 0.9 | 0.01 | 0.41 | 56.5 |
| West: Jerrara Rd | | | | | | | | | | | |
| 10 | L2 | 8 | 0.0 | 0.007 | 4.2 | LOS A | 0.0 | 0.2 | 0.17 | 0.49 | 54.5 |
| 12 | R2 | 1 | 0.0 | 0.007 | 8.9 | LOS A | 0.0 | 0.2 | 0.17 | 0.49 | 55.8 |
| Approach | | 9 | 0.0 | 0.007 | 4.7 | LOS A | 0.0 | 0.2 | 0.17 | 0.49 | 54.6 |
| All Vehicles | | 204 | 25.6 | 0.115 | 6.3 | LOS A | 0.4 | 4.1 | 0.11 | 0.52 | 53.7 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 1 [WB Ramps/SM Rd/J Rd- Project 2015 PM ]

2015 PM with Project
Roundabout

### Movement Performance - Vehicles

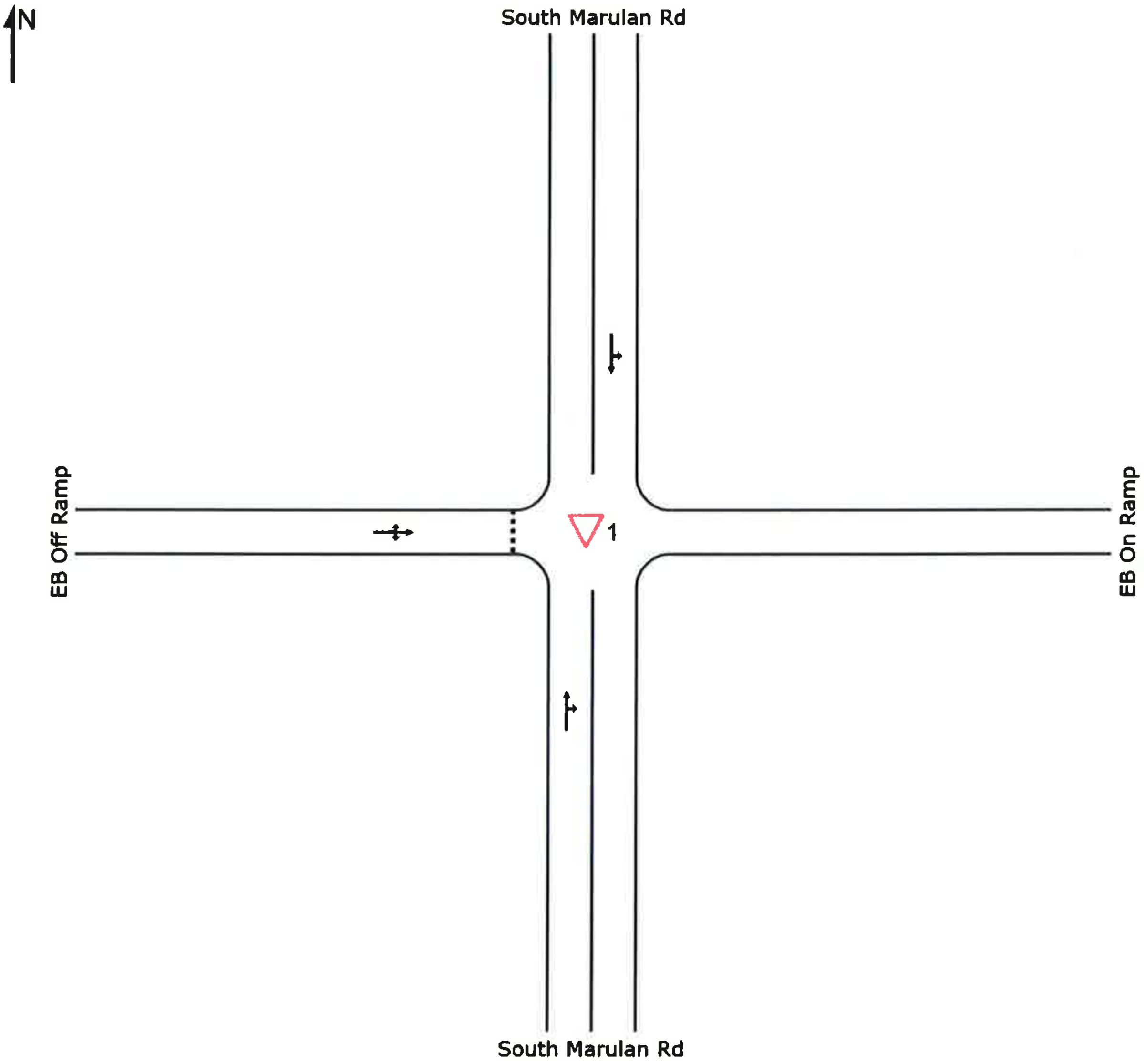
| Mov ID | OD Mov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total veh/h | HV % | v/c | sec | | Vehicles veh | Distance m | | per veh | km/h |
| South: South Marulan Rd | | | | | | | | | | | |
| 1 | L2 | 17 | 19.0 | 0.035 | 4.4 | LOS A | 0.1 | 1.1 | 0.18 | 0.45 | 54.1 |
| 2 | T1 | 21 | 20.0 | 0.035 | 4.5 | LOS A | 0.1 | 1.1 | 0.18 | 0.45 | 55.6 |
| Approach | | 38 | 19.6 | 0.035 | 4.4 | LOS A | 0.1 | 1.1 | 0.18 | 0.45 | 54.9 |
| East: WB Off Ramp | | | | | | | | | | | |
| 4 | L2 | 8 | 50.0 | 0.071 | 4.4 | LOS A | 0.2 | 3.2 | 0.15 | 0.52 | 52.9 |
| 5 | T1 | 19 | 0.0 | 0.071 | 4.2 | LOS A | 0.2 | 3.2 | 0.15 | 0.52 | 55.9 |
| 6 | R2 | 33 | 94.0 | 0.071 | 9.5 | LOS A | 0.2 | 3.2 | 0.15 | 0.52 | 52.0 |
| Approach | | 60 | 58.1 | 0.071 | 7.1 | LOS A | 0.2 | 3.2 | 0.15 | 0.52 | 53.3 |
| North: South Marulan Rd | | | | | | | | | | | |
| 8 | T1 | 11 | 40.0 | 0.034 | 4.4 | LOS A | 0.1 | 0.9 | 0.01 | 0.63 | 52.7 |
| 9 | R2 | 43 | 0.0 | 0.034 | 8.7 | LOS A | 0.1 | 0.9 | 0.01 | 0.63 | 53.6 |
| Approach | | 54 | 7.8 | 0.034 | 7.8 | LOS A | 0.1 | 0.9 | 0.01 | 0.63 | 53.4 |
| West: Jerrara Rd | | | | | | | | | | | |
| 10 | L2 | 17 | 7.0 | 0.014 | 4.2 | LOS A | 0.0 | 0.3 | 0.13 | 0.48 | 54.5 |
| 12 | R2 | 1 | 0.0 | 0.014 | 8.8 | LOS A | 0.0 | 0.3 | 0.13 | 0.48 | 56.1 |
| Approach | | 18 | 6.6 | 0.014 | 4.4 | LOS A | 0.0 | 0.3 | 0.13 | 0.48 | 54.6 |
| All Vehicles | | 169 | 28.1 | 0.071 | 6.5 | LOS A | 0.2 | 3.2 | 0.11 | 0.53 | 53.8 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## ▽ Site: 1 [EB Ramps/S M Rd- Project 2015 AM]

2015 AM with Project
Giveway / Yield (Two-Way)



**SIDRA INTERSECTION 7.0 | Copyright © 2000-2017 Akcelik and Associates Pty Ltd | sidrasolutions.com**
Organisation: TRANSPORT AND URBAN PLANNING | Created: Monday, 13 August 2018 12:10:43 PM
Project: C:\Users\Terry\Documents\14099 South Marulan.sip7

# MOVEMENT SUMMARY

## ▽ Site: 1 [EB Ramps/S M Rd- Project 2015 AM]

2015 AM with Project
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total veh/h | HV % | v/c | sec | | Vehicles veh | Distance m | | per veh | km/h |
| South: South Marulan Rd | | | | | | | | | | | |
| 2 | T1 | 57 | 0.0 | 0.088 | 0.0 | LOS A | 0.5 | 5.8 | 0.03 | 0.28 | 59.0 |
| 3 | R2 | 54 | 78.0 | 0.088 | 6.4 | LOS A | 0.5 | 5.8 | 0.03 | 0.28 | 53.5 |
| Approach | | 111 | 37.9 | 0.088 | 3.1 | NA | 0.5 | 5.8 | 0.03 | 0.28 | 56.2 |
| North: South Marulan Rd | | | | | | | | | | | |
| 7 | L2 | 1 | 0.0 | 0.001 | 5.5 | LOS A | 0.0 | 0.0 | 0.00 | 0.30 | 55.9 |
| 8 | T1 | 1 | 0.0 | 0.001 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.30 | 57.4 |
| Approach | | 2 | 0.0 | 0.001 | 2.8 | NA | 0.0 | 0.0 | 0.00 | 0.30 | 56.6 |
| West: EB Off Ramp | | | | | | | | | | | |
| 10 | L2 | 22 | 0.0 | 0.080 | 5.8 | LOS A | 0.3 | 2.5 | 0.22 | 0.56 | 53.0 |
| 11 | T1 | 2 | 0.0 | 0.080 | 5.1 | LOS A | 0.3 | 2.5 | 0.22 | 0.56 | 53.4 |
| 12 | R2 | 57 | 8.0 | 0.080 | 6.4 | LOS A | 0.3 | 2.5 | 0.22 | 0.56 | 52.4 |
| Approach | | 81 | 5.6 | 0.080 | 6.2 | LOS A | 0.3 | 2.5 | 0.22 | 0.56 | 52.6 |
| All Vehicles | | 194 | 24.0 | 0.088 | 4.4 | NA | 0.5 | 5.8 | 0.11 | 0.40 | 54.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## ▽ Site: 1 [EB Ramps/S M Rd- Project 2015 PM]

2015 PM with Project
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

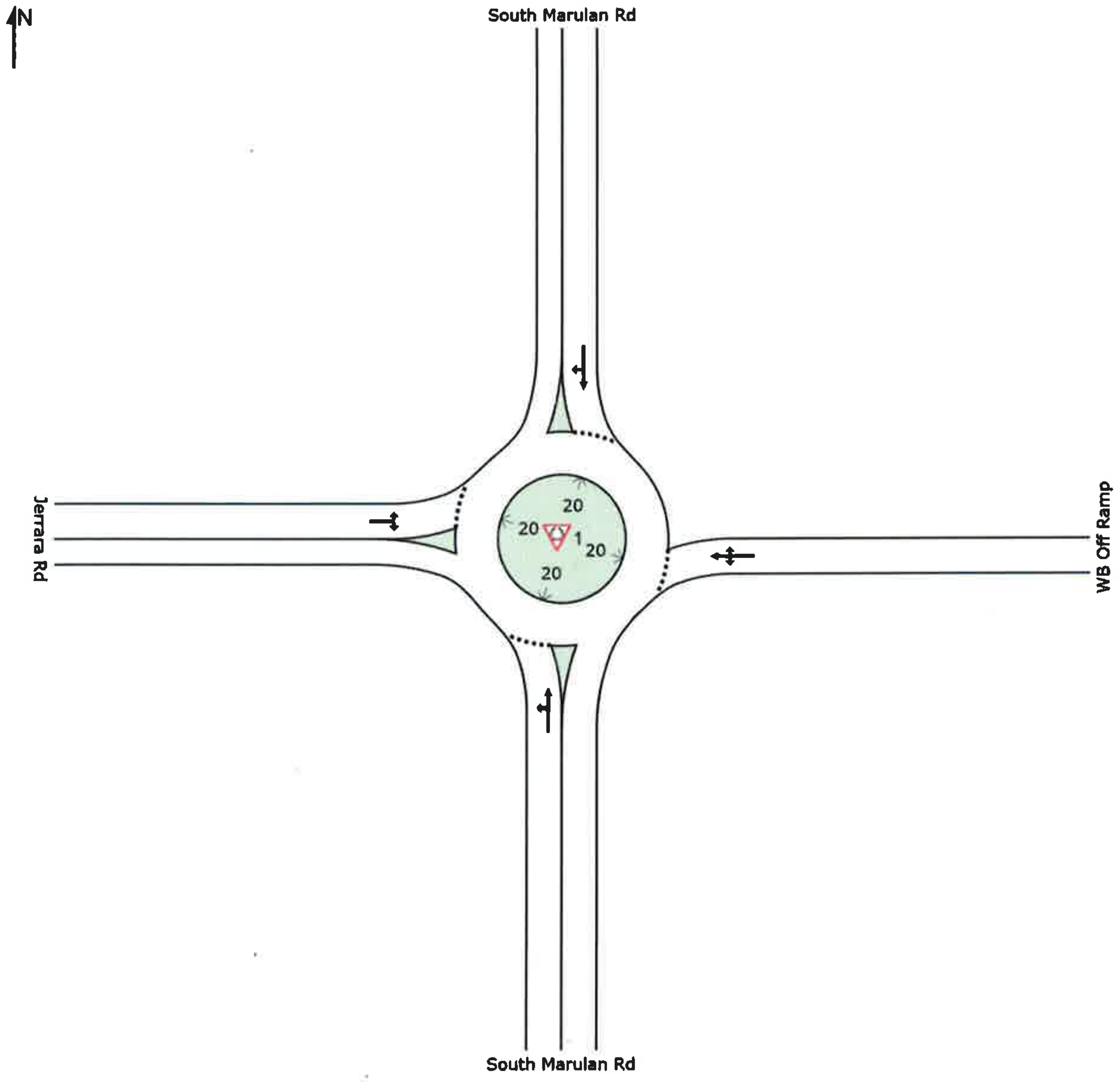
| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: South Marulan Rd | | | | | | | | | | | |
| 2 | T1 | 3 | 0.0 | 0.063 | 0.4 | LOS A | 0.3 | 4.2 | 0.18 | 0.51 | 54.9 |
| 3 | R2 | 65 | 57.0 | 0.063 | 6.5 | LOS A | 0.3 | 4.2 | 0.18 | 0.51 | 50.9 |
| Approach | | 68 | 54.4 | 0.063 | 6.3 | NA | 0.3 | 4.2 | 0.18 | 0.51 | 51.1 |
| North: South Marulan Rd | | | | | | | | | | | |
| 7 | L2 | 22 | 0.0 | 0.025 | 5.5 | LOS A | 0.0 | 0.0 | 0.00 | 0.25 | 56.2 |
| 8 | T1 | 29 | 0.0 | 0.025 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.25 | 57.7 |
| Approach | | 52 | 0.0 | 0.025 | 2.4 | NA | 0.0 | 0.0 | 0.00 | 0.25 | 57.1 |
| West: EB Off Ramp | | | | | | | | | | | |
| 10 | L2 | 4 | 0.0 | 0.034 | 5.6 | LOS A | 0.1 | 1.1 | 0.05 | 0.57 | 53.1 |
| 11 | T1 | 2 | 0.0 | 0.034 | 5.1 | LOS A | 0.1 | 1.1 | 0.05 | 0.57 | 53.5 |
| 12 | R2 | 24 | 18.0 | 0.034 | 6.4 | LOS A | 0.1 | 1.1 | 0.05 | 0.57 | 52.0 |
| Approach | | 31 | 14.3 | 0.034 | 6.2 | LOS A | 0.1 | 1.1 | 0.05 | 0.57 | 52.3 |
| All Vehicles | | 151 | 27.6 | 0.063 | 4.9 | NA | 0.3 | 4.2 | 0.09 | 0.44 | 53.3 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1 [WB Ramps/SM Rd/J Rd- Project 2025 AM & Others]

2025 AM with Project & Gunlake Proposal & Lynwood
Roundabout



# MOVEMENT SUMMARY

## Site: 1 [WB Ramps/SM Rd/J Rd- Project 2025 AM & Others]

2025 AM with Project & Gunlake Proposal & Lynwood
Roundabout

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows | | Deg. Satn | Average Delay | Level of Service | 95% Back of Queue | | Prop. Queued | Effective Stop Rate | Average Speed |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total veh/h | HV % | v/c | sec | | Vehicles veh | Distance m | | per veh | km/h |
| South: South Marulan Rd | | | | | | | | | | | |
| 1 | L2 | 13 | 58.3 | 0.042 | 4.6 | LOS A | 0.1 | 1.5 | 0.17 | 0.43 | 52.8 |
| 2 | T1 | 27 | 26.9 | 0.042 | 4.4 | LOS A | 0.1 | 1.5 | 0.17 | 0.43 | 55.4 |
| Approach | | 40 | 36.8 | 0.042 | 4.5 | LOS A | 0.1 | 1.5 | 0.17 | 0.43 | 54.6 |
| East: WB Off Ramp | | | | | | | | | | | |
| 4 | L2 | 16 | 60.0 | 0.086 | 4.3 | LOS A | 0.3 | 4.0 | 0.10 | 0.55 | 51.9 |
| 5 | T1 | 13 | 0.0 | 0.086 | 4.1 | LOS A | 0.3 | 4.0 | 0.10 | 0.55 | 55.1 |
| 6 | R2 | 48 | 77.3 | 0.086 | 9.1 | LOS A | 0.3 | 4.0 | 0.10 | 0.55 | 52.0 |
| Approach | | 77 | 61.0 | 0.086 | 7.3 | LOS A | 0.3 | 4.0 | 0.10 | 0.55 | 52.4 |
| North: South Marulan Rd | | | | | | | | | | | |
| 8 | T1 | 20 | 36.8 | 0.020 | 4.3 | LOS A | 0.1 | 0.8 | 0.01 | 0.45 | 55.3 |
| 9 | R2 | 4 | 50.0 | 0.020 | 9.2 | LOS A | 0.1 | 0.8 | 0.01 | 0.45 | 54.1 |
| Approach | | 24 | 39.1 | 0.020 | 5.2 | LOS A | 0.1 | 0.8 | 0.01 | 0.45 | 55.1 |
| West: Jerrara Rd | | | | | | | | | | | |
| 10 | L2 | 22 | 0.0 | 0.018 | 4.2 | LOS A | 0.1 | 0.4 | 0.16 | 0.48 | 54.8 |
| 12 | R2 | 1 | 0.0 | 0.018 | 8.9 | LOS A | 0.1 | 0.4 | 0.16 | 0.48 | 56.1 |
| Approach | | 23 | 0.0 | 0.018 | 4.4 | LOS A | 0.1 | 0.4 | 0.16 | 0.48 | 54.8 |
| All Vehicles | | 164 | 43.3 | 0.086 | 5.9 | LOS A | 0.3 | 4.0 | 0.11 | 0.50 | 53.7 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 1 [WB Ramps/SM Rd/J Rd- Project 2025 PM & Others]

2025 PM with Project & Gunlake Proposal & Lynwood
Roundabout

**Movement Performance - Vehicles**

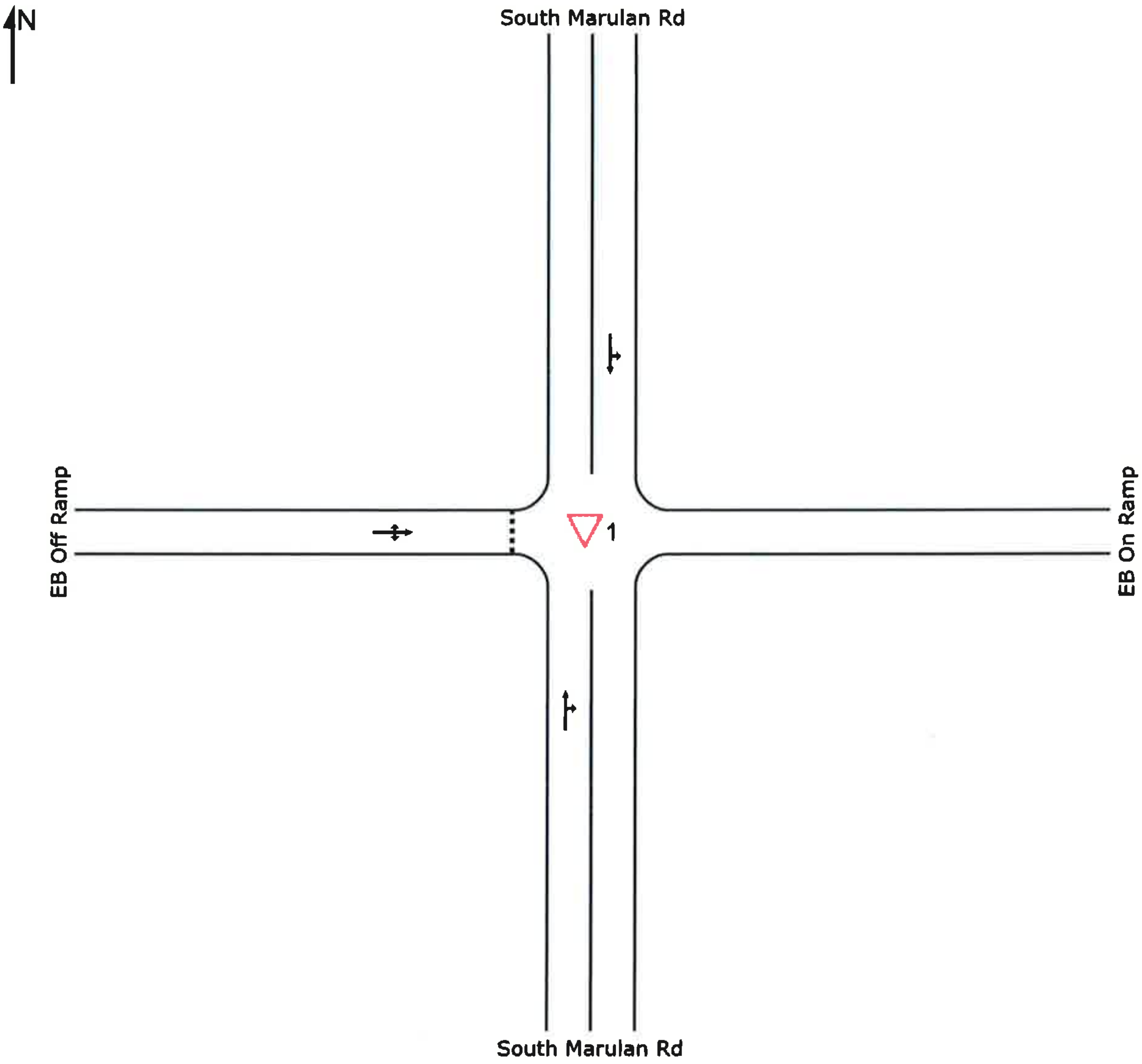
| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: South Marulan Rd | | | | | | | | | | | |
| 1 | L2 | 21 | 15.0 | 0.042 | 4.4 | LOS A | 0.1 | 1.2 | 0.21 | 0.46 | 54.1 |
| 2 | T1 | 25 | 16.7 | 0.042 | 4.5 | LOS A | 0.1 | 1.2 | 0.21 | 0.46 | 55.6 |
| Approach | | 46 | 15.9 | 0.042 | 4.5 | LOS A | 0.1 | 1.2 | 0.21 | 0.46 | 54.9 |
| East: WB Off Ramp | | | | | | | | | | | |
| 4 | L2 | 16 | 60.0 | 0.094 | 4.6 | LOS A | 0.3 | 4.4 | 0.18 | 0.55 | 51.7 |
| 5 | T1 | 13 | 0.0 | 0.094 | 4.2 | LOS A | 0.3 | 4.4 | 0.18 | 0.55 | 54.8 |
| 6 | R2 | 48 | 77.3 | 0.094 | 9.5 | LOS A | 0.3 | 4.4 | 0.18 | 0.55 | 51.7 |
| Approach | | 77 | 61.0 | 0.094 | 7.6 | LOS A | 0.3 | 4.4 | 0.18 | 0.55 | 52.2 |
| North: South Marulan Rd | | | | | | | | | | | |
| 8 | T1 | 13 | 41.7 | 0.045 | 4.4 | LOS A | 0.1 | 1.2 | 0.01 | 0.63 | 52.6 |
| 9 | R2 | 57 | 2.0 | 0.045 | 8.7 | LOS A | 0.1 | 1.2 | 0.01 | 0.63 | 53.5 |
| Approach | | 69 | 9.2 | 0.045 | 7.9 | LOS A | 0.1 | 1.2 | 0.01 | 0.63 | 53.3 |
| West: Jerrara Rd | | | | | | | | | | | |
| 10 | L2 | 21 | 5.3 | 0.018 | 4.2 | LOS A | 0.1 | 0.4 | 0.16 | 0.48 | 54.6 |
| 12 | R2 | 1 | 0.0 | 0.018 | 8.9 | LOS A | 0.1 | 0.4 | 0.16 | 0.48 | 56.1 |
| Approach | | 22 | 5.0 | 0.018 | 4.4 | LOS A | 0.1 | 0.4 | 0.16 | 0.48 | 54.6 |
| All Vehicles | | 215 | 28.8 | 0.094 | 6.7 | LOS A | 0.3 | 4.4 | 0.13 | 0.55 | 53.4 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## ▽ Site: 1 [EB Ramps/S M Rd- Project 2025 AM & Others]

2025 AM with Project & Gunlake Proposal & Lynwood
Giveway / Yield (Two-Way)



# MOVEMENT SUMMARY

## ▽ Site: 1 [EB Ramps/S M Rd- Project 2025 AM & Others]

2025 AM with Project & Gunlake Proposal & Lynwood
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows 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: South Marulan Rd | | | | | | | | | | | |
| 2 | T1 | 23 | 23.8 | 0.083 | 0.1 | LOS A | 0.4 | 5.4 | 0.10 | 0.42 | 56.1 |
| 3 | R2 | 79 | 50.7 | 0.083 | 6.2 | LOS A | 0.4 | 5.4 | 0.10 | 0.42 | 52.2 |
| Approach | | 102 | 44.6 | 0.083 | 4.9 | NA | 0.4 | 5.4 | 0.10 | 0.42 | 53.1 |
| North: South Marulan Rd | | | | | | | | | | | |
| 7 | L2 | 15 | 38.5 | 0.011 | 6.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.50 | 52.4 |
| 8 | T1 | 2 | 50.0 | 0.011 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.50 | 55.5 |
| Approach | | 17 | 39.9 | 0.011 | 5.2 | NA | 0.0 | 0.0 | 0.00 | 0.50 | 52.8 |
| West: EB Off Ramp | | | | | | | | | | | |
| 10 | L2 | 6 | 16.7 | 0.034 | 5.7 | LOS A | 0.1 | 1.5 | 0.17 | 0.56 | 52.2 |
| 11 | T1 | 1 | 0.0 | 0.034 | 5.2 | LOS A | 0.1 | 1.5 | 0.17 | 0.56 | 53.2 |
| 12 | R2 | 19 | 39.0 | 0.034 | 7.0 | LOS A | 0.1 | 1.5 | 0.17 | 0.56 | 50.9 |
| Approach | | 26 | 32.1 | 0.034 | 6.6 | LOS A | 0.1 | 1.5 | 0.17 | 0.56 | 51.3 |
| All Vehicles | | 145 | 41.8 | 0.083 | 5.2 | NA | 0.4 | 5.4 | 0.10 | 0.46 | 52.7 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## ▽ Site: 1 [EB Ramps/S M Rd- Project 2025 PM - Project & Others]

2025 PM with Project & Gunlake Proposal & Lynwood
Giveway / Yield (Two-Way)

**Movement Performance - Vehicles**

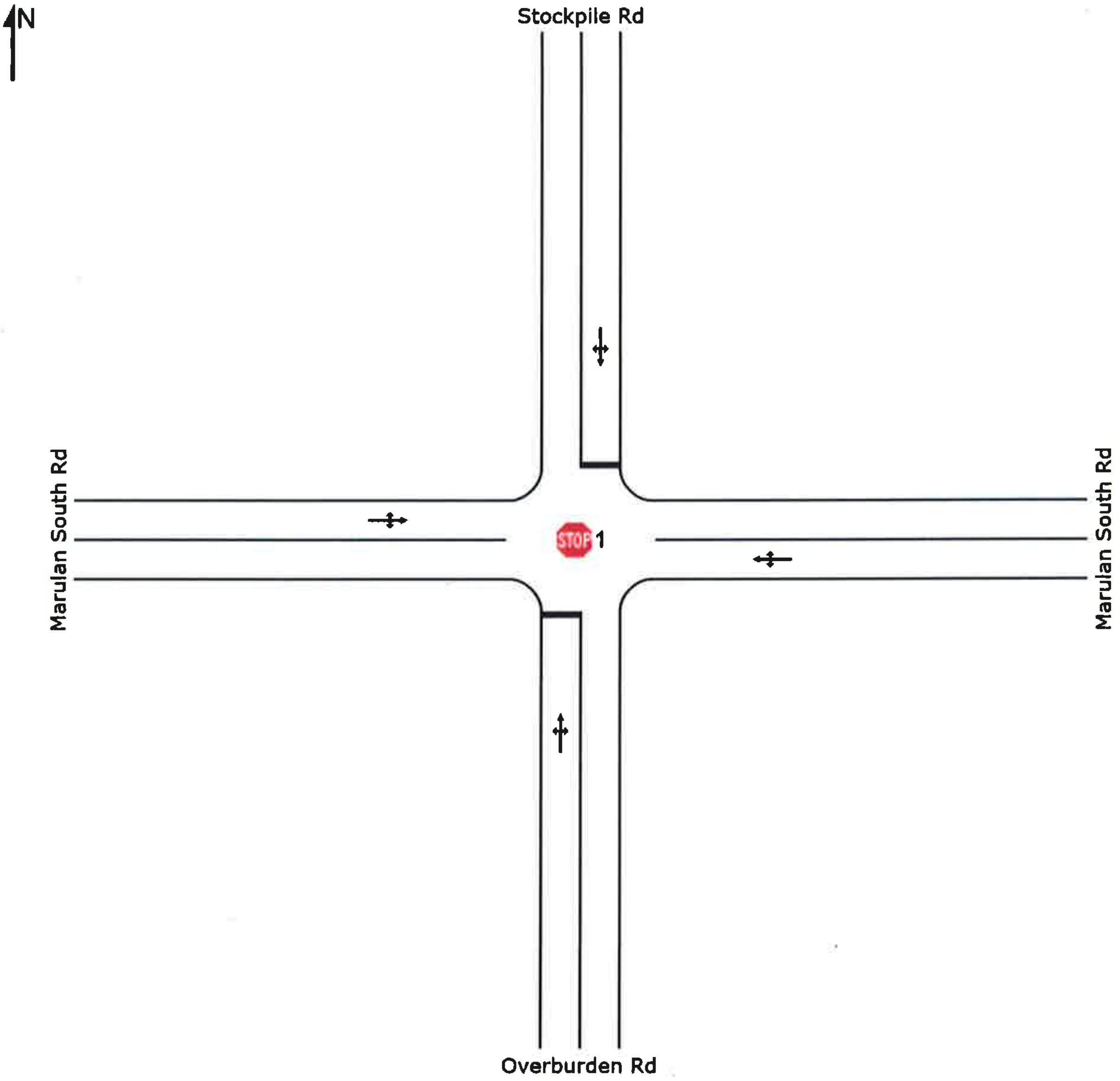
| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: South Marulan Rd | | | | | | | | | | | |
| 2 | T1 | 9 | 23.8 | 0.069 | 0.5 | LOS A | 0.3 | 4.4 | 0.23 | 0.47 | 55.1 |
| 3 | R2 | 67 | 51.0 | 0.069 | 6.6 | LOS A | 0.3 | 4.4 | 0.23 | 0.47 | 51.3 |
| Approach | | 77 | 47.6 | 0.069 | 5.9 | NA | 0.3 | 4.4 | 0.23 | 0.47 | 51.8 |
| North: South Marulan Rd | | | | | | | | | | | |
| 7 | L2 | 34 | 16.7 | 0.038 | 5.7 | LOS A | 0.0 | 0.0 | 0.00 | 0.27 | 55.5 |
| 8 | T1 | 40 | 3.0 | 0.038 | 0.0 | LOS A | 0.0 | 0.0 | 0.00 | 0.27 | 57.8 |
| Approach | | 74 | 9.3 | 0.038 | 2.6 | NA | 0.0 | 0.0 | 0.00 | 0.27 | 56.7 |
| West: EB Off Ramp | | | | | | | | | | | |
| 10 | L2 | 6 | 16.7 | 0.045 | 5.6 | LOS A | 0.2 | 1.6 | 0.11 | 0.57 | 52.3 |
| 11 | T1 | 2 | 0.0 | 0.045 | 5.3 | LOS A | 0.2 | 1.6 | 0.11 | 0.57 | 53.4 |
| 12 | R2 | 31 | 17.3 | 0.045 | 6.6 | LOS A | 0.2 | 1.6 | 0.11 | 0.57 | 52.0 |
| Approach | | 39 | 16.3 | 0.045 | 6.4 | LOS A | 0.2 | 1.6 | 0.11 | 0.57 | 52.1 |
| All Vehicles | | 189 | 26.3 | 0.069 | 4.7 | NA | 0.3 | 4.4 | 0.12 | 0.41 | 53.7 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1 [Marulan South Rd/ Stockpile Rd- AMS1 ]

AM Maximum Hour S1
Stop (Two-Way)



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Organisation: TRANSPORT AND URBAN PLANNING | Created: Monday, 13 August 2018 4:20:47 PM
Project: C:\Users\Terry\Documents\14099-2 Marulan South.sip7

# MOVEMENT SUMMARY

## Site: 1 [Marulan South Rd/ Stockpile Rd- AMS1 ]

AM Maximum Hour S1
Stop (Two-Way)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total 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: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.097 | 7.0 | LOS A | 0.3 | 4.5 | 0.33 | 0.97 | 36.3 |
| 2 | T1 | 1 | 0.0 | 0.097 | 8.2 | LOS A | 0.3 | 4.5 | 0.33 | 0.97 | 36.2 |
| 3 | R2 | 31 | 100.0 | 0.097 | 12.2 | LOS A | 0.3 | 4.5 | 0.33 | 0.97 | 36.2 |
| Approach | | 33 | 93.5 | 0.097 | 12.0 | LOS A | 0.3 | 4.5 | 0.33 | 0.97 | 36.2 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 31 | 100.0 | 0.041 | 6.2 | LOS A | 0.1 | 1.5 | 0.07 | 0.43 | 52.1 |
| 5 | T1 | 17 | 56.3 | 0.041 | 0.2 | LOS A | 0.1 | 1.5 | 0.07 | 0.43 | 55.6 |
| 6 | R2 | 5 | 40.0 | 0.041 | 6.5 | LOS A | 0.1 | 1.5 | 0.07 | 0.43 | 52.5 |
| Approach | | 53 | 80.0 | 0.041 | 5.0 | NA | 0.1 | 1.5 | 0.07 | 0.43 | 53.2 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.020 | 10.5 | LOS A | 0.1 | 0.9 | 0.29 | 0.93 | 36.6 |
| 8 | T1 | 1 | 0.0 | 0.020 | 8.3 | LOS A | 0.1 | 0.9 | 0.29 | 0.93 | 36.6 |
| 9 | R2 | 4 | 100.0 | 0.020 | 11.1 | LOS A | 0.1 | 0.9 | 0.29 | 0.93 | 36.6 |
| Approach | | 7 | 85.7 | 0.020 | 10.7 | LOS A | 0.1 | 0.9 | 0.29 | 0.93 | 36.6 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.033 | 6.2 | LOS A | 0.0 | 0.1 | 0.01 | 0.09 | 55.4 |
| 11 | T1 | 54 | 17.6 | 0.033 | 0.0 | LOS A | 0.0 | 0.1 | 0.01 | 0.09 | 59.4 |
| 12 | R2 | 1 | 0.0 | 0.033 | 5.9 | LOS A | 0.0 | 0.1 | 0.01 | 0.09 | 57.8 |
| Approach | | 59 | 23.2 | 0.033 | 0.9 | NA | 0.0 | 0.1 | 0.01 | 0.09 | 59.0 |
| All Vehicles | | 152 | 61.1 | 0.097 | 4.8 | NA | 0.3 | 4.5 | 0.11 | 0.44 | 49.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 1 [Marulan South Rd/ Stockpile Rd- PM S1]

PM Maximum Hour S1
Stop (Two-Way)

**Movement Performance - Vehicles**

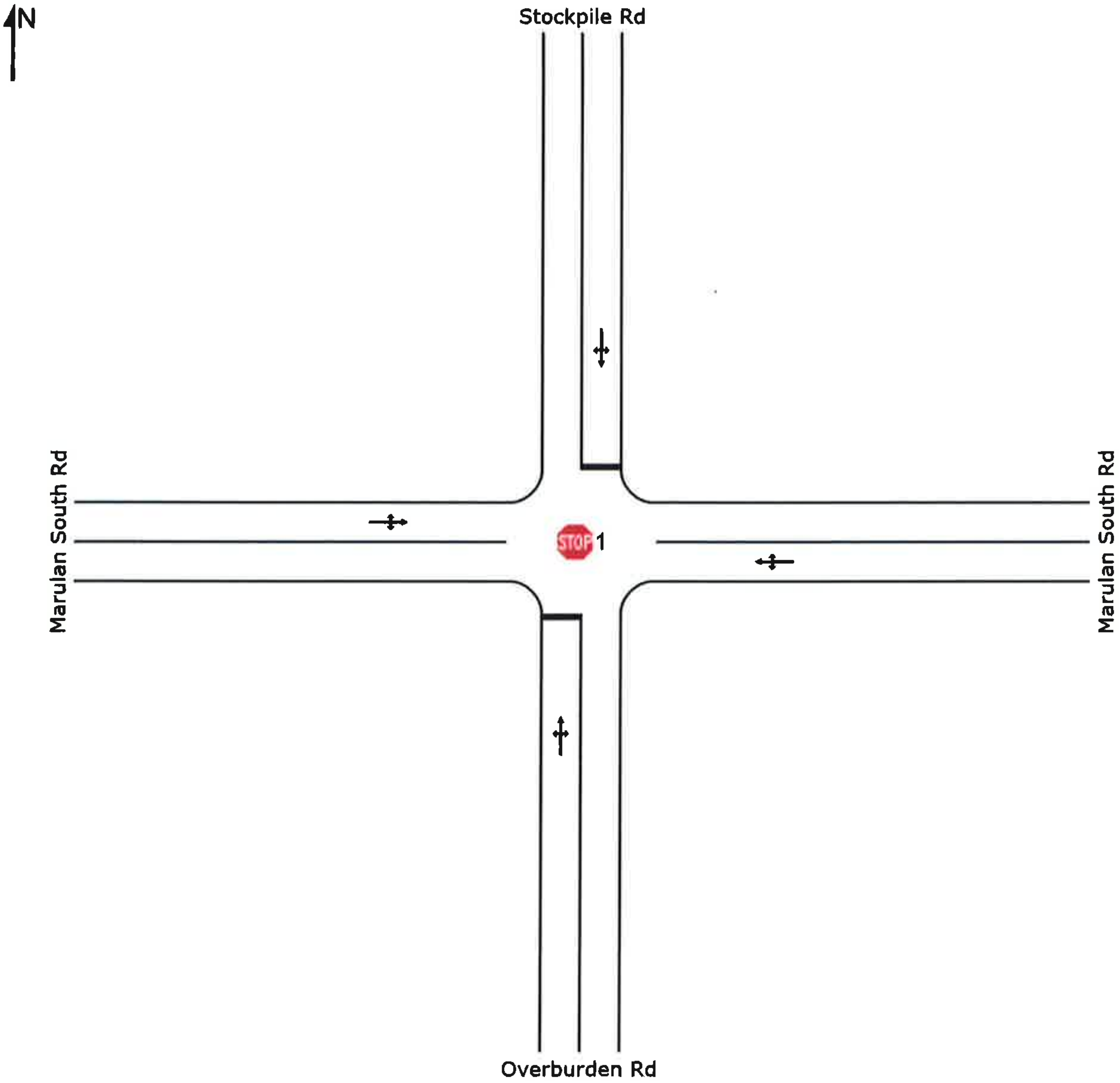
| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.092 | 7.5 | LOS A | 0.3 | 4.3 | 0.31 | 0.96 | 36.6 |
| 2 | T1 | 1 | 100.0 | 0.092 | 11.3 | LOS A | 0.3 | 4.3 | 0.31 | 0.96 | 36.4 |
| 3 | R2 | 31 | 100.0 | 0.092 | 11.2 | LOS A | 0.3 | 4.3 | 0.31 | 0.96 | 36.5 |
| Approach | | 33 | 96.8 | 0.092 | 11.1 | LOS A | 0.3 | 4.3 | 0.31 | 0.96 | 36.5 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 31 | 100.0 | 0.051 | 6.1 | LOS A | 0.0 | 0.7 | 0.01 | 0.35 | 53.7 |
| 5 | T1 | 42 | 17.5 | 0.051 | 0.0 | LOS A | 0.0 | 0.7 | 0.01 | 0.35 | 57.4 |
| 6 | R2 | 2 | 100.0 | 0.051 | 6.3 | LOS A | 0.0 | 0.7 | 0.01 | 0.35 | 53.7 |
| Approach | | 75 | 53.5 | 0.051 | 3.7 | NA | 0.0 | 0.7 | 0.01 | 0.35 | 55.7 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.018 | 8.7 | LOS A | 0.1 | 0.8 | 0.12 | 1.00 | 36.8 |
| 8 | T1 | 1 | 0.0 | 0.018 | 7.9 | LOS A | 0.1 | 0.8 | 0.12 | 1.00 | 36.9 |
| 9 | R2 | 4 | 100.0 | 0.018 | 10.3 | LOS A | 0.1 | 0.8 | 0.12 | 1.00 | 36.8 |
| Approach | | 7 | 85.7 | 0.018 | 9.6 | LOS A | 0.1 | 0.8 | 0.12 | 1.00 | 36.8 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.009 | 6.2 | LOS A | 0.0 | 0.2 | 0.06 | 0.29 | 53.2 |
| 11 | T1 | 8 | 50.0 | 0.009 | 0.1 | LOS A | 0.0 | 0.2 | 0.06 | 0.29 | 56.9 |
| 12 | R2 | 1 | 0.0 | 0.009 | 6.0 | LOS A | 0.0 | 0.2 | 0.06 | 0.29 | 55.4 |
| Approach | | 14 | 61.5 | 0.009 | 3.3 | NA | 0.0 | 0.2 | 0.06 | 0.29 | 55.6 |
| All Vehicles | | 128 | 67.2 | 0.092 | 5.2 | NA | 0.3 | 4.3 | 0.10 | 0.53 | 47.9 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1 [Marulan South Rd/ Stockpile Rd-Cross Junction AMS2]

AM Maximum Hour S2
Stop (Two-Way)



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Organisation: TRANSPORT AND URBAN PLANNING | Created: Monday, 13 August 2018 4:18:38 PM
Project: C:\Users\Terry\Documents\14099-2 Marulan South.sip7

# MOVEMENT SUMMARY

## Site: 1 [Marulan South Rd/ Stockpile Rd-Cross Junction AMS2]

AM Maximum Hour S2
Stop (Two-Way)

**Movement Performance - Vehicles**

| Mov | OD | Demand Flows | | Deg. | Average | Level of | 95% Back of Queue | | Prop. | Effective | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ID | Mov | Total | HV | Satn | Delay | Service | Vehicles | Distance | Queued | Stop Rate | Speed |
| | | veh/h | % | v/c | sec | | veh | m | | per veh | km/h |
| South: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.092 | 7.0 | LOS A | 0.3 | 4.2 | 0.30 | 1.00 | 36.6 |
| 2 | T1 | 31 | 100.0 | 0.092 | 11.3 | LOS A | 0.3 | 4.2 | 0.30 | 1.00 | 36.4 |
| 3 | R2 | 1 | 0.0 | 0.092 | 8.6 | LOS A | 0.3 | 4.2 | 0.30 | 1.00 | 36.6 |
| Approach | | 33 | 93.5 | 0.092 | 11.2 | LOS A | 0.3 | 4.2 | 0.30 | 1.00 | 36.4 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 1 | 0.0 | 0.014 | 6.2 | LOS A | 0.0 | 0.6 | 0.08 | 0.13 | 56.5 |
| 5 | T1 | 17 | 56.3 | 0.014 | 0.2 | LOS A | 0.0 | 0.6 | 0.08 | 0.13 | 58.1 |
| 6 | R2 | 2 | 100.0 | 0.014 | 6.9 | LOS A | 0.0 | 0.6 | 0.08 | 0.13 | 54.2 |
| Approach | | 20 | 57.9 | 0.014 | 1.7 | NA | 0.0 | 0.6 | 0.08 | 0.13 | 57.6 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.107 | 10.7 | LOS A | 0.4 | 5.2 | 0.32 | 0.99 | 36.4 |
| 8 | T1 | 31 | 100.0 | 0.107 | 11.3 | LOS A | 0.4 | 5.2 | 0.32 | 0.99 | 36.3 |
| 9 | R2 | 4 | 100.0 | 0.107 | 13.1 | LOS A | 0.4 | 5.2 | 0.32 | 0.99 | 36.4 |
| Approach | | 37 | 100.0 | 0.107 | 11.5 | LOS A | 0.4 | 5.2 | 0.32 | 0.99 | 36.3 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.032 | 6.1 | LOS A | 0.0 | 0.1 | 0.01 | 0.09 | 55.4 |
| 11 | T1 | 54 | 17.6 | 0.032 | 0.0 | LOS A | 0.0 | 0.1 | 0.01 | 0.09 | 59.4 |
| 12 | R2 | 1 | 0.0 | 0.032 | 5.7 | LOS A | 0.0 | 0.1 | 0.01 | 0.09 | 57.8 |
| Approach | | 59 | 23.2 | 0.032 | 0.9 | NA | 0.0 | 0.1 | 0.01 | 0.09 | 59.1 |
| All Vehicles | | 148 | 62.4 | 0.107 | 5.7 | NA | 0.4 | 5.2 | 0.16 | 0.52 | 45.6 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 1 [Marulan South Rd/ Stockpile Rd-Cross Junction PMS2 ]

PM Maximum Hour S2
Stop (Two-Way)

**Movement Performance - Vehicles**

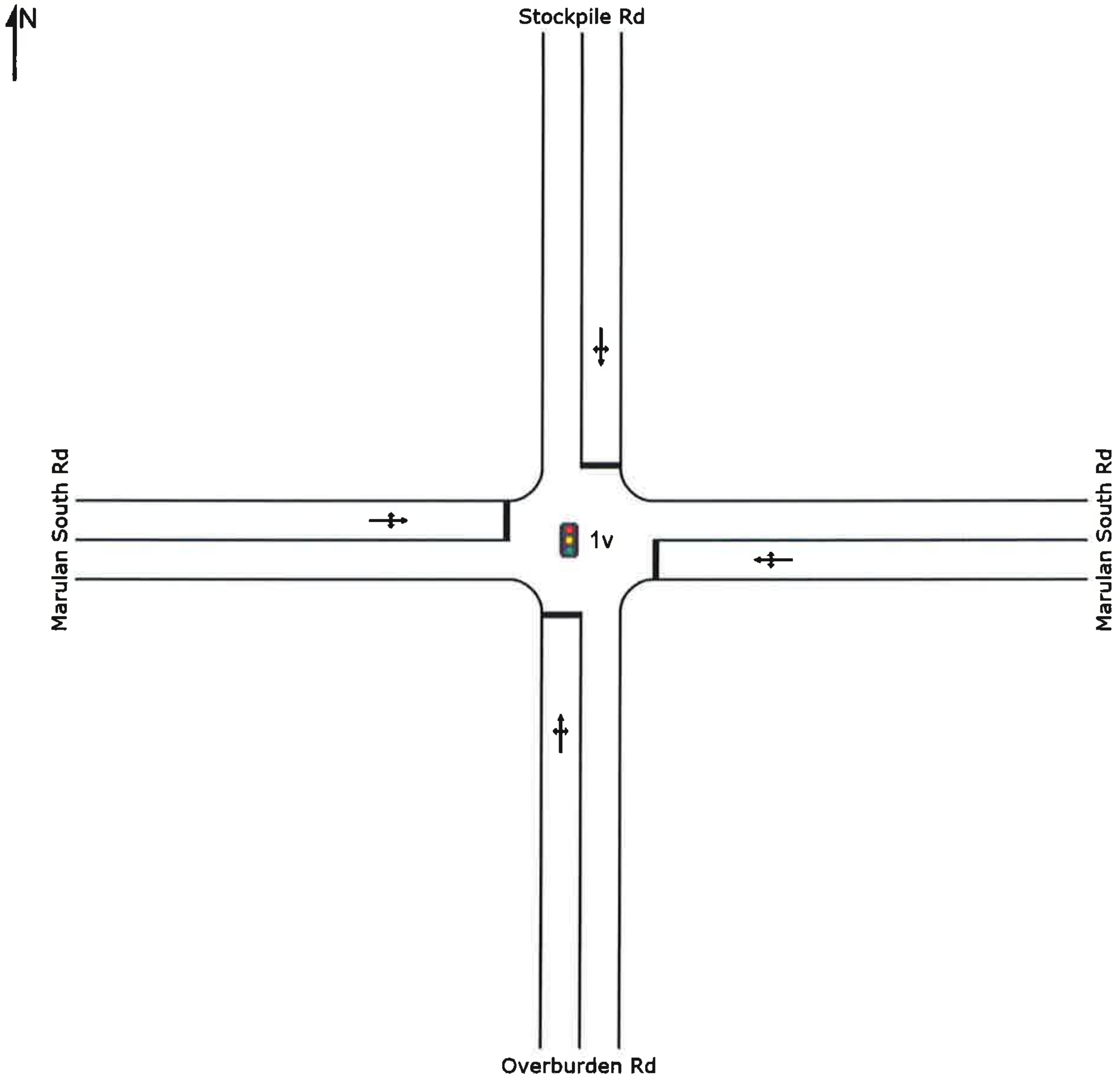
| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | 95% Back of Queue Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.086 | 7.5 | LOS A | 0.3 | 4.0 | 0.27 | 1.00 | 36.9 |
| 2 | T1 | 31 | 100.0 | 0.086 | 10.5 | LOS A | 0.3 | 4.0 | 0.27 | 1.00 | 36.7 |
| 3 | R2 | 1 | 0.0 | 0.086 | 8.2 | LOS A | 0.3 | 4.0 | 0.27 | 1.00 | 36.9 |
| Approach | | 33 | 93.5 | 0.086 | 10.4 | LOS A | 0.3 | 4.0 | 0.27 | 1.00 | 36.7 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 1 | 0.0 | 0.026 | 5.7 | LOS A | 0.0 | 0.4 | 0.02 | 0.06 | 57.9 |
| 5 | T1 | 42 | 17.5 | 0.026 | 0.0 | LOS A | 0.0 | 0.4 | 0.02 | 0.06 | 59.5 |
| 6 | R2 | 2 | 100.0 | 0.026 | 6.3 | LOS A | 0.0 | 0.4 | 0.02 | 0.06 | 55.5 |
| Approach | | 45 | 20.9 | 0.026 | 0.7 | NA | 0.0 | 0.4 | 0.02 | 0.06 | 59.2 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.100 | 8.8 | LOS A | 0.3 | 4.8 | 0.22 | 1.02 | 36.7 |
| 8 | T1 | 31 | 100.0 | 0.100 | 10.4 | LOS A | 0.3 | 4.8 | 0.22 | 1.02 | 36.6 |
| 9 | R2 | 4 | 100.0 | 0.100 | 12.1 | LOS A | 0.3 | 4.8 | 0.22 | 1.02 | 36.7 |
| Approach | | 37 | 100.0 | 0.100 | 10.5 | LOS A | 0.3 | 4.8 | 0.22 | 1.02 | 36.6 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.009 | 6.2 | LOS A | 0.0 | 0.2 | 0.04 | 0.30 | 53.3 |
| 11 | T1 | 8 | 50.0 | 0.009 | 0.0 | LOS A | 0.0 | 0.2 | 0.04 | 0.30 | 57.0 |
| 12 | R2 | 1 | 0.0 | 0.009 | 5.8 | LOS A | 0.0 | 0.2 | 0.04 | 0.30 | 55.5 |
| Approach | | 14 | 61.5 | 0.009 | 3.3 | NA | 0.0 | 0.2 | 0.04 | 0.30 | 55.7 |
| All Vehicles | | 128 | 66.4 | 0.100 | 6.1 | NA | 0.3 | 4.8 | 0.14 | 0.60 | 44.2 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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 is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1v [Marulan South Rd/ Stockpile Rd- AMS1 - TCS]

AM Maximum Hour S1 & Traffic Signals
Signals - Fixed Time Isolated



# MOVEMENT SUMMARY

## Site: 1v [Marulan South Rd/ Stockpile Rd- AMS1 - TCS]

AM Maximum Hour S1 & Traffic Signals
Signals - Fixed Time Isolated    Cycle Time = 45 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows 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: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.094 | 16.7 | LOS B | 0.6 | 7.5 | 0.76 | 0.67 | 34.0 |
| 2 | T1 | 1 | 0.0 | 0.094 | 13.3 | LOS A | 0.6 | 7.5 | 0.76 | 0.67 | 33.9 |
| 3 | R2 | 31 | 100.0 | 0.094 | 17.0 | LOS B | 0.6 | 7.5 | 0.76 | 0.67 | 33.8 |
| Approach | | 33 | 93.5 | 0.094 | 16.9 | LOS B | 0.6 | 7.5 | 0.76 | 0.67 | 33.9 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 31 | 100.0 | 0.104 | 15.5 | LOS B | 0.8 | 14.3 | 0.65 | 0.66 | 46.1 |
| 5 | T1 | 17 | 56.3 | 0.104 | 9.4 | LOS A | 0.8 | 14.3 | 0.65 | 0.66 | 48.8 |
| 6 | R2 | 5 | 40.0 | 0.104 | 15.4 | LOS B | 0.8 | 14.3 | 0.65 | 0.66 | 46.4 |
| Approach | | 53 | 80.0 | 0.104 | 14.3 | LOS A | 0.8 | 14.3 | 0.65 | 0.66 | 46.9 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.021 | 16.5 | LOS B | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| 8 | T1 | 1 | 0.0 | 0.021 | 12.8 | LOS A | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| 9 | R2 | 4 | 100.0 | 0.021 | 16.5 | LOS B | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| Approach | | 7 | 85.7 | 0.021 | 16.2 | LOS B | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.081 | 15.3 | LOS B | 0.8 | 8.6 | 0.65 | 0.53 | 48.6 |
| 11 | T1 | 54 | 17.6 | 0.081 | 9.2 | LOS A | 0.8 | 8.6 | 0.65 | 0.53 | 51.7 |
| 12 | R2 | 1 | 0.0 | 0.081 | 14.7 | LOS B | 0.8 | 8.6 | 0.65 | 0.53 | 50.5 |
| Approach | | 59 | 23.2 | 0.081 | 10.1 | LOS A | 0.8 | 8.6 | 0.65 | 0.53 | 51.5 |
| All Vehicles | | 152 | 61.1 | 0.104 | 12.9 | LOS A | 0.8 | 14.3 | 0.68 | 0.61 | 44.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 1v [Marulan South Rd/ Stockpile Rd- PM S1 - TCS]

PM Maximum Hour S1 Traffic Signals
Signals - Fixed Time Isolated  Cycle Time = 45 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

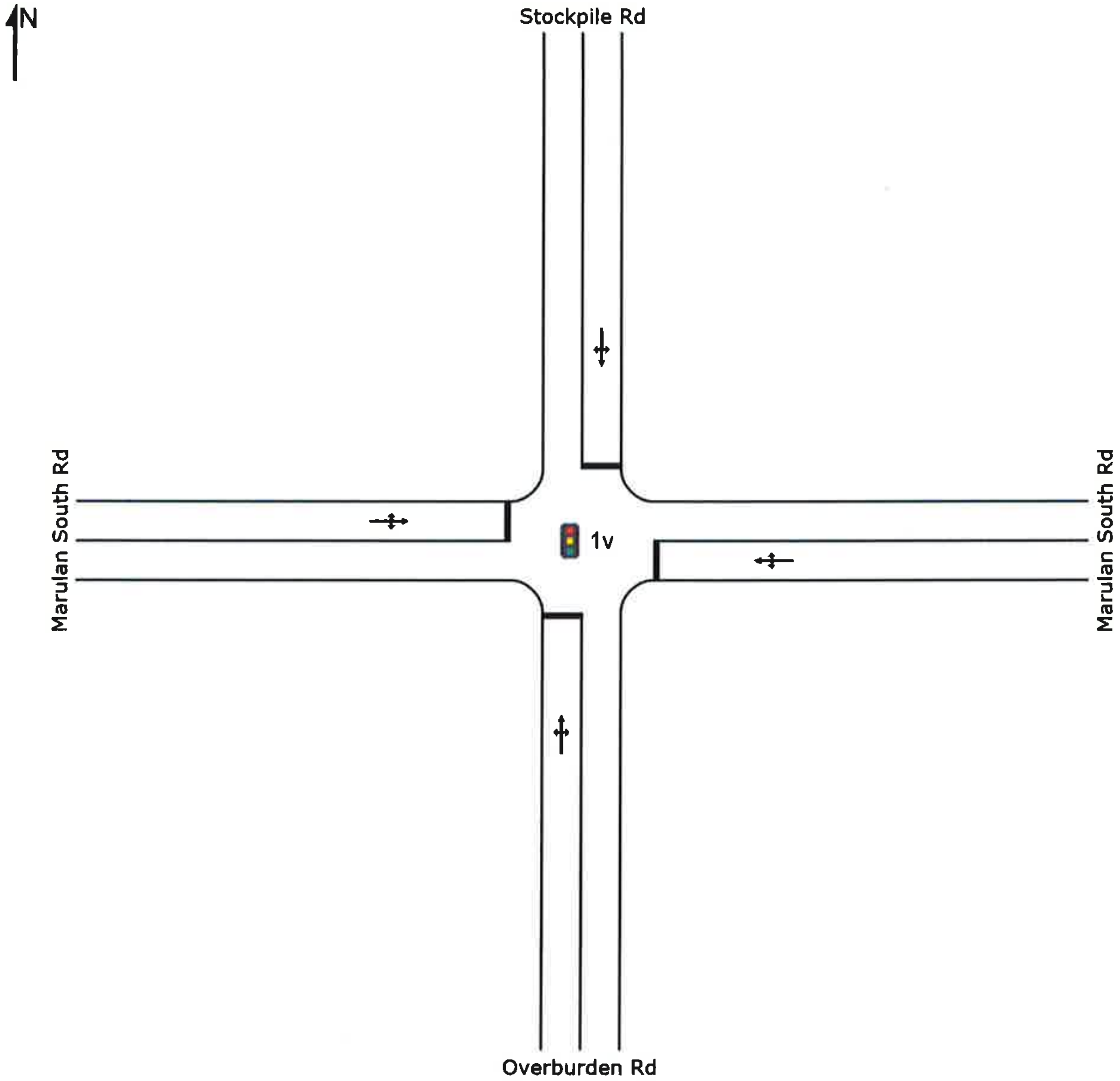
| Mov ID | OD Mov | Demand Flows Total veh/h | HV % | Deg. Satn v/c | Average Delay sec | Level of Service | 95% Back of Queue Vehicles veh | Distance m | Prop. Queued | Effective Stop Rate per veh | Average Speed km/h |
|---|---|---|---|---|---|---|---|---|---|---|---|
| South: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.095 | 16.7 | LOS B | 0.6 | 7.6 | 0.76 | 0.67 | 34.0 |
| 2 | T1 | 1 | 100.0 | 0.095 | 13.3 | LOS A | 0.6 | 7.6 | 0.76 | 0.67 | 33.9 |
| 3 | R2 | 31 | 100.0 | 0.095 | 17.0 | LOS B | 0.6 | 7.6 | 0.76 | 0.67 | 33.8 |
| Approach | | 33 | 96.8 | 0.095 | 16.8 | LOS B | 0.6 | 7.6 | 0.76 | 0.67 | 33.8 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 31 | 100.0 | 0.125 | 15.6 | LOS B | 1.1 | 16.0 | 0.66 | 0.64 | 47.2 |
| 5 | T1 | 42 | 17.5 | 0.125 | 9.5 | LOS A | 1.1 | 16.0 | 0.66 | 0.64 | 50.0 |
| 6 | R2 | 2 | 100.0 | 0.125 | 15.6 | LOS B | 1.1 | 16.0 | 0.66 | 0.64 | 47.2 |
| Approach | | 75 | 53.5 | 0.125 | 13.2 | LOS A | 1.1 | 16.0 | 0.66 | 0.64 | 48.7 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.021 | 16.5 | LOS B | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| 8 | T1 | 1 | 0.0 | 0.021 | 12.8 | LOS A | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| 9 | R2 | 4 | 100.0 | 0.021 | 16.5 | LOS B | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| Approach | | 7 | 85.7 | 0.021 | 16.2 | LOS B | 0.1 | 1.6 | 0.74 | 0.61 | 34.1 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.024 | 15.1 | LOS B | 0.2 | 3.0 | 0.63 | 0.56 | 47.2 |
| 11 | T1 | 8 | 50.0 | 0.024 | 9.0 | LOS A | 0.2 | 3.0 | 0.63 | 0.56 | 50.1 |
| 12 | R2 | 1 | 0.0 | 0.024 | 14.5 | LOS A | 0.2 | 3.0 | 0.63 | 0.56 | 49.0 |
| Approach | | 14 | 61.5 | 0.024 | 12.2 | LOS A | 0.2 | 3.0 | 0.63 | 0.56 | 49.1 |
| All Vehicles | | 128 | 67.2 | 0.125 | 13.5 | LOS A | 1.1 | 16.0 | 0.69 | 0.64 | 42.9 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# SITE LAYOUT

## Site: 1v [Marulan South Rd/ Stockpile Rd-Cross Junction AMS2 - TCS]

AM Maximum Hour S2. Traffic Signals
Signals - Fixed Time Isolated



# MOVEMENT SUMMARY

## Site: 1v [Marulan South Rd/ Stockpile Rd-Cross Junction AMS2 - TCS]

AM Maximum Hour S2. Traffic Signals
Signals - Fixed Time Isolated    Cycle Time = 45 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows Total veh/h | Demand Flows 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: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.087 | 16.6 | LOS B | 0.5 | 7.4 | 0.76 | 0.57 | 35.0 |
| 2 | T1 | 31 | 100.0 | 0.087 | 13.2 | LOS A | 0.5 | 7.4 | 0.76 | 0.57 | 34.9 |
| 3 | R2 | 1 | 0.0 | 0.087 | 16.6 | LOS B | 0.5 | 7.4 | 0.76 | 0.57 | 35.0 |
| Approach | | 33 | 93.5 | 0.087 | 13.3 | LOS A | 0.5 | 7.4 | 0.76 | 0.57 | 34.9 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 1 | 0.0 | 0.034 | 14.5 | LOS B | 0.3 | 4.3 | 0.63 | 0.51 | 49.9 |
| 5 | T1 | 17 | 56.3 | 0.034 | 9.0 | LOS A | 0.3 | 4.3 | 0.63 | 0.51 | 51.0 |
| 6 | R2 | 2 | 100.0 | 0.034 | 15.1 | LOS B | 0.3 | 4.3 | 0.63 | 0.51 | 48.1 |
| Approach | | 20 | 57.9 | 0.034 | 10.4 | LOS A | 0.3 | 4.3 | 0.63 | 0.51 | 50.7 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.104 | 17.0 | LOS B | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| 8 | T1 | 31 | 100.0 | 0.104 | 13.3 | LOS A | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| 9 | R2 | 4 | 100.0 | 0.104 | 17.0 | LOS B | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| Approach | | 37 | 100.0 | 0.104 | 13.9 | LOS A | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.081 | 15.3 | LOS B | 0.8 | 8.6 | 0.65 | 0.53 | 48.6 |
| 11 | T1 | 54 | 17.6 | 0.081 | 9.2 | LOS A | 0.8 | 8.6 | 0.65 | 0.53 | 51.7 |
| 12 | R2 | 1 | 0.0 | 0.081 | 14.7 | LOS B | 0.8 | 8.6 | 0.65 | 0.53 | 50.5 |
| Approach | | 59 | 23.2 | 0.081 | 10.1 | LOS A | 0.8 | 8.6 | 0.65 | 0.53 | 51.5 |
| All Vehicles | | 148 | 62.4 | 0.104 | 11.6 | LOS A | 0.8 | 8.7 | 0.70 | 0.55 | 42.0 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# MOVEMENT SUMMARY

## Site: 1v [Marulan South Rd/ Stockpile Rd-Cross Junction PMS2 - Conversion]

PM Maximum Hour S2. Traafic Signals

Signals - Fixed Time Isolated    Cycle Time = 45 seconds (User-Given Phase Times)

**Movement Performance - Vehicles**

| Mov ID | OD Mov | Demand Flows | | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total veh/h | HV % | | | | Vehicles veh | Distance m | | | |
| South: Overburden Rd | | | | | | | | | | | |
| 1 | L2 | 1 | 0.0 | 0.087 | 16.6 | LOS B | 0.5 | 7.4 | 0.76 | 0.57 | 35.0 |
| 2 | T1 | 31 | 100.0 | 0.087 | 13.2 | LOS A | 0.5 | 7.4 | 0.76 | 0.57 | 34.9 |
| 3 | R2 | 1 | 0.0 | 0.087 | 16.6 | LOS B | 0.5 | 7.4 | 0.76 | 0.57 | 35.0 |
| Approach | | 33 | 93.5 | 0.087 | 13.3 | LOS A | 0.5 | 7.4 | 0.76 | 0.57 | 34.9 |
| East: Marulan South Rd | | | | | | | | | | | |
| 4 | L2 | 1 | 0.0 | 0.062 | 14.6 | LOS B | 0.6 | 6.3 | 0.64 | 0.51 | 50.6 |
| 5 | T1 | 42 | 17.5 | 0.062 | 9.1 | LOS A | 0.6 | 6.3 | 0.64 | 0.51 | 51.9 |
| 6 | R2 | 2 | 100.0 | 0.062 | 15.2 | LOS B | 0.6 | 6.3 | 0.64 | 0.51 | 48.8 |
| Approach | | 45 | 20.9 | 0.062 | 9.7 | LOS A | 0.6 | 6.3 | 0.64 | 0.51 | 51.7 |
| North: Stockpile Rd | | | | | | | | | | | |
| 7 | L2 | 2 | 100.0 | 0.104 | 17.0 | LOS B | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| 8 | T1 | 31 | 100.0 | 0.104 | 13.3 | LOS A | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| 9 | R2 | 4 | 100.0 | 0.104 | 17.0 | LOS B | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| Approach | | 37 | 100.0 | 0.104 | 13.9 | LOS A | 0.6 | 8.7 | 0.76 | 0.59 | 34.7 |
| West: Marulan South Rd | | | | | | | | | | | |
| 10 | L2 | 4 | 100.0 | 0.024 | 15.1 | LOS B | 0.2 | 3.0 | 0.63 | 0.56 | 47.2 |
| 11 | T1 | 8 | 50.0 | 0.024 | 9.0 | LOS A | 0.2 | 3.0 | 0.63 | 0.56 | 50.1 |
| 12 | R2 | 1 | 0.0 | 0.024 | 14.5 | LOS A | 0.2 | 3.0 | 0.63 | 0.56 | 49.0 |
| Approach | | 14 | 61.5 | 0.024 | 12.2 | LOS A | 0.2 | 3.0 | 0.63 | 0.56 | 49.1 |
| All Vehicles | | 128 | 66.4 | 0.104 | 11.9 | LOS A | 0.6 | 8.7 | 0.70 | 0.55 | 40.8 |

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

# Appendix U

## Economic assessment

## VOLUME 7

# Marulan South Limestone Mine Continued Operations

## Economic Assessment

*Prepared for*

**Boral Cement Limited**
**C/- Element Environment Pty Ltd**

*By*

**Gillespie Economics**
**Email:** gillecon@bigpond.net.au

**March 2019**

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## EXECUTIVE SUMMARY

Gillespie Economics has been engaged by Element Environment Pty Ltd (Element) on behalf of Boral Cement Limited (Boral) to complete an Economic Assessment for the Marulan South Limestone Mine Continued Operations (the Project). Boral is seeking approval for continued operations at the existing Marulan South Limestone Mine for a 30 year period.

This Economic Assessment relates to the preparation of each of the following types of analyses:

- A Cost Benefit Analysis (CBA) of the Project;
- A Local Effects Analysis (LEA), including using input-output (IO) analysis for two regions:
  - The regional economy of Goulburn Mulwaree Local Government Area (LGA); and
  - The NSW economy.
- An assessment against economic heads of consideration in the Secretary's Environment Assessment Requirements (SEARs).

### CBA

A CBA of the Project indicated that it would have net social benefits to Australia of between $488M and $643M, and net social benefits to NSW of between $166M and $321M. Hence the Project is desirable and justified from an economic efficiency perspective. Environmental, social and cultural impacts of the Project have been minimised through Project design and mitigation, offset and compensation measures. The economic value of residual impacts are considered to be immaterial from an aggregated economic efficiency perspective.

While the main environmental, cultural and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $488M and $643M for the Project to be questionable from an Australian economic efficiency perspective, and greater than between $166M and $321M for the Project to be questionable from NSW economic efficiency perspective.

### LEA

The Project will provided continued employment for approximately 118 employees on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North Ryde that would otherwise not be employed if it weren’t for the mine.

Economic activity analysis, using IO analysis, estimated that the Project, including the 118 employees on-site, would make up to the following direct and indirect average annual contribution to the regional economy[1] for approximately 30 years:

- $82M in annual direct and indirect regional output or business turnover;
- $48M in annual direct and indirect regional value added;
- $14M in annual direct and indirect household income; and
- 198 direct and indirect jobs.

The Project is estimated to make up to the following direct and indirect average annual contribution to the NSW economy for 30 years:

---

[1] The Local Government Area of Goulburn Mulwaree.

- $137M in annual direct and indirect regional output or business turnover;
- $74M in annual direct and indirect regional value added;
- $27M in annual direct and indirect household income; and
- 364 direct and indirect jobs.

With regard to the SEARs heads of consideration:

- the resource proposed to be mined is part of an estimated in-situ resource of 640 million tonnes of high grade limestone.
- the Project is an extension and continuation of the existing Marulan South Limestone Mine and as such the Project can utilise infrastructure servicing the existing mine.
- numerous sectors in the regional economy have some dependence on the Project as 92% of the existing workforce live in the Goulburn Mulwaree LGA and hence a material component of their expenditure would flow-on to local businesses. Similarly, Boral has identified that it spends considerable operational expenditure with local firms.
- the Project will provide continued direct employment for approximately 191 full time personnel in connection with the mine, including lime manufacturing, administration and logistics. This includes 118 personnel on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North Ryde that would otherwise not be employed if it weren’t for the mine. It will also provide indirect employment in the regional economy from employee and Project expenditure.
- the capital investment associated with the Project is estimated at $111M.
- the Project will generate royalties of $44M in total or $15M present value.
- the Project is a continuation of an existing mining operation and hence no additional demand for NSW or local community infrastructure is expected.

# 1 INTRODUCTION

## 1.1 Introduction

Gillespie Economics has been engaged by Element Environment Pty Ltd (Element) on behalf of Boral Cement Limited (Boral) to complete an Economic Assessment for the Marulan South Limestone Mine Continued Operations (the Project). The purpose of the Economic Assessment is to form part of an Environmental Impact Statement (EIS) being prepared by Element to support an application for State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the continuation of the Marulan South Limestone Mine (the Project).

## 1.2 Legislative Context and Guidelines[2]

This Economic Assessment has been carried out in accordance with:

- the Secretary's Environmental Assessment Requirements (SEARs) for the Project that relate to economics i.e.
    - an assessment of the likely economic impacts of the development, paying particular attention to:
        - the significance of the resource;
        - the economic benefits of the project for the State and region; and
        - the demand for the provision of local infrastructure and services.
    - the reasons why the development should be approved having regard to biophysical, **economic** and social **considerations**, including the principles of ecologically sustainable development.
- Clause 7(1)(f) of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* which requires environmental assessments to provide "*the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, economic and social considerations…"* Note to Clause 7 (1) (f) states that "*A cost benefit analysis may be submitted or referred to in the reasons justifying the carrying out of the development, activity or infrastructure."*
- Section 79C of the EP&A Act which requires the following two matters to be taken into consideration by the consent authority in determining a development application:
    - the public interest (taken as the collective public interest of households in NSW); and
    - the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and ***economic impacts in the locality***.
- the following standards, guidelines and policies:
    - NSW Government (2015) *Guideline for the economic assessment of mining and coal seam gas proposals*;
    - NSW Government (2018) *Technical Notes Supporting the Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals*;
    - NSW Treasury (2017) *NSW Government Guide to Cost-Benefit Analysis*; and

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[2] Refer to Attachment 1 for the legislative context for economic methods in Environmental Impact Assessment (EIA) in NSW.

  - James and Gillespie (2002) *Draft Guideline for Economic Effects and Evaluation in Environmental Impact Assessment (referred to in the SEARs)*.

To meet the above requirements two types of analysis are needed:

- a cost benefit analysis (CBA) which is the primary way that economists evaluate the net benefits of projects and policies, provide economic justification for a project and addresses the public interest;

- a local effects analysis (LEA) to assess the impacts of the Project in the locality, specifically:

  - effects relating to local employment;
  - effects relating to non-labour project expenditure; and
  - environmental and social impacts on the local community.[3]

Economic analysis tools of CBA and LEA are not mechanised decision-making tools, but rather a means of analysis that provides useful information for decision-makers to consider alongside the performance of a project in meeting other, often conflicting, government goals and objectives.

### 1.3 Report Outline

Section 2 outlines the scope of the project, a summary of the impacts of the project and the proposed mitigation measures, as assessed in the EIS[4]. This is the information on which the Economic Assessment is based. Section 3 provides an overview of the CBA and LEA approach used in this study. Section 4 and 5 document the CBA and LEA of the Project, respectively. Section 6 provides a supplementary LEA. Section 7 specifically addresses the SEARs and conclusions are provided in Section 8.

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[3] Refer to Attachment 2 for an introduction to economic methods.

[4] The reader should refer to the EIS for more detailed qualitative consideration of the scope of the Project, Project impacts and mitigation measures.

# 2 PROJECT DESCRIPTION

## 2.1 Overview

Boral owns and operates the Marulan South Limestone Mine (the mine). It is a long standing open cut mine that has produced up to 3.38 million tonnes of limestone based products per year for the cement, steel, agricultural, construction and commercial markets.

The mine is a strategically important asset for Boral, as it supplies the main ingredient for the manufacture of cement at Boral's Berrima Cement Works. This is also a strategically important operation for Sydney based consumers of these products as this represents around 60% of the cement sold in NSW and feeds into more than 30% of concrete sold in Sydney.

The mine operates under Consolidated Mining Lease No. 16 (CML 16), Mining Lease No. 1716, Environment Protection Licence (EPL) 944 and a combination of development consents issued by Goulburn Mulwaree Council and continuing use rights.

Due to changes between the *Mining Act 1992* and the EP&A Act, when mining moves beyond the area covered by the current Mining Operations Plan, a development consent under the EP&A Act will need to be in place.

An EIS has been prepared by Element on behalf of Boral for submission to the Department of Planning and Environment to satisfy the provisions of Part 4 of the EP&A Act. Boral is seeking approval for continued operations at the site through a development application for a State Significant Development including a 30 year mine plan, associated overburden emplacement areas and a mine water supply dam.

## 2.2 Site Description

### *2.2.1 Site Location*

The mine is in Marulan South, 10 km southeast of Marulan village and 35 km east of Goulburn, within the Goulburn Mulwaree Local Government Area in the Southern Tablelands of NSW. Access is via Marulan South Road, which connects the mine and Boral's Peppertree Hard Rock Quarry (Peppertree Quarry) with the Hume Highway approximately 9 km to the northwest. Boral's private rail line connects the mine and Peppertree Quarry with the Main Southern Railway approximately 6 km to the north.

### *2.2.2 Land Use and Ownership*

CML 16 (which encompasses ML 1716) covers an area of 616.5 hectares (ha), which includes land owned by Boral (approximately 475 ha), Crown Land (adjoining to the south and east) and five privately owned titles. There is also Boral owned land surrounding the mine that does not fall within CML 16.

Land use surrounding the mine is a mixture of extractive industry, grazing, rural residential, commercial/industrial and conservation.

The mine is separated from the Bungonia State Conservation Area to the south by Bungonia Creek and is separated from the Shoalhaven River and Morton National Park to the east by Barbers Creek.

Peppertree Quarry, owned by Boral Resources (NSW) Pty Limited, borders the mine to the north. The site of the former village of Marulan South is between the mine and Peppertree Quarry on land owned by Boral. The village was established principally to service the mine but has been uninhabited since the late 1990's. The majority of the village's infrastructure has been removed and only a village hall and former bowling club remains. The bowling club has been converted into administration offices for the mine and the hall is used by the mine services team.

A small number of rural landholdings surround the Boral properties to the north and west, including an agricultural lime manufacturing facility, fireworks storage facility, turkey farm and rural residential (a number of these properties are actively grazed). The main access for these properties is via Marulan South Road. Rural residential properties are also located to the northeast of the mine along Long Point Road. These properties are separated from the mine by the deep Barbers Creek gorge.

### *2.2.3 Zoning*

The majority of the site is zoned RU1 - Primary Production zone under the Goulburn Mulwaree Local Environmental Plan (LEP) 2009. Mining and extractive industries are permissible in this zone with consent.

The remaining area is zoned E3 - Environmental Management. Under this zone mining and extractive industries are prohibited development, although historically mining has occurred within these areas under “existing use rights” as mining and processing operations commenced well before the commencement of the Mulwaree Planning Scheme Ordinance (PSO) on 15 May 1970. Notwithstanding that both mining and extractive industries are prohibited in the E3 zone these activities are permissible pursuant to State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007. In accordance with Clause 7(1)(b)(i) of this SEPP mining can be carried out with consent in any zone which has agriculture as a permissible land use (with or without consent). Agriculture is permitted with consent in the E3 - Environmental Management zone under the Goulburn Mulwaree LEP 2009. Similarly, Clause 7(3)(a) of this SEPP makes it clear that extractive industries can be carried out with consent in any zone which has agriculture as a permissible land use (with or without consent). Therefore, both mining and extractive industries are land uses which can be carried out provided development consent is granted.

Boral operates the mine pursuant to Section 109 of the EP&A Act and the continuance of an existing use and its expansion is possible provided the necessary approvals are in place. Therefore, there are no environmental planning issues that would prohibit approval of expanded operations at the mine.

Importantly, the Project aims to improve the stability of existing overburden emplacements and improve rehabilitation outcomes over the entire site.

## 2.3 Existing Operations

The mine is sited on a high grade limestone resource. Subject to market demand the mine has typically produced 3 to 3.38 million tonnes of limestone and 120,000 to 200,000 tonnes of shale per annum.

The mine currently produces a range of limestone products for internal and external customers in the Southern Highlands/Tablelands, the Illawarra and Metropolitan Sydney markets for use primarily in cement and lime manufacture, steel making, agriculture and other commercial uses. Products produced at the mine are despatched by road and rail, with the majority despatched by rail.

Historically limestone mining was focused on the approximately 200-300 m wide Eastern Limestone and was split between a North Pit and a South Pit. A limestone wall (referred to by the mine as the ‘centre ridge’) rising almost to the original land surface, divided the two pits. The North and South Pits were recently joined in 2016/2017 by mining the centre ridge to form a single contiguous pit, approximately 2 km in length. However, the North Pit/South Pit nomenclature remains important as current mining operation locations continue to be reported with respect to one or other of the old pits.
Limestone and shale are extracted using open-cut hard rock drill and blast techniques. Material is loaded using front end loaders and hauled either to stockpiles or the processing plant using haul

trucks. Oversized material is stockpiled and reduced in size using a hydraulic hammer attached to an excavator.

Limestone processing facilities including primary and secondary crushing, screening, conveying and stockpiling plant and equipment are in the northern end of the North Pit. Kiln stone grade limestone is also processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment. Overburden from stripping operations is emplaced in the Western Overburden Emplacement, west of the open cut pits.

The current operations are 24 hour, 7 days per week with personnel employed on a series of 8, 10 and 12 hour shifts to cover the different operational aspects of the mine. Blasting is restricted to daylight hours and on weekdays, excluding public holidays.

## 2.4 The Proposed Project

### *2.4.1 Mining Operations*

Boral proposes to continue mining limestone from the mine at a rate of up to 4 million tonnes per annum (mtpa) for a period of up to 30 years. This represents an increase in extraction rate from historic levels (peak of 3.38 mtpa) due to forecast increased demand from the construction industry. Shale will continue to be extracted at a rate of up to 200,000 tonnes per annum (tpa).

The proposed 30 year mine plan accesses approximately 120 million tonnes of limestone down to a depth of 335 m AHD. The mine footprint focuses on an expansion of the North Pit westwards to mine the Middle Limestone and to mine deeper into the Eastern Limestone. As the Middle Limestone lies approximately 70 m to 150 m west of the Eastern Limestone, the 30 year mine plan avoids mining where practical the interburden between these two limestone units thereby creating a smaller second, north-south oriented West Pit with a ridge remaining between. The North Pit will also be expanded southwards, encompassing part of the South Pit, leaving the remainder of the South Pit for overburden emplacement and a visual barrier.

In addition to mining approximately 5 million tonnes of shale, the extraction of the limestone requires the removal of approximately 108 million tonnes of overburden over the 30 year period. This material will be emplaced within existing and proposed overburden emplacement areas.

Limestone will continue to be mined using drilling and blasting methods. Shale will continue to be mined by excavator/front end loader. Limestone, shale and overburden will be transported to the primary crusher, stockpile areas and overburden emplacements respectively, using the load and haul fleet of trucks.

Products produced at the mine will continue to be despatched by road and rail, with the majority despatched by rail.

The limestone sand plant, produces a crushed and air classified limestone sand for use in concrete. The mine currently produces 500,000 tpa for Peppertree Quarry and propose to increase production of manufactured sand to approximately 1 million tpa.

Boral’s adjoining Peppertree Quarry currently has approval to emplace some of its overburden in the South Pit mine void. As the South Pit is required for the emplacement of over 30 million tonnes of overburden from the mine after the removal of accessible limestone, Boral proposes to emplace up to 15 million tonnes of overburden from Peppertree Quarry within the Northern Overburden Emplacement.

### *2.4.2 Associated Infrastructure*

*Processing*

The existing facilities for processing limestone will continue to be utilised to produce a series of graded and blended limestone products that are despatched from site for use primarily in cement manufacture, steel making, commercial and agricultural applications.

Limestone processing facilities include primary and secondary crushing, screening, conveying and stockpiling plant and equipment located north-west of the North Pit and extending to the tertiary crushing, screening, bin storage and despatch (rail and road) systems that form part of the main processing facilities.

Kiln stone grade limestone will also continue to be processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment.

Processing infrastructure and the reclaim and stockpile area at the northern end of the North Pit will be relocated during the life of the 30 year pit to enable full development of the mine plan. The timing and location of this is presented in the EIS.

Shale and white clay will not be processed and will be stockpiled directly from the pit, ready for dispatch by road to the Berrima and Maldon cement operations.

*Water Supply*

Water supply for the Project, including dust suppression, processing activities and some non-potable amenities will be from existing and new on-site dams and a proposed new water supply dam on Marulan Creek. This dam would be located on Boral owned land north of Peppertree Quarry and utilises Boral’s adjoining Tallong water pipeline to transfer water to the mine. This dam would require the purchase of water entitlements.

Mine water demand will also be supplemented by Tallong Weir via the Tallong water pipeline.

*Rail*

No changes are proposed to the existing rail infrastructure. A 1.2 km long passing line was constructed at Medway Junction during construction of the Peppertree Quarry, which will also be used by the mine to enhance access to the Main Southern Railway.

*Road*

Road access from the mine to the Hume Highway is via Marulan South Road. The proposed Western Overburden Emplacement extends northwards over Marulan South Road. Boral propose to realign a section of Marulan South Road, to accommodate the northern portion of the proposed Western Overburden Emplacement.

All public roads within the former village of Marulan South as well as the section of Marulan South Road between Boral’s operations and the entrance to the agricultural lime manufacturing facility will be de-proclaimed.

*Power*

Power supply to the mine is via a high voltage power line that commences at a sub-station on the southern side of Marulan South Road, immediately west of the Project boundary. A section of this power line will be relocated to accommodate the proposed Northern Overburden Emplacement.

### *2.4.3 Transport*

The majority of limestone products will continue to be transported to customers by rail for cement, steel, commercial and agricultural uses. Boral seeks no limitation on the volume of products transported by rail.

Manufactured sand will continue to be transported by truck along a dedicated internal road, across Marulan South Road and into Peppertree Quarry for blending and dispatch by rail.

Agricultural lime, quick lime and fine limestone products will continue to be transported by powder tanker, bulk bags on trucks or open tipper trucks along Marulan South Road.

Shale, limestone aggregates, sand and tertiary crushed products will be transported by predominantly truck and dog along Marulan South Road.

The adjoining Peppertree Quarry is currently approved to transport all products by rail. Boral will seek to transport approximately 150,000 tpa of Peppertree Quarry's products from the mine to customers via Marulan South Road. This could be achieved by back loading to a new shared road sales product stockpile area by the trucks carrying the limestone sand to Peppertree Quarry. A new road sales product stockpile area is proposed on the northern side of Marulan South Road, immediately west of the mine and Peppertree Quarry entrances. This shared finished product stockpile area, includes a weighbridge and wheel wash and will service both the mine and Peppertree Quarry.

In total, Boral is seeking to transport up to 600,000 tpa of limestone and hard rock products along Marulan South Road to the Hume Highway, as well as 120,000 tpa of limestone products to the agricultural lime manufacturing facility.

## 2.5 Project Impacts

This Section summarises the biophysical impacts of the Project based on the technical assessments in the EIS. It provides the basis for the economic consideration of impacts in latter parts of this report.

### *2.5.1 Soils and Land Capability*

The Biophysical Strategic Agricultural Land (BSAL) assessment determined that the nearest regionally mapped BSAL land is approximately 7.5 km to the north-east of the Project site, and that the land and soils in the Project site are not BSAL. An assessment of land capability found at the Project site is summarised in Table 2.1.

**Table 2.1 - Area of Land Capability Classes in the Project Site**

| Land capability class | Assessment area (ha) | | Total (ha) |
|---|---|---|---|
| | Northern | Southern | |
| Class V: moderate to low capability land | 27.5 | 127.2 | 155 |
| Class VII: very low capability land | – | 119.8 | 119.8 |
| Class VIII: extremely low capability land | 0.2 | 230.4 | 230.6 |
| Not assessed: mining disturbed land | – | 340.6 | 340.6 |
| **Total** | | | **846** |

Management measures will not be required to maintain land capability in the Project site given the low pre-disturbance capability classes (V, VII and VIII) and the relatively small area of proposed disturbance (256.5 ha). Therefore, the Project will have minimal negative impact on the overall land capability.

### *2.5.2 Noise and Blasting*

The Noise and Blasting Assessment assessed the potential operational noise, blasting, construction noise and road traffic noise impacts of the Project. The study found that:

- predicted noise emissions from the mine operation, including low frequency noise, comply with the Project noise trigger levels at all receivers and during all operating periods (day, evening and night).
- only the construction of the Marulan Creek Dam and associated vehicle access tracks will be outside the operational area of the mine. The other construction activities would occur within the mine, with equipment comparable to operational activities already assessed. Noise emissions from the construction of the Marulan Creek Dam are predicted to comply with the relevant construction noise criteria during standard construction hours at all identified receivers.
- during operation of the mine there would be an increase in traffic volumes Traffic noise is predicted to increase during the day by up to 2 dBA and during the night by up to 1 dBA at both the worst affected and typical residence and will therefore comply with the traffic noise criterion at all receivers.
- no changes are proposed to the existing rail infrastructure or to the maximum of six trains that depart the mine per day. Therefore, there will be no increase in rail noise associated with the Project. The rail noise from a combination of the mine and Peppertree Quarry trains using the Boral private rail line, is below the RING criteria for non-network rail lines during all time periods.
- predicted blast vibration and overpressure levels are well below the building damage criteria, human annoyance and discomfort criteria, at all sensitive receivers.

### *2.5.3 Air Quality*

The air quality impact assessment examined potential air quality impacts that may arise from the proposed continued operation of the Marulan South Limestone Mine. The assessment utilised air dispersion modelling and focused on potential dust impacts from the proposal in isolation (incrementally) and cumulative with other nearby operations (the Peppertree Quarry) and background levels of dust. The assessment also investigated the potential air quality impacts associated with emissions from the processing activities.

The dispersion modelling predictions showed that the Project with the application of normal, good practice dust mitigation and management strategies would not lead to any air quality levels above the relevant criteria at any privately-owned sensitive receptors. The assessment of cumulative 24-hour average $PM_{10}$ concentrations found that the Project, in conjunction with operations at the Peppertree Quarry, would not result in any additional days above the 24-hour average $PM_{10}$ criterion.

The dispersion modelling predictions show that the Project with the application of suitable dust mitigation and management strategies would not lead to any air quality levels above the relevant criteria at any privately-owned sensitive receivers.

The assessment of cumulative 24 hour average $PM_{10}$ concentrations found that the Project, in conjunction with operations at the Peppertree Quarry, would not result in any additional days above the 24 hour average $PM_{10}$ criterion at the privately owned sensitive receiver locations. The Boral owned receiver B4 is predicted to exceed the annual average $PM_{10}$ criteria in Stage 1.

### *2.5.4 Greenhouse Gases*

Greenhouse gas emissions arise from both the construction and operation of the Project. The total estimated emissions from construction activities associated with the Project is 14,179 $tCO_2$-e. This includes emissions associated with the following construction activities:

- vegetation clearing to prepare the site for construction;
- spreading of mulched vegetation;
- lost carbon sink due to land clearing;
- site office operations;
- Marulan Creek Dam;
- Marulan South Road Realignment;
- powerline relocation;
- Road Sales Stockpile Area; and
- Stockpile Reclaim Area relocation.

The total estimated emissions from the operation of the Project is 122,703 $tCO_2$-e. The predominant source of emissions from continued operation of the mine are expected to be from electricity and fuel use. These emissions would be generated by the following activities:

- overburden removal;
- limestone mining;
- clay shale mining;
- hauling of limestone and clay shale to processing/stockpile facility;
- hauling of overburden to emplacements;
- limestone processing;
- kiln stone grade limestone processing;
- clay shale and white clay processing;
- water use; and
- transport of product to customers by rail and road (external to the Project site).

The overall emissions summary is provided in Table 2.2.

**Table 2.2 - Project Emissions Summary**

| Period | Scope 1 Estimated emissions (tCO2-e) | Scope 2 Estimated emissions (tCO2-e) | Scope 3 Estimated emissions (tCO2-e) | Total Estimated emissions (tCO2-e) |
|---|---|---|---|---|
| Construction | 13,971.64 | 7.81 | 199.24 | 14,178.69 |
| Annual Operation | 94,660 | 15,780 | 12,263 | 122,703 |

### *2.5.5 Surface Water*

Potential surface water impacts relate to water supply, water quality of discharges and flooding.

The main water source for the Project will be runoff, which will be collected in sediment basins and mine water dams. It includes the construction of the Marulan Creek Dam. There will be a requirement to either transfer Boral's existing entitlements for water from Tallong Weir and/or acquire additional water licences from the Barbers Creek management zone to cover the maximum supplementary 183 ML/yr supply from Mural Creek Dam. In addition, under the 2011 Greater Metropolitan Region Groundwater Sources WSP, groundwater extraction requires an authorisation under a water access licence or some form of exemption. Therefore, all groundwater take (incidental or otherwise) needs to be accounted for by obtaining a groundwater entitlement sufficient to account for the peak take prior to that extraction occurring. In order to address this requirement Boral obtained additional groundwater entitlement (WAL41976) of 838ML in September 2017.

Water will be released from the mine as occasional overflows from the water management system. Impacts from releases are likely to be minimal as the proposed water management system will reduce sediment loads. Any dissolved metals and metalloids in initial runoff and seepage from most overburden emplacements are unlikely to mobilise and impact surface water quality as they are sparingly soluble in slightly alkaline contact water.

While there could be minor flooding of the pit floor during operations and post-mining, this will not result in overflows from the pit during floods.

Boral will undertake ongoing monitoring of the occasional water discharges from the site, as well as the water balance.

### *2.5.6 Groundwater*

The impact of the future mining activities was assessed against the Aquifer Interference Policy ‘minimal impact considerations’ for less productive groundwater sources using a numerical groundwater flow model. Impacts were considered on fractured rock aquifers around the mine, groundwater users, groundwater dependent ecosystems, springs and groundwater quality. The study found that:

- proposed expansion of the mine to the west into the limestone-sedimentary-metamorphic blocks will have minimal impacts on groundwater as this area has already been drained by the naturally occurring interconnected structural features. The only groundwater that will be removed in this area will be that contained in the porous spaces of the limestone. Mining will result in a slight increase in groundwater inflows to the pits due to the increased groundwater gradient towards the pits, which will increase by 1 $m^3$/day over the proposed 30 year mine life.
- groundwater drawdown will be more extensive in the upper North Pit and along the eastern edge of the pit between the current North and South pits by the end of mining. The 1 m drawdown contour encompasses the area from approximately 620 m northeast of the northern edge of the pit to approximately 290 m from the eastern edge of the current pit. The 1 m drawdown contour will expand after mining to reach equilibrium approximately 1.2 km to the north-east of the void and approximately 600 m to the west and east of the void. However, no groundwater users will be impacted by the Project. Boral’s current production wells WP16/WP17 and in-pit monitoring wells MW1 and MW2 will be consumed by the mine.
- flora and fauna surveys identified aquatic fauna and spring dependent flora of high ecological value along drainage lines, especially Barbers Creek and Bungonia Gorge. There is no apparent impact of current mining activities on the aquatic fauna and the potential groundwater drawdown associated with the Project is unlikely to impact GDEs as the drawdown zone only marginally overlaps with the zones with high potential for groundwater interaction.

- springs have been observed at the base of Bungonia Gorge and are assumed to occur elsewhere near the mine where the water table is intersected by the slopes of gorges. Springs are unlikely to be adversely impacted as mining will result in an increase of 11 $m^3$/day of outflow from the pit to the underlying geology.
- the limestone aquifer is currently recharged by rainfall, surface runoff and from adjacent geological units. The Project will not change these recharge pathways, provided the proposed surface water management measures are implemented, which will maintain surface water flow and quality in the pit. The geochemical investigation of the overburden and limestone ore demonstrated that overburden emplacement and ore stockpiling will have a minimal to negligible impact on groundwater quality. Recharge from the bedrock into the Bungonia Creek alluvium will only reduce by 1% as a result of the Project, and there will be no decrease to the Barbers Creek alluvium. Therefore, impacts on the baseflow water quality of the creeks will be minimal.

There is an established ground and surface water level and quality monitoring network around the mine, which will continue to be used and maintained during the life of the Project. Groundwater monitoring wells which are removed during mining will be replaced over the life of the Project if determined to be necessary by an appropriately qualified groundwater specialist.

The primary residual impact on groundwater from the Project will be an approximately 1 m drawdown of the water table to approximately 1.2 km north-east of the northern extent of the mine, and approximately 600 m east and west of the final void. This drawdown is not predicted to impact any private groundwater bores. Therefore, 'make good' arrangements with surrounding land owners will not be necessary. The modelled level and extent of drawdown will be verified by groundwater monitoring, and changes will be investigated if drawdown is deeper or more extensive than predicted.

### *2.5.7 Terrestrial Ecology*

The Project will directly and indirectly impact biodiversity during construction and operation. Most impacts on biodiversity will occur during construction associated with clearing of native vegetation and removal of habitat.

The following direct impacts will result from the Project:

- clearing of native vegetation and associated habitat, conservatively estimated to be 182.4 ha, including 88.6 ha of White Box Yellow Box Blakely's Red Gum Grassy Woodland TEC;
- clearing of associated species credit fauna habitat, comprising;
  - clearing of an estimated 132.4 ha of Koala habitat;
  - clearing of an estimated 140.3 ha of Large-eared Pied Bat habitat; and
- removal of one individual *Solanum celatum*.

Assessments of significance were undertaken for direct impacts on White Box Yellow Box Blakely's Red Gum Grassy Woodland TEC, and potential impacts to habitat associated with the Koala and Large-eared Pied Bat. An assessment of significance was also undertaken for Grey-headed Flying Fox habitat, and other EPBC listed migratory species.

The assessments of significance had the following conclusions:

- the removal of TEC and impact to Koala habitat will have a significant impact and triggers the need to offset the impacts under the EPBC Act;
- offsets will not be required for the Large-eared Pied Bat under the EPBC Act, but offsets will be required under the BC Act; and
- impacts on the other threatened and migratory species listed under the EPBC Act will not be significant and will not require offsetting.

Indirect impacts will mostly occur during the construction phase of the Project and will be short term and largely confined to the Project site and immediate surrounds. The primary indirect impacts will be:

- increased noise, dust and light spill from the construction and operation of the Project;
- loss of connectivity and fragmentation of habitats at a regional scale through clearing of intact areas of native vegetation;
- increased edge-effects for surrounding vegetated areas;
- changes in vegetation composition and structure as well as available fauna habitats due to altered fire regimes (more or less frequent fire);
- erosion and sedimentation in areas adjoining construction and operational activities; and
- spread of weed propagules, which could lead to invasion of native vegetation by weeds.

The proposed offset strategy includes a combination of:

- a 1,000 ha property already purchased by Boral within the Bungonia subregion for the purposes of offsetting for the current Project;
- the purchase of credits that would be available at a number of proposed Stewardship sites; and
- a remaining credit liability which would either be paid into the Biodiversity Conservation Trust Fund or through establishment of additional Stewardship sites

### *2.5.8 Aquatic Ecology*

The Project is positioned at the headwaters of the Barbers Creek and Bungonia Creek, which are tributaries to the Shoalhaven River. The Shoalhaven River is, at its closest point, approximately 1.5 km east of the Project site.

The Project site is drained by ephemeral drainage lines of Marulan Creek and Tangarang Creek into Barbers Creek to the east and Bungonia Creek to the south.

The catchments of both creeks contain several farm dams and Tangarang Creek has been dammed to supply water for Peppertree Quarry.

There is expected to be some impact on aquatic ecology, particularly in close proximity to and immediately downstream of the proposed Marulan Creek Dam, with this impact diminishing with distance downstream as more water/aquatic habitat is available. However, the impacts of the Marulan Creek Dam on aquatic ecology is likely to be minimal given that:

- the system currently has an altered flow regime from farm dams;
- downstream will likely receive 10% of natural inflows as part of the dam management; and
- the ecology is modified and adapted to an ephemeral/low flow environment.
- the dam structure would provide some aquatic habitat for lentic invertebrates, macrophytes, birds, amphibians and fish.

There may be minor alterations to the flow regime of Tangarang Creek associated with an increase in total catchment area as a result of the Project. However, the magnitude of change is considered unlikely to significantly impact aquatic ecology and may in fact provide more habitat with the increased flow.

### *2.5.9 Stygofauna and Groundwater Dependent Ecosystems*

Groundwater sources in the Project site include shallow unconsolidated aquifers and deep consolidated aquifers. The shallow groundwater is in the pore spaces in the sediment or regolith. The deep groundwater is in the rock fractures in the bedrock, which have been caused by geologic and structural movement associated with intrusive volcanic activity or dissolution of limestone.

No stygofauna were identified within the current area of operation of the Marulan Limestone Mine or the Project site, however stygofauna were found in one location outside the Project site. In addition to stygofauna, a number of groundwater dependent springs were identified in the surrounding downslope water catchments that include Bungonia Creek and Barbers Creek.

The aquifer risk assessment process was applied to each of the stygofauna survey sites to determine the risk of stygofauna across the Project site being adversely impacted by the Project. This involved using the survey results to note presence of fauna at the sites, determining the ecological value of the site and determining the risk posed by Project impacts to determine the overall risk.

All of the groundwater monitoring wells/bores and the Bungonia Creek Upper site had low ecological value, while the remaining spring sites had high ecological value given the abundance and diversity of species and the ecosystem health.

The ecological risk was low at all sites as it is predicted that the groundwater table is likely to only reduce by 1 m within approximately 290 m of the eastern edge of the current mine pit as a result of mining, and flows/water quality will be maintained at the springs. Additionally, none of the ground dependent ecosystems will be directly impacted by mining as they are outside the disturbance area.

Overall, the assessment determined the Project poses a low risk to stygofauna.

### *2.5.10 Traffic and Transport*

Boral is proposing upgrades to Marulan South Road by way of the realignment of a section of the road, and widening the pavement in the narrower sections to meet Mulwaree Goulburn Council's DCP requirements, as well as a new cross junction intersection and associated works in Marulan South Road adjacent the Road Sales Stockpile Area.

The assessment of the traffic impacts of the additional product truck movements on the adjoining road network and intersections found that the impacts would be satisfactory and there will be minimal changes to the Level of Service and vehicle delays on the road network, including at all key intersections.

The Project is not expected to have any negative impacts on the other road users and or on road safety.

The construction impacts associated with the road upgrading works will be managed through separate Construction Traffic Management Plans which will be prepared with full consultation with Goulburn Mulwaree Council, following approval of the Project.

Boral is currently paying a contribution to Council for road maintenance and will continue to do so with the Project in place.

### *2.5.11 Aboriginal Heritage*

Seventy five sites were considered in the Aboriginal Heritage Assessment. Forty nine sites will be impacted by the Project, 25 sites will not be impacted and one site will be removed as part of approved mining. Of the impacted sites, 39 will be totally lost and 10 will be totally disturbed. However, only one site of high significance will be impacted, while 6 of moderate significance will be impacted.

**Table 2.3 - Aboriginal Heritage Sites Impacted**

| IMPACT LEVEL | SIGNIFICANCE | | | TOTAL |
|---|---|---|---|---|
| | LOW | MODERATE | HIGH | |
| **No impact** | | | | |
| Mining (previously mined) | 1 | | | **1** |
| None | 20 | 5* | | **25** |
| **Total disturbance** | | | | |
| Marulan Creek Dam flood area | 9 | 1 | | **10** |
| **Total loss** | | | | |
| Emplacement | 27 | 3 | | **30** |
| Haul road | 3 | | | **3** |
| Marulan Creek Dam disturbance footprint | 1 | 2 | 1 | **4** |
| Marulan Creek Dam haul road | 2 | | | **2** |
| **Total** | **63** | **11** | **1** | **75** |

* Includes test pits MSL 045 and MSL 048 which will have areas of nearby sensitivity that will be impacted.

### *2.5.12 Historic Heritage*

There is little opportunity to revise the proposed disturbance footprint to avoid impacts to historic heritage items due the shape and orientation of the limestone resource, and seven items of local heritage significance in the Project site will be completely or partially removed. However, there will be opportunities to implement management measures prior to development of the areas containing the items. This will enable data to be extracted which will be useful for future research on spatial analysis, comparative analysis and the material culture created by nineteenth and early twentieth century miners.

### *2.5.13 Visual Impacts*

The nature, extent and significance of the potential visual impacts of the Project were considered with reference to the range of public and private places that could be affected.

The Visual Impact Assessment found that the Project has a low overall visual exposure to its visual catchment. Despite there being a number of rural properties and commercial operations within 3km of the closest part of the Project, (medium viewing distance and sensitivity classes) there is low visual exposure of the Project to those receivers and most have no views of it. The Project is not exposed to view from roads that carry either through traffic or significant numbers of viewers and is not in a destination that would attract visitation by tourists.

However, the Project is partly exposed to views from parts of two reserves of natural landscape, Bungonia NP and Morton NP. There would be some residual visual impacts on these locations, as mitigation of impacts will reduce, but not eliminate impacts. The greatest visual exposure of the Project is to the Bungonia Lookdown in Bungonia NP and there is lesser exposure to a short section of a track leading south into the Morton National Park from the Long Point lookout.

The visual exposure of night time lighting has been considered and determined to be of low visual exposure. The assessment concludes that while there are some residual visual impacts, these are minor in significance.

### 2.6 Mitigation Measures

Boral proposes to work in partnership with Goulburn Mulwaree Council and the local community so that the benefits of the Project to the region are maximised and impacts minimised, as far as possible. In this respect, a range of general and specific economic impact mitigation and management measures are proposed and would include:

#### *Potential Environmental, Cultural and Social Impacts*

- A range of measures to mitigate, offset and compensate for potential environmental, cultural and social impacts of the Project. A full outline of these is provided in the EIS.

#### *Potential Workforce Impacts*

- Provision of ongoing employment for the existing workforce which would be made redundant if the Project is not approved;
- Employment of regional residents preferentially where they have the required skills and experience and demonstrate a cultural fit with the organisation;
- Working with recruitment, education and training providers in the region to encourage the provision of future employment and training opportunities for skills that would be directly and indirectly generated by mining projects; and
- Participating, as appropriate, in business group meetings, events or programs in the regional community.

#### Potential Business Impacts

- Purchasing local non-labour inputs to production preferentially where local producers can be cost and quality competitive, to support local industries.

# 3 ECONOMIC ASSESSMENT METHODS

## 3.1 Introduction

The economic methods used to assess the Project and its impacts (as summarised in Section 2) are outlined below.

## 3.2 Cost Benefit Analysis

### *3.2.1 Background*

Economic assessment is primarily concerned with identifying changes in aggregate wealth, from a national perspective, associated with alternative resource use patterns. CBA is the standard technique applied to estimate these wealth changes.

CBA has its theoretical underpinnings in neoclassical welfare economics. CBA applications in NSW are guided by these theoretical foundations as well as the NSW Treasury (2017). CBA applications within the NSW EIA framework are further guided by the NSW Government (2015) *Guidelines for the economic assessment of mining and coal seam gas proposals* and as identified in the SEARs James and Gillespie (2002) *Draft Guideline for Economic Effects and Evaluation in Environmental Impact Assessment.*

CBA is concerned with a single objective of the EP&A Act and governments, i.e. economic efficiency.
It provides a comparison of the present value of aggregate benefits to society, as a result of a project, policy or program, with the present value of the aggregate costs. These benefits and costs are defined and valued based on the microeconomic underpinnings of CBA. In particular, it is the values held by individuals in the society that are relevant, including both financial and non-financial values. Provided the present value of aggregate benefits to society exceed the present value of aggregate costs (i.e. a net present value of greater than zero), the project is considered to improve the well-being of society and hence is desirable from an economic efficiency perspective.

### *3.2.2 Definition of society*

CBA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government.

The most inclusive definition of society includes all people, no matter where they live or to which government they owe allegiance to (Boardman et al. 2001). However, in practice most analysts define society at the national level based on the notion that the citizens of a country share a common constitution that sets out fundamental values and rules for making collective choices and that the citizens of other countries have their own constitutions that make them distinct societies (Boardman et al. 2001).

While most applications of CBA are performed at the national level, "to incorporate national distinctions in a CBA is far easier said than done. Thus many CBAs end up estimating the net benefits for global society, if only implicitly" (Bureau of Transport Economics 1999, p. 2).

With respect to the application of CBA in relation to mining and coal seam gas proposals, NSW Government (2015) guidelines define the public interest, and hence society, as the households of NSW.

CBA undertaken at a sub-national perspective requires attribution of primary costs and benefits to different geographic scales and results in a number of costs and benefits that accrue to people outside the region of analysis being excluded (Boardman *et al.* 2001). It may also result in additional costs and benefits, such as secondary net benefits, that are normally omitted from CBA, being included.

For this study, the CBA is initially undertaken from a global perspective i.e. including all the costs and benefits of a project, no matter who they accrue to, and then truncated to assess whether there are net benefits to Australia and NSW.

### 3.2.3 Definition of the project scope

The definition of the project for which approval is being sought has important implications for the identification of the costs and benefits of a project. Even when a CBA is undertaken from a global perspective, and includes costs and benefits of a project that accrue outside the national border, only the costs and benefits associated with the defined project are relevant. For mining projects, typically only the costs and benefits from mining the resource and delivering it to Port or domestic users, are relevant.

Limestone is an intermediate good i.e. it is an input to other production processes such as production of cement. However, these other production processes themselves require approval and, in CBA, would be assessed as separate projects (NSW Treasury, 2007). The Project definition, including impacts and mitigation measures, is summarised in Section 2. For the purposes of the CBA the Project accords with the EIS which includes transport impacts, ex mine gate.

### 3.2.4 Net production benefits

CBA of mining proposals invariably involves a trade-off between:

- The net production benefits of a project; and
- The environmental, social and cultural impacts (most of which are costs of mining but some of which may be benefits) including economic benefits to existing landholders, economic benefits to workers, net public infrastructure costs and economic benefits to suppliers (NSW Government, 2015).

Net production benefits can be estimated based on market data on the projected financial[5] value of the resource less the capital and operating costs of projects, including opportunity costs of capital and land already in the ownership of mining companies. This is normally commercial-in-confidence data provided by the proponent. Production costs and benefits over time are discounted to a present value.

### 3.2.5 Environmental, social and cultural impacts

The consideration of non-market impacts in CBA relies on the assessment of other experts contributing information on the biophysical impacts. The EIS process results in detailed (non-monetary) consideration of the environmental, social and cultural impacts of a project and the proposed means of mitigating the impacts. Only where some physical impacts are identified by other experts can economists attempt to consider the economic consequences of these impacts.

At its simplest level, CBA may summarise the consequences of the environmental, social and cultural impacts of a project (based on the assessments in the EIS), for people’s well-being. These qualitatively described impacts can then be considered alongside the quantified net production benefits, providing important information to the decision-maker about the economic efficiency trade-offs involved with a project.

At the next level of analysis, attempts may be made to value some of the environmental, social and cultural impacts. These environmental, social and cultural impacts generally fall into three categories, those which:

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[5] In limited cases the financial value may not reflect the economic value and therefore it is necessary to determine a shadow price for the resource.

- can be readily identified, measured in physical terms and valued in monetary terms;
- can be identified and measured in physical terms but cannot easily be valued in money terms; and
- are known to exist but cannot be precisely identified, measured or valued (NSW Treasury, 2007).

Impacts in the first and second category can potentially be valued in monetary terms using benefit transfer or, subject to available resources, primary non-market valuation methods. Benefit transfer involves using information on the physical magnitude of impacts and applying per unit value estimates obtained from non-market valuation studies undertaken in other contexts.

Primary non-market valuation methods include choice modelling and the contingent valuation method where a sample of the community is surveyed to ascertain their willingness to pay to avoid a unit change in the level of a biophysical attribute. Other methods include the property valuation approach where changes in environmental quality may result in changes in property value.

In addition to biophysical externalities, payments to landholders or workers over and above their opportunity cost can represent an economic benefit to landholders and workers, respectively. Where this occurs it can be estimated using market data on payments to be made and opportunity costs.

Where a project imposes a cost on public infrastructure in excess of payments made for that infrastructure there is an additional social costs for inclusion in CBA. These costs can potentially be estimated based on analysis of infrastructure costs and payments.

In attempting to value the impacts of a project on the well-being of people, there is also the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in CBA (NSW Government, 2012). NSW Government (2012) suggests that values that are less than 5% of the quantified net present value of a project are unlikely to be material. Where benefits and costs cannot be quantified these items should be included in the analysis in a qualitative manner (NSW Treasury, 2007; NSW Government, 2015).

### *3.2.6 Consideration of net social benefits*

The consideration of the net social benefits of a project combines the value estimate of net production benefits and the qualitative and quantitative estimates of the environmental, social and cultural impacts.

In combining these considerations, it should be noted that the estimates of net production benefits of a project generally includes accounting for costs aimed at mitigating, offsetting or compensating for the main environmental, social and cultural impacts. This includes the costs of purchasing properties adversely affected by noise and dust, providing mitigation measures for properties moderately impacted by noise and dust or experiencing visual impacts, the costs of providing ecological offsets and the cost of purchasing groundwater and surface water entitlements in the water market and the costs of public infrastructure impacts. Including these costs in the capital and operating costs of a project effectively internalises the respective and otherwise, non-monetary environmental, social and cultural costs of a project. To avoid double counting of impacts, only residual impacts, after mitigation, offset and compensation, require additional consideration.

Even when no quantitative valuation is undertaken of the environmental, social and cultural impacts of a project, the threshold value approach can be utilised to inform the decision-maker of the economic efficiency trade-offs. The estimated net production benefits of a project provides the threshold value that the non-quantified environmental, social and cultural impacts of a project (based on the assessments in the EIS), after mitigation, offset and compensation by the proponent, would need to exceed for them to outweigh the net production benefits.

Where the main environmental, social and cultural impacts of a project are valued in monetary terms, stronger conclusions can be drawn about the economic efficiency of a project i.e. the well-being of society.

Any other residual environmental, cultural or social costs that remain unquantified in the analysis[6] can also be considered using the threshold value approach. The costs of these unquantified environmental, cultural and social impacts would need to be valued by society at greater than the quantified net social benefit of a project to make it questionable from an economic efficiency perspective.

### *3.2.7 Consideration of the distribution of costs and benefits*

While CBA, undertaken at different scales, can provide qualitative and quantitative information on how costs and benefits are distributed, welfare economics and CBA are explicitly neutral on intra and intergenerational distribution of costs and benefits. There is no welfare criterion in economics for determining what constitutes a fair and equitable distribution of costs and benefits. Judgements about intra and intergenerational equity are subjective and are therefore left to decision-makers.

Nevertheless, it should be noted that the costs and benefits in CBA are defined and valued based on the values held by individuals in the current generation. There is no way to measure the value that future generations hold for impacts of current day projects as they are not here to express it. However, as identified by Boardman et al., (2001), this is not considered a serious problem for CBA because:

- Few policies involve impacts that only appear in the far future. Consequently, the willingness to pay of people alive today can be used to predict how future generations will value them;
- Most people alive today care about the well-being of their children, grandchildren and great grandchildren, whether or not they have yet been born. They are therefore likely to include the interests of these generations to some extent in their own valuations of impacts. Because people cannot predict with certainty the place that their future offspring will hold in society, they are likely to take a very broad view of future impacts; and
- Discounting used in CBA also reduces the influence of costs and benefits that occur a long way into the future.

Furthermore, increased wealth (e.g. royalties and taxes) generated by projects that have a net benefit to the current community can be used to improve the services (e.g. health, school and community services) and environment (e.g. protected areas) that are passed on to future generations.

As identified by the Productivity Commission (2006), a policy option that provides the highest net benefit, as indicated by CBA, would also be consistent with the principles of ecologically sustainable development.

### *3.2.8 Consideration of other objectives of Government*

CBA does not address other objectives of the EP&A Act and governments. Decision-makers therefore need to consider the economic efficiency implications of a project, as indicated by CBA, alongside the performance of a project in meeting other conflicting goals and objectives of the EP&A Act and government.

### *3.2.9 Key steps in Cost Benefit Analysis*

The key steps in CBA are summarised in Box 1.

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[6] Including potential impacts that were unknown at the time of the preparation of the EIS or arise during the EIA process due to differences in technical opinions.

| Box 1: Key steps in a CBA |
|---|
| **Step 1: Establish the base case** against which to assess the potential economic, social and environmental impacts of changes due to the project. |
| **Step 2: Define the project** including all significant inputs required to achieve the project's objectives. |
| **Step 3: Quantify the changes** from the base case resulting from the project. This will focus on the incremental changes to a range of factors (for example, environmental, economic, social) resulting from the project. |
| **Step 4: Estimate the monetary value of these changes** and aggregate these values in a consistent manner to assess the outcomes. Where market prices exist, they are a starting point for valuations of both outputs and of inputs used for production. For non-market goods, as for many environmental impacts and some social impacts, the aim is to value them as they would be valued in money terms by the individuals who experience them. |
| **Step 5: Estimate the Net Present Value (NPV)** of the project's future net benefits, using an appropriate discount rate. |
| **Step 6: Undertake sensitivity analysis** on the key range of variables, particularly given the uncertainties related to specific benefits and costs. |
| **Step 7: Assess the distribution of costs and benefits** across different groups. |
| **Step 8: Report CBA results, including all major unquantified impacts** so the appraisal addresses and incorporates all material relevant to the decision maker**.** |

Source: NSW Government (2015)

Section 4 reports on the CBA of the Project at different geographic scales based on the financial, technical and environmental advice provided by Boral and its' specialist consultants.

## 3.3 Local Effects Analysis

### *3.3.1 Introduction*

LEA aims to address the consequences of the proposal in its "locality" as required by Section 79C of the EP&A Act. It is intended to complement CBA by translating effects at the NSW level to impacts on the communities located near the project site. It also provides additional information to describe changes that are anticipated within a locality, such as employment changes. LEA is intended to inform the scale of change rather than being representative of costs and benefits to the local community.

NSW Government (2015) identifies that for the purpose of a LEA the locality is defined as the Statistical Area Level 3[7] (SA3) that contains the proposed project. The relevant population group is defined as those people ordinarily resident in the locality at the time of the proposal.

The local effects required to be analysed in a LEA are:

- local employment and income effects
- other local industry effects, for example on suppliers; and
- environmental and social change in the local community.

### *3.3.2 Direct effects relating to local employment*

The *Guidelines for the economic assessment of mining and coal seam gas proposals* (NSW Government 2015) identify that only employment of people ordinarily resident in the region at the time of the proposal be included in the initial estimation of direct local employment increases.[8]

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[7] In this case the Goulburn Mulwaree LGA has been chosen to represent the locality. The SA3 that contains Goulburn Mulwaree LGA also contains five other LGAs.

[8] Employment filled by those migrating into a region to live are excluded, as are jobs filled by those who reside outside the region.

The guidelines assume that these people would otherwise be employed in the region and so the increased disposable wages for the region as a result of a project is the difference between the average net income of these people in the mining industry and the average net income in other industries.[9]

The incremental full-time equivalent direct employment from a project to the locality is estimated as the increase in net income divided by the average net income in the mining sector.

The aim of this approach is to gauge the incremental impacts for existing residents of the locality. However, as a direct measure of regional employment and wages for existing residents it is likely to understate effects because it assumes that:

- existing local residents employed by a project are already employed in the region i.e. they are not unemployed or coming from new participants in the labour force;
- jobs vacancies in the region created by those filling the positions in a project remain unfilled for the duration of the project i.e. it essentially assumes that the regional economy and the wider Australian economy is at full employment. Refer to Attachment 3 for a discussion of the job chain effect and a comparison to input-output (IO) analysis.

From a regional economy perspective (rather than focused on existing residents), it is also likely to understate effects since it does not take into account the income spending of those who may migrate into the region to live during the life of a project.

### *3.3.3 Estimating effects related to non-labour project expenditure*

In addition to the incremental direct regional employment and wages generated by a project, the other major economic effect will be expenditure in the region on other, non-labour, inputs. These can be estimated for construction and operation phases of a project. Identified local expenditure may not all accrue to the region, particularly for margin sectors such as wholesale and retail trade purchases where only the margin would accrue to the regional business entities unless products are also manufactured locally.

### *3.3.4 Second round/flow-on effects*

The Guidelines (NSW Government 2015) identify that flow-on effects can also be extremely important for local communities and should therefore also be considered either qualitatively or using techniques such as IO analysis and for larger projects computable general equilibrium (CGE) modelling, provided the assumptions and limitations of the methods are identified. A comparison of IO analysis and CGE modelling is provided in Attachment 4.

### *3.3.5 Effects on other local industries*

The LEA should also give consideration to potential impacts such as:

- displacement of other land uses, where the project uses land that would otherwise be used for other purposes;
- where the project affects choices of external parties, particularly tourism and business travel; and
- where the project creates temporary effects on other industries that cause short run market adjustments in the cost of living for local residents, particularly food and housing markets.

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[9] Wages paid to those migrating into a region to live are excluded as a wages benefit to the region.

### ***3.3.6 Environmental and social impacts on the local community (Externalities)***

Finally, every LEA should assess positive and negative externalities created by the proposed project on the locality, with a focus on material, unmitigated effects. This information is available from the CBA.

### ***3.3.7 Input-output analysis***

Section 5 undertakes a LEA as identified above and consistent with the NSW Government Guidelines (2015). In addition, an IO analysis (refer to Attachment 4) of the Project is undertaken to identify the gross regional economic activity that the Project will provide to the region. As identified in Attachment 3, incorporation of consideration of the "job chain" effect means that the direct incremental employment and income to a region approximates the total income of those employed in the region who already reside in the region or migrate into the region to live i.e. the gross footprint of economic activity estimated using IO analysis is also an indicator of the net effect.

IO analysis essentially involves two steps:

- construction of an appropriate IO table (regional transaction table) that can be used to identify the economic structure of the region and multipliers for each sector of the economy; and
- identification of the initial impact or stimulus of the project (construction and/or operation) in a form that is compatible with the IO equations so that the IO multipliers and flow-on effects can then be estimated (West, 1993).

The IO method is based on a number of assumptions that are outlined in Attachment 5. Most notably IO analysis assumes that the regional economy has access to sufficient labour and capital resources (from both inside and outside the region) so that an individual project does not result in any regional price changes e.g. wages in other industries or house rentals, which would lead to contractions (“crowding out”) of economic activity in other sectors in the same region. Any "crowding" out is assumed to occur outside the region where the Project is concentrated and the regional impact analysis is focused. A dynamic CGE approach may overcome the limitation of IO analysis but is unlikely to be warranted at local or regional scale or with small scale impacts.

The consequence of the assumptions of IO analysis, is that IO modelling results provide an upper bound economic activity impact estimate.

IO analysis identifies the economic activity of a project on the economy in terms of four main indicators:

- ***Gross regional output*** – the gross value of business turnover;
- ***Value-added*** – the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output. These costs exclude income costs;
- ***Income*** – the wages paid to employees including imputed wages for self employed and business owners; and
- ***Employment*** – the number of people employed (including self-employed, full-time and part-time).

These indicators of economic activity are not equivalent to the economic measures of consumer and producer surplus that are relevant in the CBA framework.

Gross regional output is a measure of total revenue or turnover. All costs of production would need to be subtracted from total revenue to make it approximate the measure of producer surplus. Value-added is an indicator of net value to producers, but unlike the producer surplus measure, it does not take account of all production costs – only non-labour costs are subtracted from revenue. Income or wages paid to employees is a cost to the producer in the CBA framework and is one of the costs subtracted from revenue or output to calculate the producer surplus or net benefit to producers. Employment is a non-financial indicator identifying the physical number of jobs associated with an activity.

Unlike CBA there are no decision rules to identify whether an increase or decrease in economic activity is desirable, although it is often implicitly assumed that more economic activity is good and less economic activity is bad. However, not all economic activity is desirable from a community welfare perspective since it may be associated with say environmental degradation, crime, etc.

As well as providing an indication of gross economic activity in a region, economic activity analysis can have important links to social impact assessment since changes in income and employment levels can impact population levels and their ability to maintain community infrastructure (schools, hospitals, housing etc), broader community and cultural value systems and inter-relationships.

## 4 COST BENEFIT ANALYSIS OF THE PROJECT

### 4.1 Introduction

This Section reports on a CBA of the Project based on financial, technical and environmental advice provided by Boral and its' specialist consultants.

### 4.2 Identification of the Base Case and the Project

Identification of the "base case" or "without" Project scenario is required in order to facilitate the identification and estimation of the incremental economic benefits and costs of the Project.

Under the base case, existing mining of 3.38 Mtpa of limestone at the Marulan South Limestone Mine would cease by the end of 2021, with associated rehabilitation and site decommissioning. The buffer land required for the Project would be used for agricultural purposes, predominantly livestock grazing, with associated remnant vegetation which is dominated by open grassland and open woodland, with areas of closed woodland.

In contrast, the Project is as described in Section 2 with mining up to 4 Mtpa of limestone over a 30-year period from 2020.

Because a 30-year approval is being sought, for the purpose of the CBA at the end this period it is assumed that the residual value of capital equipment and land would be realised through sale or alternative use and the mine site would be decommissioned and rehabilitated. However, there is sufficient insitu resource for continuation of the mine past this time frame, subject to continuing demand for materials and Boral obtaining further approvals.

CBA is primarily concerned with the evaluation of a project relative to the counterfactual of "no project". Where there are a number of alternatives to a project then these can also be evaluated using CBA. However, alternatives need to be feasible to the proponent.

The Project assessed in the EIS and evaluated in the CBA is considered by Boral to be the most feasible alternative required for minimising environmental, cultural and social impacts whilst maximising resource recovery, operational efficiency and ensuring ongoing employment for the existing workforce. It is therefore this option that is proposed by Boral and was subject to detailed economic analysis.

## 4.3 Identification of Benefits and Costs

Relative to the base case or “without” Project scenario, the Project may have the potential incremental economic benefits and costs shown in Table 4.1. The main potential economic benefit is the producer surplus (net production benefits) generated from mining, producer surplus generated from ex-mine transportation to customers, any wage benefits to employment, nonmarket benefits to employment, economic benefits to existing landholders or benefits to suppliers. The main potential economic costs relate to any environmental, social and cultural costs of mining and product transportation, including any net public infrastructure costs and loss of surpluses to other industries.

**Table 4.1 – Potential Incremental Economic Benefits and Costs of the Project**

| Category | Costs | Benefits |
|---|---|---|
| Net production benefits from mining | Opportunity costs of capital equipment<br>Opportunity cost of land[1]<br>Development costs including labour, capital equipment and acquisition costs for impacted properties and biodiversity offsets[1]<br>Operating costs of mine including labour and mitigation, offsetting and compensation measures<br>Rehabilitation and decommissioning costs at end of the Project life | Avoided decommissioning and rehabilitation costs<br>Value of limestone<br>Residual value of capital equipment and land at end of Project life |
| Net production benefits from ex-mine transport | Capital and operating costs | Revenues |
| Potential environmental, social and cultural impacts of mining, processing and transportation, after mitigation, offsetting and compensation | Agricultural production<br>Noise impacts<br>Blasting impacts<br>Air quality impacts<br>Greenhouse gas impacts<br>Surface water impacts<br>Groundwater impacts<br>Ecological impacts<br>Transport impacts<br>Aboriginal heritage impacts<br>Historic heritage impacts<br>Visual impacts<br>Net public infrastructure costs<br>Loss of surplus to other industries | Wage benefits to employment<br>Non-market benefits of employment<br>Economic benefits to existing landholders<br>Economic benefits to suppliers |

[1] The value of foregone agricultural production is included in the value of land.

It should be noted that the potential environmental, social and cultural costs listed in Table 4.1 are only economic costs to the extent that they affect individual and community well-being through direct use of resources by individuals or non-use. If the potential impacts do not occur or are mitigated, compensated or offset to the extent where community wellbeing is insignificantly affected (i.e. costs are borne by the proponent), then no environmental, social or cultural economic costs should be included in the Project CBA apart from the mitigation, compensation or offsetting costs.

## 4.4 Quantification/Valuation of Benefits and Costs

Consistent with NSW Treasury (2017), NSW Government (2015) and James and Gillespie (2002), the analysis was undertaken in real values with discounting at 7 percent (%) and sensitivity testing at 4%, 7% and 10%.

The analysis period is 32 years, coinciding with the Project life and including two pre Project years (2018, 2019). Any impacts that occur after this period are included in the final year of the analysis as a terminal value.

Where competitive market prices are available, they have generally been used as an indicator of economic values. Environmental, cultural and social impacts have initially been left unquantified and interpreted using the threshold value method.

An attempt has also been made to estimate environmental, cultural and social impacts using market data and benefit transfer[10] and incorporate them into an estimate of the net social benefit of the Project. However, even with the inclusion of these values, the estimated net social benefits of the Project provides another threshold value that any residual or non-quantified economic costs would need to exceed to make the Project questionable from an economic efficiency perspective.

### *4.4.1 Production costs and benefits of mining*[11]

#### *Production Costs*

*Opportunity Cost of Land and Capital*

Currently all of the land required for the Project is owned or in the process of being acquired by Boral, apart from some Crown land. There is an opportunity cost associated with using this land that has already been acquired for the Project instead of its next best use e.g. rural production. An indication of the opportunity cost of the land can be gained from its market value, estimated at $14M. This opportunity cost is assumed to occur in 2021 when mining under the base case would cease.

The Project will also use a range of capital equipment and infrastructure from the existing Marulan South Limestone Mine operations. There is an opportunity cost associated with using this equipment and infrastructure for the Project instead of using it in its next best use. An indication of the opportunity cost of the capital equipment and infrastructure can be gained from its market value, estimated at $44M. This opportunity cost is assumed to occur in 2021.

*Development Cost of the Project*

The incremental capital costs over the life of the mine (including contingencies) are estimated at $111M. Capital costs of the Project primarily relate to major fixed plant replacement/upgrades, mobile equipment as well as the following:

- construction of the Marulan Creek Dam Wall (including pump station and vehicle access track);
- construction of the Marulan South Road Realignment;
- widening of the pavement in the narrower sections of Marulan South Road to meet Goulburn Mulwaree Council's Development Control Plan requirements;
- construction of the new intersection and associated works in Marulan South Road adjacent the Road Sales Stockpile Area;
- construction of the relocated Stockpile Reclaim Area;
- construction of the Road Sales Stockpile Area (including wheel wash, weighbridge and noise bunds);
- the relocation of High Voltage powerlines; and
- construction of sediment basins and clean water dams and pumps.

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[10] Benefit transfer refers to borrowing economic values that have been determined for other study sites.

[11] All values reported in this section are undiscounted Australian dollars unless otherwise specified.

Additional one-off costs of $4M have been included for:

- acquisition of biodiversity offsets and surface water and groundwater WALs; and
- preparation of required Management Plans e.g. Air Quality, Aboriginal Heritage, Historic Heritage etc.

Capital costs and one-off costs are included in the economic analysis in the years of the Project in which they are expected to occur.

*Annual Operating Costs of the Project*

The operating costs of the Project include those associated with mining (including implementation of management plans and management of biodiversity offsets), limestone production, and general costs (including overheads and administration). These costs include labour costs, which reflect the value of labour resources in their next best use. Average operating costs (excluding depreciation and royalties) are estimated at approximately $31M per annum over the 30 year life of the Project.

While royalties are a cost to Boral, they are part of the overall net production benefit of the mining activity that is redistributed by government. Royalties are therefore not included in the calculation of the resource costs of operating the Project. Nevertheless, it should be noted that the Project would generate total royalties in the order of $44M ($15M present value at 7% discount rate).

Depreciation has been omitted from the estimation of operating costs since depreciation is an accounting means of allocating the cost of a capital asset over the years of its estimated useful life. The economic capital costs are included in the development costs of the Project in the years in which they occur.

*Rehabilitation and Decommissioning Costs*

At the end of the Project life, the mine site will be decommissioned and rehabilitated at an estimated cost of $19M. Other annual rehabilitation costs are included in the annual operating costs of the Project.

***Production Benefits***

*Avoided Rehabilitation and Decommissioning Costs*

Under the base case, or “without” Project scenario, decommissioning and rehabilitation costs of approximately $19M would be incurred in 2021. With the Project, these costs will occur in 2049. The avoided costs in 2021 are a benefit of the Project.

*Value of Lime and Limestone*

The main economic benefit of the Project is the market value of the annual lime and limestone products that are produced for external and internal sale.

In the order of 964 kt of products (quicklime, hydrate, limestone, aglime, manufactured sand and fines) are sold externally. The majority of limestone is sold internally, predominantly to Boral’s Berrima Cement Works.

Product sold externally is sold at market value, reflecting its economic value, while internal transactions are sold at cost. Internal transactions therefore do not reflect the true value of the product and hence a shadow price is required i.e. imputation of the market value of internal transactions (assumed to be $18/t). This additional surplus (the difference between the imputed market value of internal transactions and actual financial value of internal transactions) that accrues from the Project has been reported separately to the surplus based on financial values.

There is uncertainty around future limestone prices and hence assumed values have been subjected to sensitivity testing (see Section 4.6).

*Residual Value at End of the Evaluation Period*

At the end of the Project, capital equipment and land (excluding offsets which are required to be protected in perpetuity) may have some residual value that could be realised by sale or alternative use.

The primary objective of the rehabilitation strategy is to rehabilitate impacted land to a stable state in accordance with relevant standards, thereby reducing erosion, sedimentation, dust emissions and visual impacts, while reestablishing biodiversity values.

It is assumed that capital equipment and land (not including the biodiversity offsets) have a residual value of $44M and $14M, respectively at the end of the Project life.

### *4.4.2 Production costs and benefits of product transport*

The costs and benefits of mining considered in Section 4.4.1 include costs and revenues/benefits of activities up to the mine gate. Since product transport externalities are a consideration of the EIS, economic benefits associated with transportation of mine product to customers also needs to be considered. These net production benefits essentially relate to the net revenue that accrues to transport provided.

The annual net production benefits of product transport has been estimated based on a range of assumptions about product volumes, mode of transport, production destination, unit transport revenue and the percentage of total revenue that is net revenue. These are summarised in Table 4.2.

**Table 4.2 - Marulan South Limestone Mine Annual Transport Summary**

| Product | Tonnes | Mode | Destination | Provider | Transport Revenue $ /t | Annual Transport Value $ | Net Revenue % | Transport Net Revenue |
|---|---|---|---|---|---|---|---|---|
| Berrima Limestone | 2,150,000 | Rail | Berrima NSW | External | $6 | $12,900,000 | 16% | $2,064,000 |
| Bluescope Tertiary Limestone | 480,000 | Rail | Port Kembla | External | $10 | $4,800,000 | 16% | $768,000 |
| Manufactured Sand | 1,000,000 | Road | Peppertree Quarry | External | $1 | $700,000 | 13% | $91,000 |
| Lime products | 92,000 | Road | NSW Various | Boral | $70 | $6,440,000 | 13% | $837,200 |
| Lime products | 8,000 | Road | VIC Melbourne | External | $85 | $680,000 | 13% | $88,400 |
| Lime products | 20,000 | Road | QLD Various | External | $130 | $2,600,000 | 13% | $338,000 |
| Limestone filler | 120,000 | Road | NSW Goulburn Area | External | $20 | $2,400,000 | 13% | $312,000 |
| Agricultural | 120,000 | Road | Marulan | External | $3 | $360,000 | 13% | $46,800 |
| Aggregates | 105,000 | Road | Southern Highlands Various | Boral | $12 | $1,260,000 | 13% | $163,800 |
| Mineral Addition | 105,000 | Road | Port Kembla | Boral | $16 | $1,680,000 | 13% | $218,400 |
| **Total** | **4,200,000** | | | | | **$33,820,000** | | **$4,927,600** |

Note: The percentage of transport total revenue that is net revenue was based on the ratio of gross operating surplus to revenue for the road transport sector and rail sector in the 2015-16 National Input-Output Table.

### *4.4.3 Environmental, social and cultural costs and benefits*

The environmental, social and cultural impacts of the Project, as assessed in the EIS, are summarised in Section 2. This Section considers these impacts from an economic perspective. Attachment 5 summarises the treatment of the environmental, social and cultural impacts of the Project in the CBA.

***Agricultural Production***

The Project site includes 505.4 ha of Class V to VIII land capability. In economics, the significance of these impacts is determined by their opportunity cost which is the foregone net returns from the next best alternative use e.g. agriculture. In a competitive market, the gross economic value of agricultural production is reflected in the prices received for the goods that are produced and the economic costs of production are reflected in the costs of inputs.

In a properly functioning land market, the present value of the potential net financial benefits of future potential agricultural production is reflected in land prices.

Unless there is a demonstrated failure in agricultural markets to adequately reflect the scarcity of agricultural products or a failure in land markets to adequately reflect the scarcity of agricultural land, then the market price of land reflects the opportunity cost of using that land for alternative uses.

In this analysis, the opportunity costs of any foregone agricultural production, as a result of the Project, has already been incorporated in the CBA through inclusion of the full value of land required for the Project (including land already owned by Boral).

***Noise***

The impact of the Project noise on nearby properties can potentially be valued using the property value method, where the change in property value as a result of the noise impacts are estimated, or the defensive expenditure method and damage cost method where the costs of mitigation are estimated.

The Noise and Blasting Assessment concluded that the mine construction, operation, traffic and rail noise levels would comply with relevant noise criteria. Hence, impacts are considered to be immaterial from an aggregate economic efficiency perspective. No economic costs are included in the CBA, apart from the costs of general mitigation and monitoring measures that are proposed.

***Blasting***

Blasting for the Project has the potential to cause structural damage or human discomfort at properties surrounding the Project. These impacts can potentially be valued using the property valuation method, defensive behaviour method or damage cost method. However, the Noise and Blasting Assessment concluded that blasting associated with the Project is predicted to produce ground vibration and overpressure levels well below the building damage criteria, human annoyance and discomfort criteria, at all sensitive receivers. Consequently, impacts are considered to be immaterial from an aggregate economic efficiency perspective and no economic costs have been included in the CBA for blasting impacts apart from the cost of proposed general mitigation and monitoring measures.

***Air Quality***

The impact of the Project dust emissions can potentially be valued using the property value method, where the change in property value as a result of the air quality impacts are estimated, the cost of illness method where changes in health episodes as a result of emissions are estimated and/or the defensive expenditure method and damage cost method where the costs of mitigation are estimated.

The air quality assessment indicated that no properties will be impacted by exceedances of air quality criteria as a result of the Project. These criteria are set at levels to protect against health effects and nuisance dust effects (Department of Environment and Conservation 2005). Consequently, impacts are considered to be immaterial from an aggregate economic efficiency perspective and no economic costs are included in the CBA apart from the costs of proposed general mitigation and monitoring measures.

It is recognised that for many pollutants, such as $PM_{10}$, while a threshold for impacts exists at the individual level[12] there may be no threshold at the population level. That is, even at low background concentrations, some vulnerable people are exposed to concentrations that adversely affect health. Hence, any increase in emissions may have some health effects. Following this approach some studies have used benefit transfer to imply a per unit health cost associated with any increase in emissions.

However, there are a number of issues with this approach. Firstly, Government criteria are set at levels to protect against health effects and nuisance dust effects (Department of Environment and Conservation 2005). Secondly, for residual air quality impacts to be valued some dose-response function would be required between the below Government policy criteria particulate matter generated by the Project, the level of local resident exposure and changes to health incidents. Once a dose-response function is estimated, health incidents could be valued in economic terms. At a broad level no such dose-response impacts have been shown for residents in mining areas compared to other areas. For instance, Merritt, Cretikos, Smith, and Durrheim (2013) in an analysis of general practice data for rural communities in close proximity to coal mining and coal-fired power generation in the Hunter Valley region of NSW found that there is no significantly higher rates of problems managed or medications prescribed for Hunter region residents compared with the rest of rural NSW. It is therefore unlikely that a single mining project that meets government air quality criteria at nearby properties will have any material health impacts. At a project level, the air quality assessment on which the Economic Assessment relies was undertaken in accordance with the Government policy and did not investigate dose-response functions for emissions below Government criteria, that could be used to value residual impacts.

Finally, studies such as PAE Holmes (2013) that suggest an economic value per tonne of $PM_{2.5}$ emissions, are based on values from other countries (which the benefit transfer literature would caution against using[13]) and ignore the nature of the receiving environment. As identified by the Productivity Commission (2006) *"the existence and magnitude of externalities depends in part on where they occur".* The Project occurs in a rural environment with low density occupation. It is therefore difficult to conceive of material residual air quality impacts of the Project.

### *Greenhouse Gases*

GHG emissions of relevance to the scope of the Project CBA are those attributable to the Project i.e. the site preparation, construction and operation of the mine continuation including the transport of limestone to the Boral Cement works and other domestic customers. For this analysis the CBA has included the 13,979 t $CO_2$-e Scope 1 and 2 emissions during construction and the 110,440 t $CO_2$-e Scope 1 and 2 emissions per year during mine operation.

To place an economic value on $CO_2$-e emissions, a shadow price of $CO_2$-e is required that reflects its global social costs. The global social cost of $CO_2$-e is the present value of additional economic

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[12] Most people are not at risk of severe acute health effects at current background levels.

[13] Benefit transfer requires that the study and policy site should be ecologically similar; the environmental change under consideration at the policy site is similar to the proposed change at the study site; the policy contexts, including the range of substitute sites available need to be comparable between the source and the target sites; and the socioeconomic characteristics and preferences of the populations impacted by the source and the target sites' policies should be similar.

damages now and in the future caused by an additional tonne of $CO_2$-e emissions. There is great uncertainty around the global social cost of $CO_2$-e with a wide range of estimated damage costs reported in the literature. An alternative method to placing a value on the global damage costs of $CO_2$-e is to examine the price of $CO_2$-e taxes, since an efficient tax should reflect the global social cost of $CO_2$-e. Again, however, there is a wide range of prices. For this analysis, a shadow price of AUD$23/t $CO_2$-e was used. Sensitivity testing assuming a shadow price from AUD$8/t $CO_2$-e to AUD$40/t $CO_2$-e was also undertaken (refer to Section 4.6)[14].

This represents the global social cost of carbon i.e. the cost of carbon emissions to the population of the whole world. This value is relevant to a CBA undertaken at the global level. For a CBA undertaken at the national and NSW level some means of apportioning global damage costs to residents of Australia and NSW is required (Gayer and Viscusi 2014). In the absence of any studies that have focused on the social damage cost of carbon emissions to Australia and NSW, this has been undertaken using Australia's share of global GDP (around 1%). An alternative approach would be Australia's share of world population which is considerably less than 1%. The share attributable to NSW is based on population.

### *Surface Water*

Surface water is a potential input into numerous alternative production processes and so its use for mining has an opportunity cost, i.e. its value in the next best alternative use. In NSW the government has established a market framework to facilitate the allocation of surface water. Water access and use is only permissible with possession of a WAL (except in the case of harvestable rights, native title rights and some stock and domestic rights). Water Sharing Plans that are prepared under the *Water Management Act, 2000* set the rules by which water is shared between all users, including the environment, in each water management area in NSW. These plans also set rules for water trading, that is, the buying and selling of water licences and also annual water allocations (Montoya 2010). Consequently, the market value for surface water can be considered to give a reasonable indication of its economic value in alternative uses such as agriculture, i.e. its opportunity cost

The opportunity cost of 183 ML/year extracted from Marulan Creek Dam has been included in the CBA by applying an assumed market value of water of $1,800/ML. This is a use value of the water. Assuming that the WAL water would otherwise be allocated to other uses e.g. agriculture, there are no incremental non-use impacts e.g. aquatic ecology impacts, of using this water for mining instead of alternative uses such as agriculture.

### *Groundwater*

Groundwater impacts that result in a reduction in baseflow of rivers potentially have an opportunity cost, as the river baseflow could potentially be used for other purposes. An indication of this opportunity costs has been included in the CBA by applying an assumed market value of water from the Goulburn Fractured Rock Groundwater Source Water Sharing Plan of $800/ML to the maximum predicted level of reduction in baseflow i.e. 838ML, for perpetuity. Some non-use impacts may potentially arise in relation to groundwater impacts. However, the Groundwater Assessment found that potential groundwater drawdown is unlikely to impact GDEs or the springs at the base of the Bungonia Gorge. No material non-use impacts are therefore likely to arise with respect to groundwater drawdown.

No private registered bores will be impacted by the Project and hence no material impacts from an aggregate economic efficiency perspective were identified for inclusion in the CBA.

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[14] It is noted that an alternative approach to valuation is based on the 'replacement cost' approach (Department of Industry (2014).

### *Water Discharges*

Water will be released from the mine as occasional overflows from the water management system. The nature of the overburden material is such that water discharges are unlikely to contain dissolved metals or metaloids and the water management system will reduce sediments. Any discharges will be undertaken in a controlled manner with appropriate water quality monitoring. Hence no economic costs are included in the CBA apart from the costs associated with upgrading the existing mine water management system, to include additional storages. These costs are included in the capital costs of the Project.

### *Ecology*

The Project will not have any material impacts on Stydofauna or GDEs and impacts on aquatic ecology are expected to be minimal given the existing altered flow regime.

The impacted vegetation, and associated fauna, is likely to have non-use values to the community that would be lost as a result of the Project. These values could potentially be estimated using non-market valuation methods. However, it is government policy that biodiversity offsets are provided that improve or at least maintain biodiversity values. The provision of offsets is also likely to have non-use values to the community that would be gained as a result of the Project. Provided the values held by the community for the offsets are equal or greater than values that would be lost then no additional economic costs warrant inclusion in the CBA apart from the capital and operating costs of providing the offsets. These costs are included in the capital and operating costs of the Project.

### *Road Transport*

The Traffic Impact Assessment found that the impacts of the additional product truck movements on the adjoining road network and intersections would be satisfactory and there will be minimal changes to the Level of Service and vehicle delays on the road network, including at all key intersections. It also found that the Project is not expected to have any negative impacts on the other road users and or on road safety.

However, there is an identified need for a number of proposed upgrades including upgrade to Marulan South Road by way of the realignment of a section of the road, and widening the pavement in the narrower sections to meet Goulburn Mulwaree Council’s DCP requirements, as well as a new intersection and associated works in Marulan South Road adjacent the Road Sales Stockpile Area.

The cost of these upgrades is included in the capital costs of the Project. The continuing contribution to Council for road maintenance is included in the operating costs of the Project.

### *Aboriginal Heritage*

Forty nine Aboriginal heritage sites will be impact by the Project. Of the impacted sites, 39 will be totally lost and 10 will be totally disturbed. However, only one site of high significance will be impacted, while 6 of moderate significance will be impacted.

Any impacts on Aboriginal heritage sites may impact the well-being of the Aboriginal community. However, monetisation of these impacts is problematic and so these impacts are best left to consideration as part of the preparation of the Aboriginal Cultural Heritage Assessment Report.

Impacts on Aboriginal heritage sites have been shown in some instances to reduce the well-being of the broader community (Gillespie Economic 2008, 2009, 2009b) while in other instances the impact on the community's well-being has been mixed (Windle and Rolfe 2003).

For the purpose of this analysis, the impacts on Aboriginal heritage remains unquantified although the cost of preparing and implementing an Aboriginal Heritage Management Plan is included in the capital and operating costs of the Project.

### *Historic Heritage*

The Historic Heritage Impact Assessment identified seven items of local heritage significance in the Project site will be completely or partially removed. These impacts can potentially be valued using non-market valuation methods such as choice modelling.

No specific non-market valuation study has been undertaken in relation to the two heritage items assessed as being of local heritage significance that will be impacted. However, Allens Consulting Pty Ltd (2005)[15] *Valuing the Priceless: The Value of Historic Heritage in Australia,* prepared for the Heritage Chairs and Officials of Australia and New Zealand, found that respondent utility is increased by an increase in the number of heritage places protected — average household willingness to pay across Australia for the protection of additional places from loss was estimated to be $5.53 per household each year for every 1,000 places protected. Indexing this value to 2018 and aggregating it to 79% of the Australian, NSW and Goulburn Mulwarree LGA households (as reflected by the survey response rate) and converting to a present value using a 7% discount rate gives a nonuse economic value of $612,000 per place for the Australian population, $196,000 per place for the NSW population and $840 for the population of the Goulburn Mulwaree LGA[16].

The impacts of the directly impacted heritage items are therefore estimated at $4.3M for the Australian population, $1.4M for the NSW population and $0.006M for the Goulburn Mulwaree LGA population. To the extent that some of these impacts are mitigated e.g. via detailed archival recording in accordance with the Historic Heritage Management Plan, this may overstate heritage impacts in relation to items that will be demolished.

### *Visual Impacts*

The impact of the Project on visual amenity at nearby properties can potentially be valued using the property value method, where the change in property value as a result of the visual impacts are estimated, the travel cost method where recreation amenity is impacted, or the defensive expenditure method and damage cost method where the costs of mitigation are estimated.

The Visual Impact Assessment found that the Project has a low overall visual exposure to its visual catchment with the main effect being some residual visual impacts from parts of two reserves of natural landscape, Bungonia National Park (NP) and Morton NP. The greatest visual exposure of the Project is to the Bungonia Lookdown lookout in Bungonia NP and there is lesser exposure to a short section of the track leading south into the Morton NP from the Long Point lookout.

To the extent that this residual visual impact reduces visitation to these sites or diminishes the recreational experience of visitors, relative to the scenario of no mine, there is potentially an economic cost that could be included in the CBA. However, any economic cost is unlikely to be material from an aggregate economic efficiency perspective.

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[15] Historic heritage places included in this study comprised: buildings (e.g. houses, shops and churches); pioneering huts, farms and shearing sheds; Aboriginal missions; designed gardens and parks; old mines, factories and other industrial sites; railways, roads, bridges and ports; ruins; places that show how people lived and worked; shipwrecks; monuments and memorials dedicated to important historic people and events; and historic streets, suburbs and towns.

[16] It is recognised that there may be a distance decay relationship where households located closer to the impacted heritage items have higher values than those located further away. However, the study referred to for benefit transfer values did not investigate this issue.

### *Market Benefits to Workers*

In standard CBA, the wages associated with employment are considered an economic cost of production with this cost included in the calculation of net production benefits (producer surplus). Where labour resources used in a project would otherwise be employed at a lower wage or would be unemployed, a shadow price of labour is included in the estimation of producer surplus rather than the actual wage (Boardman et al. 2001). The shadow price of labour is lower than the actual wage and has the effect of increasing the magnitude of the producer surplus benefit of a project.

Estimation of this economic value of employment from the Project requires a number of assumptions such as what proportion of the Project workforce that would otherwise be unemployed or underemployed, the duration of time that this would occur and the opportunity cost of labour in an unemployed or underemployed state i.e. the reservation wage rate.

Some indication of the potential magnitude of these benefits can be gained by making a number of assumptions. Following the approach of Streeting and Hamilton (1991)[17] if it were assumed that 50% of the direct workforce of the Project[18] (191 jobs) would otherwise be unemployed for three years and that the reservation wage for these people was $39,350[19] compared to a wage of $97,000 then the market employment benefit in terms of income would be $13M present value, at a 7% discount rate. Since 92% of the current workforce reside in the region, 92% of this economic benefit of the Project would accrue to the region. Values at alternate discount rates and percentages of unemployed are provided in the following table.

**Table 4.3 - Potential Economic Benefits to Workers Under Alternative Assumptions ($M present value)**

| | **Discount Rate** | | |
|---|---|---|---|
| **% UE for 3 years** | **4%** | **7%** | **10%** |
| 50% | $14 | $13 | $11 |
| 25% | $7 | $6 | $6 |
| 75% | $21 | $19 | $17 |
| Wage premium benefit | $133 | $90 | $65 |

Alternatively, if the economic benefit to workers is taken as the difference between the mean employee income in the region[20] $53,517 (ABS 2016) and the wage in the Project i.e. $97,000 pa, over the life of the Project, then the potential economic benefit to workers would be $90M, present value at 7% discount rate.

### *Non-market Value of Employment*

This above treatment of employment in CBA relate to the market value or opportunity cost of labour resources. However, CBA also includes non-market values i.e. the values that individuals in a community hold for things even though they are not traded in markets. For example, people have been shown to value environmental resources even though they may never use the resource. These are referred to as existence values and are underpinned by the view in neoclassical welfare economics that individuals are the best judge of what has value to them. As identified by Portney (1994), the concept of existence values should be interpreted more broadly than just relating to environmental resources and may also apply to the employment of others. Refer to Attachment 7.

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[17] Streeting and Hamilton (1991) *An Economic Analysis of the Forests of South-Eastern Australia*, Resource Assessment Commission, Research Paper Number 5.

[18] All sourced from NSW.

[19] As estimated by the unemployment benefits plus income tax payable on a mining wage, following the reservation wage rate approach used by Streeting and Hamilton (1991).

[20] ABS does no publish data on average wages by industry sector and therefore it is not possible to estimate the average wage of those not in the mining or quarrying industry.

Empirical evidence for these values was found in three choice modelling studies of mining projects in NSW. In a study of the Metropolitan Colliery in the NSW Southern Coalfields, Gillespie Economics (2008) estimated the value the community would hold for the 320 jobs provided over 23 years at $756M (present value). In a similar study of the Bulli Seam Operations, Gillespie Economics (2009a) estimated the value the community would hold for the 1,170 jobs provided over 30 years at $870M (present value). In a study for the Warkworth Mine extension, Gillespie Economics (2009b) estimated the value the community would hold for 951 jobs from 2022 to 2031 at $286M (present value). These studies are considered reasonable for benefit transfer since they relate to mining in NSW with the population sampled being NSW households.

The Project will provide continued employment for the approximately 191 direct employees of Boral for a period of 30 years. Using benefit transfer from the more conservative Bulli Seam Operation study and applying the employment value to the estimated direct employment of the Project[21] gives an estimated $142M for the non-market employment benefits of the Project to NSW households.

In the context of a fully employed economy there may be some contention about the inclusion of this value. Consequently, the results are reported with and without these values.

### *Economic Benefits to Existing Landholders*

Private land required for the Project is either already owned by the proponent or in the process of being purchased. To the extent that future purchases prices are in excess of the opportunity cost of the land there may be some economic benefit that accrues to landholders. However, this is commercial in confidence information and is omitted from the analysis.

### *Economic Benefits to Suppliers*

The focus of CBA is generally on primary costs and benefits i.e. first round impacts. Secondary net benefits that accrue to firms that sell to or buy from a project are ignored. This is because in a competitive market, all resources are assumed to be fully employed, and so increases in the production of goods and services required as inputs to the project will withdraw labour and raw materials from other industries. The additional net benefits (surpluses) to suppliers to the Project will be offset by decreases in net benefits in other industries and so there is no net secondary benefit to the economy as a whole.

For CBA undertaken at a sub-national perspective some secondary benefits to suppliers may accrue if net benefits that accrue to firms within say NSW are offset by a reduction in economic activity outside NSW. However, no economic benefits to suppliers are included in this analysis.

### *Net Public Infrastructure Impacts*

Potential impacts of the Project on infrastructure include increased maintenance costs on local roads - paid for by Section 94 contributions and use of utilities paid for by user fees. Consequently, no net infrastructure costs to government are envisaged as a result of the Project.

### *Loss of Surplus to Other Industries*

The land the subject of the Project has potential for agricultural uses. However, the land has low agricultural capability and historic grazing has been sporadic and intermittent. Loss of surpluses from agriculture are therefore likely to be insignificant. The opportunity cost of using this land for mining instead of agriculture is reflected in the market value which is included as an opportunity costs as described earlier. This opportunity cost is borne by Boral, as current or future owner of the land.

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[21] This is consistent with the non-market valuation studies which focused on direct employees.

***Impact on Adjoining Land Values***

An issue raised in consultations, was that an expansion of the mining footprint towards adjoining properties may decrease their land values. This issues is discussed in Attachment 10 and summarised here.

The value of land is a function of the attributes of the property including structural, access and environmental attributes. For remote rural properties there is a simple relationship between the agricultural income earning potential of the land and the capital value of the property

There has been much conjecture about the impact of mines on surrounding property values but little rigorous study. Conceptually, if surrounding properties are likely to be impacted by noise, odour, vibration or visually, then there would be some impact on property values, with the greatest impact on property values being felt by properties experiencing the greatest impacts from the mine. Logically, where impacts exist or are expected to exist they are likely to be greatest with closer proximity to the mine and therefore there is likely to be some gradient of property value impact that decreases with distance from the mine.

However, the existence of property value impacts and the distance gradient of these impacts are expected to be related to actual or expected physical impacts from the site rather than a simple distance relationship. Where noise, dust, vibration, odour and visual impacts are contained, no impacts would be expected to occur.

## 4.5 Consolidation of Value Estimates

The present value of costs and benefits, using a 7% discount rate, is provided in Table 4.4. The top half of the Table identifies production costs and benefits of the Project associated with mining and product transportation. Mining production costs includes capital and operating costs associated with the mitigation, offset and compensation of environmental, social and cultural impacts. The bottom of the Table summarises the residual environmental, social and cultural impacts of the Project after mitigation, offset and compensation.

The Project is estimated to have total net production benefits (mining and product transportation) of $581M. Assuming 25% foreign ownership of Boral, $492M of these net production benefits would accrue to Australia[22]. The estimated net production benefits that accrue to Australia can be used as a threshold value or reference value against which the relative value of the residual environmental impacts of the Project, after mitigation, compensation and offset, may be assessed. This threshold value is the opportunity cost to society of not proceeding with the Project. The threshold value indicates the price that the Australian community must value any residual environmental impacts of the Project (be willing to pay) to justify in economic efficiency terms the no development option.

For the Project to be questionable from an economic efficiency perspective, all incremental residual environmental impacts from the Project, that impact Australia[23], would need to be valued by the community at greater than the estimate of the Australian net production benefits i.e. greater than $492M. This is equivalent to each household in Australia valuing the residual environmental, social and cultural impacts at $55. If only households located in NSW hold values for the residual environmental, social and cultural impacts of the Project then the threshold willingness to pay per household would be $170. The equivalent figure for the region is $40,000.

Instead of leaving the analysis as a threshold value exercise, an attempt has been made to quantitatively consider the environmental, social and cultural impacts of the Project. From Table 4.4 it

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[22] This is the net production benefits of the Project minus the residual producer surplus accruing overseas.

[23] Consistent with the approach to considering net production benefits, environmental impacts that occur outside Australia would be excluded from the analysis. This is mainly relevant to the consideration of greenhouse gas impacts.

can be seen that most of the potential impacts are internalised into the capital and operating costs of the proponent via mitigation, offset or compensation, and hence are incorporated into the estimate of net production benefits. Other impacts to Australia are estimated at approximately $4M, considerably less than the estimated $492M net production benefits of the Project to Australia.

Overall, the Project is estimated to have net social benefits to Australia of between $488M and $643M (the latter incorporating the benefits of employment), and hence is desirable and justified from an economic efficiency perspective.

While the major environmental, cultural and social impacts have been quantified and included in the Project CBA, any other residual environmental, cultural or social impacts that remain unquantified would need to be valued at greater than between $488M and $643M for the Project to be questionable from an Australian economic perspective.

## Table 4.4 - Global and National Cost Benefit Analysis Results of the Project (Present Values @7% discount rate)

| | **Costs** | | **Benefits** | |
|---|---|---|---|---|
| | **Description** | **Value ($M)** | **Description** | **Value ($M)** |
| **Net production benefits from mining** | Opportunity cost of land | $11 | Avoided decommissioning and rehabilitation costs | $14 |
| | Opportunity cost of capital | $33 | Financial value of limestone products - internal and external sales | $595 |
| | Development costs | $48 | Additional economic value from internal sales | $304 |
| | Operating costs ex royalties | $291 | Residual value of capital | $2 |
| | Decommissioning and rehabilitation costs | $2 | Residual value of land | $5 |
| | ***Sub-total*** | $386 | ***Sub-total*** | $920 |
| | **Net Production Benefits** | | | **$535 ($447)** |
| **Net production benefits from ex-mine transport** | Transport costs | $275 | Transport revenue | $321 |
| | **Net Production Benefits** | | | **$47 ($45)** |
| | **Total Net Production Benefits** | | | **$581M ($492M)** |
| **Environmental, social and cultural impacts** | Greenhouse gas impacts | $28 ($0.3) | Market values of employment | $13 |
| | Agricultural impacts | Included in opportunity cost of land | Non-market values of employment | $142 |
| | Noise impacts | No material impacts | Economic benefits to existing landholders | Not quantified |
| | Blasting | No material impacts | Economic benefits to suppliers | Unquantified |
| | Air quality impacts | No properties impacted by exceedances | | |
| | Surface water | Cost of WALs included in capital costs | | |
| | Groundwater | Cost of WALs included in capital costs | | |
| | Ecology | Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs | | |
| | Road transport impacts | No capacity issues. Cost of upgrades and road maintenance included in capital and operating costs | | |
| | Aboriginal heritage | Unquantified | | |
| | Historic heritage impacts | $3 | | |
| | Visual impacts | No material impacts | | |
| | Net public infrastructure costs | No material impacts | | |
| | Loss of surplus to other industries | No material impacts | | |
| | ***Non-market impacts sub-total*** | **$31 ($4)** | | **$155** |
| **NET SOCIAL BENEFITS – including employment benefits** | | | | **$705 ($643)** |
| **NET SOCIAL BENEFITS – excluding employment benefits** | | | | **$550 ($488)** |

Note: totals may have minor discrepancies due to rounding. When impacts accrue globally, the numbers in brackets relates to the level of impact estimated to accrue to Australia

Residual net producer surplus to Boral Shareholders i.e. producer surplus less company tax, is apportioned by 75% in accordance with the estimated level of Australian shareholdings.

No material impacts does not mean that there will be no impacts but that aggregated immaterial impacts are not likely to amount to more than 5% of the quantified net production benefits of the Project.

### 4.6 NSW Costs and Benefits

The NSW Government (2015) guidelines have a particular focus on the costs and benefits to NSW. Table 4.5 identifies the costs and benefits to NSW. Impacts that have a national dimension are apportioned to NSW, in particular:

- 100% of mining royalties are attributed to NSW;
- 32% of the estimated company tax generated from the Project (mining and product transport) is attributed to NSW (NSW Guidelines 2015);
- 32% of the residual net producer surplus from the Project (mining and product transport) is apportioned to NSW;
- 100% of potential wages benefits are attributable to NSW based on an assumption that all incremental employment (to the base case) will be filled by NSW residents;
- 100% of the potential nonmarket values of employment are attributable to NSW based on benefit transfer from a study that surveyed the NSW population;
- greenhouse gas impacts to Australia are attributed to NSW based on NSW's share of the Australian population;
- all other potential environmental, social and cultural impacts would accrue to NSW households. However, in accordance with Government policy and regulation these impacts are largely mitigated, compensated or offset by the proponent.

On this basis, the costs and the benefits of the Project to NSW are summarised in Table 4.5. The estimated Net Social Benefits of the Project to NSW range from $166M and $321M, present value at 7% discount rate (the latter including employment benefits). Consequently, as well as resulting in net benefits to Australia, the Project would also result in net benefits to NSW.

Any unquantified residual impacts of the Project after mitigation, offset and compensation would need to be valued at greater than $166M and $321M, present value for the Project to be questionable from an NSW economic efficiency perspective.

**Table 4.5 - Cost Benefit Analysis Results of the Project - NSW (Present Values @7% discount rate)**

| COSTS | VALUE ($M) | BENEFITS | VALUE ($M) |
|---|---|---|---|
| ***Environmental, social and cultural impacts*** | | ***Net Production Benefits of Mining*** | |
| Greenhouse gas impacts | $0 | Royalties | $15 |
| Agricultural impacts | No material impacts<br>Included in opportunity cost of land | Direct company tax | $25 |
| Noise impacts | No material impacts | Residual net production benefits | $33 |
| Blasting | No material impacts | Economic surplus passed on internally | |
| Air quality impacts | No properties impacted by exceedances | *Company tax* | $29 |
| Surface water | Cost of WALs included in capital costs | *Residual net production benefits* | $51 |
| Groundwater | Cost of WALs included in capital costs | Contributions not linked to demand | $0 |
| Ecology | Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs | ***Sub-total*** | **$153** |
| Road transport impacts | No capacity or safety issues. Cost of upgrades and road maintenance included in capital and operating costs | ***Net Production Benefits of Product Transport*** | |
| Aboriginal heritage | Unquantified | Boral company tax | $1 |
| | | Boral residual net production benefits | $2 |
| | | Other transport providers company tax | $3 |
| | | Other transport providers residual net production benefits | $8 |
| | | ***Sub-total*** | **$14** |
| Historic heritage impacts | $1 | ***Additional benefits*** | |
| Visual impacts | No material impacts* | Wage benefits to employment | $13 |
| Net public infrastructure costs | No material impacts* | Non-market benefits of employment | $142 |
| Loss of surplus to other industries | No material impacts* | Economic benefits to existing landholders | Not quantified |
| | | Economic benefits to suppliers | $0 |
| **Total** | **$1** | ***Sub-total*** | ***$155*** |
| **NET SOCIAL BENEFITS – including employment benefits** | | | **$321** |
| **NET SOCIAL BENEFITS – excluding employment benefits** | | | **$166** |

The approach used in this section is that where impacts do not exist, are offset or compensated for, it is assumed that they are immaterial. Immaterial does not mean that there will be no impacts but aggregate immaterial impacts are not likely to amount to more than 5% of the quantified net production benefits of the Project

It should be noted that this is residual net production benefit is not equivalent to profit and hence should not be used to infer profitability of the Project. It is a residual amount after royalties and company tax are subtracted from the estimated total producer surplus of the Project. The estimation of taxable income uses accounting principles and is different to the estimation of net production benefits. In particular, taxable income includes the depreciation of capital rather than actual capital costs when they occur.

The non-market benefit of heritage is greater at the national level as the source study surveyed national households. At the NSW level results are only aggregated to NSW households.

## 4.7 Distribution of NSW Costs and Benefits

As identified in Section 3, CBA is only concerned with the single objective of economic efficiency. CBA and welfare economics provide no guidance on what is a fair, equitable or preferable distribution of costs and benefits. Nevertheless, CBA can provide qualitative and quantitative information for the decision-maker on how economic efficiency costs and benefits are distributed.

The costs and benefits of the Project to NSW are potentially distributed among a range of stakeholders as identified in Table 4.6.

## Table 4.6 - Incidence of NSW Costs and Benefits

| BENEFITS AND COSTS | INCIDENCE OF COSTS AND BENEFITS | MAGNITUDE OF IMPACT ($M) |
|---|---|---|
| ***Net Production Benefits of Mining*** | | |
| Royalties | NSW Government and NSW households | $15 |
| Direct company tax | NSW Government and NSW households | $25 |
| Residual net production benefits | Boral and its Australian shareholders | $33 |
| Economic surplus passed on internally | | |
| *Company tax* | NSW Government and NSW households | $29 |
| *Residual net production benefits* | Boral and its Australian shareholders | $51 |
| Contributions without a nexus | Goulburn-Mulwaree Council and residents of the LGA | $0 |
| ***Net Production Benefits of Product Transport*** | | |
| Boral company tax | NSW Government and NSW households | $1 |
| Boral residual net production benefits | Boral and its Australian shareholders | $2 |
| Other transport providers company tax | NSW Government and NSW households | $3 |
| Other transport providers residual net production benefits to | Other transport providers and their owners/shareholders | $8 |
| ***Additional benefits*** | | |
| Wage benefits to employment | Employees of the Project who reside in NSW | $8 |
| Non-market benefits of employment | NSW households | $88 |
| Economic benefits to existing landholders | Local landholders who sell land required for Project including buffer land | Not quantified |
| Economic benefits to suppliers | Regional and State suppliers of inputs to production | $0 |
| ***Environmental, social and cultural costs**** | | |
| Greenhouse gas impacts | Local and NSW households | $0.1 |
| Agricultural impacts | Boral | No material impacts<br>Included in opportunity cost of land |
| Noise impacts | Adjoining landholders | No material impacts |
| Blasting | Adjoining landholders | No material impacts |
| Air quality impacts | Adjoining landholders | No properties impacted by exceedances |
| Surface water | Local surface water users | Cost of WALs included in capital costs |
| Groundwater | Local groundwater users | Cost of WALs included in capital costs |
| Ecology | Local and NSW households | Some loss of values but offset. Cost of biodiversity offset included in capital costs and operating costs |
| Road transport impacts | Local residents | No capacity or safety issues. Cost of upgrades and road maintenance included in capital and operating costs |
| Aboriginal heritage | Aboriginal people and other local and NSW households who value Aboriginal heritage | Unquantified |
| Historic heritage impacts | Local and NSW households who value heritage | $1 |
| Visual impacts | Adjoining landholders and visitors to Bungonia and Morton NPs | No material impacts* |
| Net public infrastructure costs | NSW Government and NSW households | No material impacts* |
| Loss of surplus to other industries | Local industries adversely impacted by the Project | No material impacts* |

* NSW regulations require many impacts to be borne by the proponent via mitigation, offset and compensation. Where these measures perfectly mitigate, offset or compensate then no residual impacts occur and all impacts are borne by the proponent. This table identifies who bears residual impacts where mitigation, offset and compensation is imperfect.

### 4.8 Risk and sensitivity analysis

The main areas of environmental risks associated with mining projects relate to:

- the financial viability of a project from unexpected downturns in prices and any consequent environmental impacts from premature cessation of operations;

- ecological risk associated with whether the biodiversity offsets will adequately compensate for the direct ecological impacts;
- other environmental, social and cultural impacts estimations and required mitigation measures.

The Planning Assessment Commission has previously identified that the financial viability of projects is a risk assumed by the mine owners. Nevertheless, it should be noted that the Project is the continuation of an existing financial viable operation. Boral is willing to invest in the Project and has a fiduciary responsibility to its shareholders. It is highly unlikely Boral's investment would take place and then operations would cease, leaving residual environmental impacts at the site. However, the risk that this might occur is mitigated by the fact that Boral is required to pay a rehabilitation security deposit to the NSW Department of Resources and Energy as holder of a mining authority under the Mining Act. This security deposit is held by the Department to ensure that legal obligations in relation to rehabilitation and safety of the site can be met following mine closure. If rehabilitation obligations are not met to the satisfaction of the Minister, then the security funds would be used by NSW Department of Resources and Energy to meet the relevant requirements.

The provision of biodiversity offsets can be associated with a number of risks, including in relation to the biodiversity benefits of additional management of offsets, success in reconstruction of ecological communities, time-lags between impacts and provision of offsets as well as between management actions and achievement of ecological outcomes. These risks are mitigated through offset ratio requirements in the provision of offsets and commitment to the offset actions prior to the commencement of works under approval. The biodiversity offset package, with an appropriate offset ratio to account for ecological risks is being developed in consultation with the NSW Office of Environment and Heritage, and will be committed to prior to the commencement of the Project.

There is some risk associated with the estimation of environmental, social and cultural impacts of the Project and the level of mitigation measures proposed. However, it should be noted that impacts have generally been assessed based on the maximum annual levels of production and hence are likely to be overstated. Ongoing monitoring will ensure that appropriate mitigation measures are implemented as required.

The NPVs of the Project presented in Table 4.4 and Table 4.5 are based on a range of assumptions around which there is some level of uncertainty. Uncertainty in a CBA can be dealt with through changing the values of critical variables in the analysis (James and Gillespie, 2002) to determine the effect on the NPV[24].

In this sensitivity analysis, the CB results for NSW were tested for changes to the following variables at a 4%, 7% and 10% discount rate:

- Opportunity costs of land;
- Opportunity costs of capital equipment;
- Capital costs;
- Operating costs;
- Decommissioning costs;
- Value of mine products;
- Production levels;
- Residual value of land;

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[24] Quantitative risk analysis could also potentially be undertaken. However, this requires information on the probability distributions for input variables in the analysis. This information is not available and so the sensitivity testing is limited to uncertainty analysis.

- Residual value of capital;
- Greenhouse costs;
- Historic heritage values.

Results are reported in Table 4.7. What this analysis indicates, is that CBA results at the NSW level are most sensitive to changes in revenue, production volume and operating costs.

The Project is the continuation of an existing mining operation and hence operating costs in this location and geological environment are known. Estimates of operating costs of the Project are therefore likely to be reasonably accurate and 20% increases each and every year of the analysis as reported in the sensitivity analysis is highly unlikely.

The sensitivity analysis indicated that the CBA results are not sensitive to changes in capital costs, opportunity costs of land and capital equipment or environmental costs that have not already been internalised into production costs, such as greenhouse gas costs and Historic heritage impacts. Since mitigation, offset and compensation costs are small components of the capital and operating costs of the Project, it is unlikely that large changes in these cost levels would have any significant impact on the CBA results.

Under all scenarios examined, the Project has net social benefits to NSW.

**Table 4.7 - NSW CBA Sensitivity Testing (Present Value $Millions) (Excluding Employment Benefits)**

| | 4% Discount Rate | 7% Discount Rate | 10% Discount Rate |
|---|---|---|---|
| **CENTRAL ANALYSIS** | $259 | $166 | $113 |
| **INCREASE 20%** | | | |
| Opportunity cost of land | $259 | $166 | $112 |
| Opportunity cost of capital equipment | $258 | $165 | $111 |
| Development costs | $256 | $164 | $111 |
| Operating costs | $236 | $151 | $102 |
| Decommissioning costs | $259 | $167 | $113 |
| Value of mine products | $307 | $198 | $134 |
| Volume of production | $311 | $200 | $136 |
| Residual value of land | $259 | $166 | $113 |
| Residual value of capital | $259 | $166 | $113 |
| Transport net value | $263 | $169 | $115 |
| Historic heritage values | $259 | $166 | $112 |
| **Global Greenhouse Costs @ $40/Tonne (T)** | $259 | $166 | $113 |

| | 4% Discount Rate | 7% Discount Rate | 10% Discount Rate |
|---|---|---|---|
| **DECREASE 20%** | | | |
| Opportunity cost of land | $259 | $167 | $113 |
| Opportunity cost of capital equipment | $260 | $168 | $114 |
| Development costs | $262 | $169 | $114 |
| Operating costs | $282 | $182 | $123 |
| Decommissioning costs | $258 | $166 | $112 |
| Value of mine products | $211 | $135 | $91 |
| Volume of production | $207 | $132 | $89 |
| Residual value of land | $259 | $166 | $113 |
| Residual value of capital | $259 | $166 | $113 |
| Transport net value | $255 | $163 | $111 |
| Historic heritage values | $259 | $166 | $113 |
| **Global Greenhouse Costs @ $8/T** | $259 | $166 | $113 |

# 5 LOCAL EFFECTS ANALYSIS

## 5.1 Introduction

The CBA in Section 4 is concerned with whether the incremental benefits of the Project exceed the incremental costs and therefore whether the community would, in aggregate, be better off 'with' the Project compared to 'without' it. This Section and Section 6 examines local effects using two different methods.

The Local Area is defined as the LGA of Goulburn-Mulwaree, within which the Project is located.

## 5.2 Direct Effects Related to Employment

The Project will provided continued employment for approximately 118 employees on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North Ryde that would otherwise not be employed if it weren't for the mine.

However, only 118 direct employees work at the mine. Ninety two percent (108) of these reside in the Goulburn Mulwaree LGA, with the remainder residing elsewhere in NSW.

Assuming that without the Project those residing in Goulburn Mulwaree LGA would otherwise be employed elsewhere in the LGA, the incremental disposable wages accruing to the region is $3,095,363 per annum. This is equivalent to 42 FTE jobs in the mining sector.

**Table 5.1 - Analysis of Net Income Increase and FTE Job Increase**

| | Ordinarily reside in the locality |
|---|---|
| a) Direct employment during operations phase | 108 |
| b) Average net income in mining sector | $73,238 |
| c) Average net income in other industries* | $44,577 |
| d) Average increase in net income per job (b-c) | $28,661 |
| e) Increase in net income per year due to direct employment | $3,095,363 |
| f) FTE (e/b) | 42 |

*This information is not available from the ABS and hence average income across all sectors is used.

## 5.3 Direct Effects Related to Non-labour Expenditure

The total annual non-labour expenditure (after subtraction of wages to mine workers) is estimated at $19M per annum.

However, not all of this expenditure will accrue to the local area. From the location quotient analysis and allocation of margins and taxes undertaken for Section 6, $7.1M of non-labour expenditure is estimated to accrue to the local area.

## 5.4 Second Round and Flow-on Effects

The incremental expenditure by employees and non-labour expenditure that is captured by the local area provides flow-on economic activity to the local economy, which can be estimated in terms of economic activity indicators of output, value-added, income and employment. Section 6 provides a full assessment of flow-on effects arising from both labour expenditure and non-labour expenditure. From this analysis the Type 11A employment and income multiplier for incremental impacts is 1.66 and 1.53, respectively. Applying these multipliers to the direct net employment and net income effects calculated above in accordance with the NSW Guideline (2015) results in the Project contributing $5,099,959 per annum in total local income and 70 local jobs.

While non-labour expenditure would also provide flow-on effects in terms of indicators of economic activity other than income and employment, there is no "expenditure multiplier". Its effects, estimated in terms of output, value-added, income and employment would need to be estimated using IO analysis or similar - refer to Section 6.

**Table 5.2 - Flow-on Effects Associated with Net Direct Employment and Income**

| | Direct | Flow-on | Total |
|---|---|---|---|
| Employment | 42 | 28 | 70 |
| Net income | $3,095,363 | $1,634,352 | $4,729,715 |
| Net non-labour expenditure | $7,125,538 | | |

### 5.5 Effects on Other Industries

#### *5.5.1 Regional economic impacts of displaced agriculture*

The Project could potentially result in a reduction in agricultural activity from land directly impacted by the extension area, the biodiversity offset area and the purchase of groundwater WALs. However:

- the land affected by the Project area has low agricultural capability (land and soil capability class VI to VIII);
- land purchased for biodiversity offsets is also likely to have low agricultural capability or be difficult to clear and develop for agriculture; and
- there is up to 53,074 ML/year available for extraction from the Goulburn Fractured Rock Groundwater Source with only 12% of this currently being allocated.

Consequently, agricultural impacts of the Project are expected to be minimal.

#### *5.5.2 Wage impacts*

In the short-run, increased regional demand for labour as a result of the Project (relative to the situation of no Project) could potentially result in some increased pressure on wages in other sectors of the economy. The magnitude and duration of this upward wages pressure would depend on the level of demand for labour, the availability of labour resources in the region and the availability and mobility of labour from outside the region. The incremental direct employment and income impacts of the Project, as estimated in Section 6, will contribute in the order of 1% of direct regional employment and direct regional wages, respectively. The contribution is smaller using the approach above. As shown in Figure 4.6, the main employment sectors in the regional economy have on average 14% of their labour residing outside the region, reflecting the mobility of labour. Unemployment in the region was at 916 people or 6.0% in June 2018 (Department of Employment, 2018). Wage impacts are therefore not likely to be significant. Where upward pressure on regional wages occurs, it represents an economic transfer between employers and owners of skills and would attract skilled labour to the region leading to downward pressure on wages.

#### *5.5.3 Housing impacts*

The Project is a continuation of existing mining operation. No additional workforce is anticipated and hence there will be no additional demand for housing or community infrastructure.

### 5.6 Environmental and Social Impacts on the Local Community (Externalities)

The main externalities that potentially accrue from the Project and the magnitude of these to the local area are summarised in Table 5.3.

**Table 5.3 - Environmental and Social Impacts on the Local Community ($M)**

| **Environmental, social and cultural costs** | **Incidence of Impacts** | **Magnitude of Local Impact** |
|---|---|---|
| Greenhouse gas impacts | Local and NSW households | $0 |
| Agricultural impacts | Boral | No material impacts |
| Noise impacts | Adjoining landholders | No properties impacted by exceedances |
| Blasting | Adjoining landholders | No properties impacted by exceedances |
| Air quality impacts | Adjoining landholders | No properties impacted by exceedances |
| Surface water | Local surface water users | If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact. |
| Groundwater | Local groundwater users | If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact. |
| Ecology | Local and NSW households | Some loss of values but offset by provision of biodiversity offsets |
| Road transport impacts | Local residents | No capacity or safety issues. Cost of upgrades and road maintenance included in capital and operating costs |
| Aboriginal heritage | Aboriginal people and other local and NSW households | 49 sites impacted. 1 site of high significance and 6 of moderate significance |
| Historic heritage impacts | Local and NSW households | 7 items of local significance impacted $0 |
| Visual impacts | Adjoining landholders | No material impacts |
| Net public infrastructure costs | NSW Government and NSW households | No material impacts |
| Loss of surplus to other industries | Local industries adversely impacted by the Project | No impacts |

### 5.7 Summary of Local Effects

A summary of local effects of the Project is provided in Table 5.4.

**Table 5.4 - Summary of Local Effects**

| | Project Direct | Project Direct: Local | Net Effect | Total Net Effect |
|---|---|---|---|---|
| **Employment related** | | | | |
| Employment (FTE) | 42 | 28 | 70 | 42 |
| Income (per annum) | $3,095,363 | $1,634,352 | $4,729,715 | $3,095,363 |
| Other non-labour expenditure | $7,125,538 | | | $7,125,538 |
| Second round and flow-on effects | Refer to Section 6 | | | |
| Contraction in other sectors | No material impact | | | |
| Displaced activities | Not applicable | | | |
| Wage price impacts | No material impact | | | |
| Housing price impacts | No material impact | | | |
| **Externality impacts** | **Incidence of Impacts** | **Magnitude of Impact** | | |
| Greenhouse gas impacts | Local and NSW households | $0 | | |
| Agricultural impacts | Boral | No material impacts | | |
| Noise impacts | Adjoining landholders | No properties impacted by exceedances | | |
| Blasting | Adjoining landholders | No properties impacted by exceedances | | |
| Air quality impacts | Adjoining landholders | No properties impacted by exceedances | | |
| Surface water | Local surface water users | If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact. | | |
| Groundwater | Local groundwater users | If WALs purchased off landholders then they are compensated. If from controlled allocation then no impact. | | |
| Ecology | Local and NSW households | Some loss of values but offset by provision of biodiversity offsets | | |
| Road transport impacts | Local residents | No capacity or safety issues. Cost of upgrades and road maintenance included in capital and operating costs | | |
| Aboriginal heritage | Aboriginal people and other local and NSW households | 49 sites impacted. 1 site of high significance and 6 of moderate significance | | |
| Historic heritage impacts | Local and NSW households | 7 items of local significance impacted<br>$0 | | |
| Visual impacts | Adjoining landholders | No material impacts | | |
| Net public infrastructure costs | NSW Government and NSW households | No material impacts | | |
| Loss of surplus to other industries | Local industries adversely impacted by the Project | No impacts | | |

# 6 SUPPLEMENTARY LOCAL EFFECTS ANALYSIS

## 6.1 Introduction

This Section uses IO analysis to identify the gross economic activity footprint associated with the Project on the local economy.

## 6.2 Structure of the Local Economy

For the purpose of the analysis the economy is defined as the Goulburn Mulwaree LGA. This is the region where the Project is located and the majority of the Project operational workforce reside.

A 2015 IO table of the regional economy was developed using the Generation of Input-Output Tables (GRIT) procedure (Attachment 8) using a 2014-15 IO table of the National economy as the parent table and 2016 Census employment by industry data for NSW and the region. The 114 sector IO table of the regional economy was aggregated to 50 sectors and 8 sectors for the purpose of describing the economy.

A highly aggregated 2015 IO table for the regional economy is provided in Table 6.1. The rows of this table indicates how the gross regional output of an industry is allocated as sales to other industries, to households, to exports and other final demands (OFD - which includes stock changes, capital expenditure and government expenditure). The corresponding column shows the sources of inputs to produce that gross regional output. These include purchases of intermediate inputs from other industries, the use of labour (household income), the returns to capital or other value-added (OVA - which includes gross operating surplus and net indirect taxes and subsidies) and goods and services imported from outside the region. The number of people employed in each industry is also indicated in the final row.

Output for the regional economy is estimated at $5,279M. Value-added for the regional economy is estimated at $1,491M, comprising $848M to households as wages and salaries (including payments to self employed persons and employees) and $643M in OVA.

The employment total working in the regional economy was 11,560.

The economic structure of the regional economy can be compared with that for NSW through a comparison of results from the respective IO models (Figures 6.1 and 6.2). This reveals that the agriculture, mining, trade/accommodation and public and personal services sectors in the regional economy are of greater relative importance than they are to the NSW economy, while the business services sectors are of less relative importance than they are to the NSW economy.

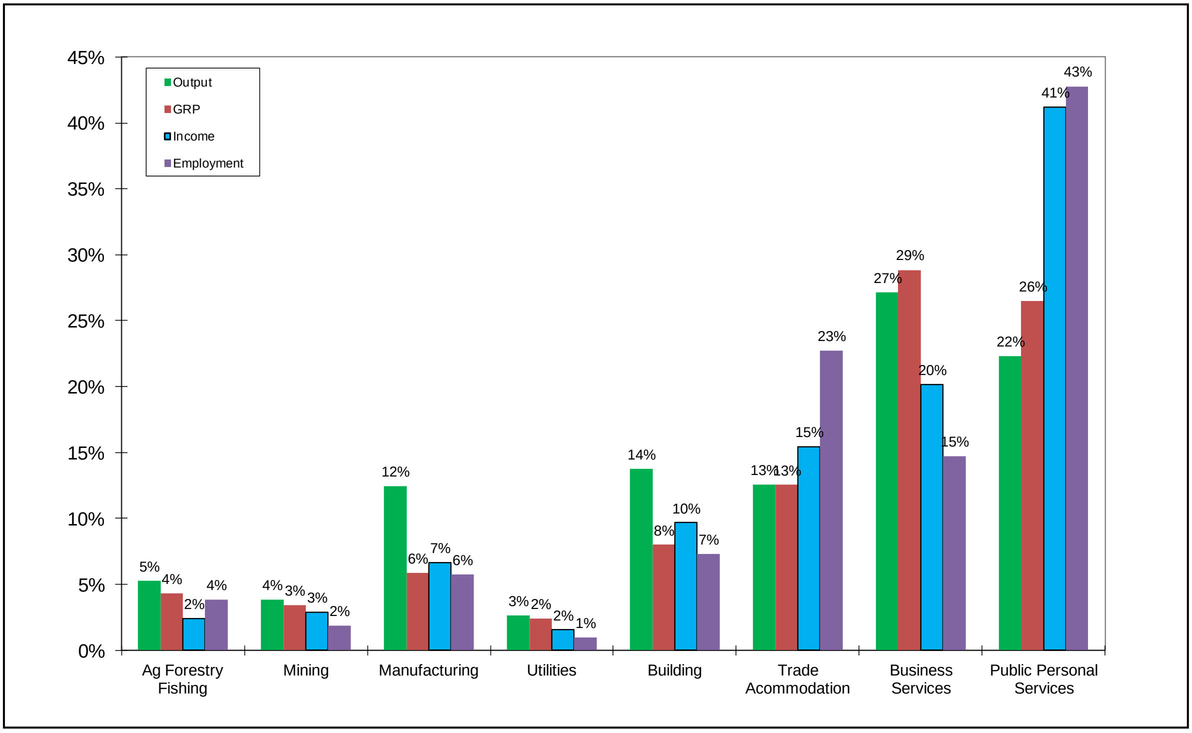
Figures 6.3 to 6.5 provide a more expansive sectoral distribution of gross regional output, employment, household income, value-added, exports and imports, and can be used to provide some more detail in the description of the economic structure of the regional economy.

In terms of output and value-added, the retail trade sector and ownership of dwellings sector are the most significant sectors to the regional economy. The retail trade sector is the most significant sector for employment followed by the health sectors, education sectors, accommodation/restaurants sectors and community care service sectors. Education sectors, community care services sectors, health sectors, education sectors and retail trade sectors are the most significant sectors for income. The construction trade services sectors and metal manufacturing sectors are the largest sectors for imports while the food manufacturing sectors and other mining  sectors and are the largest sectors for exports.

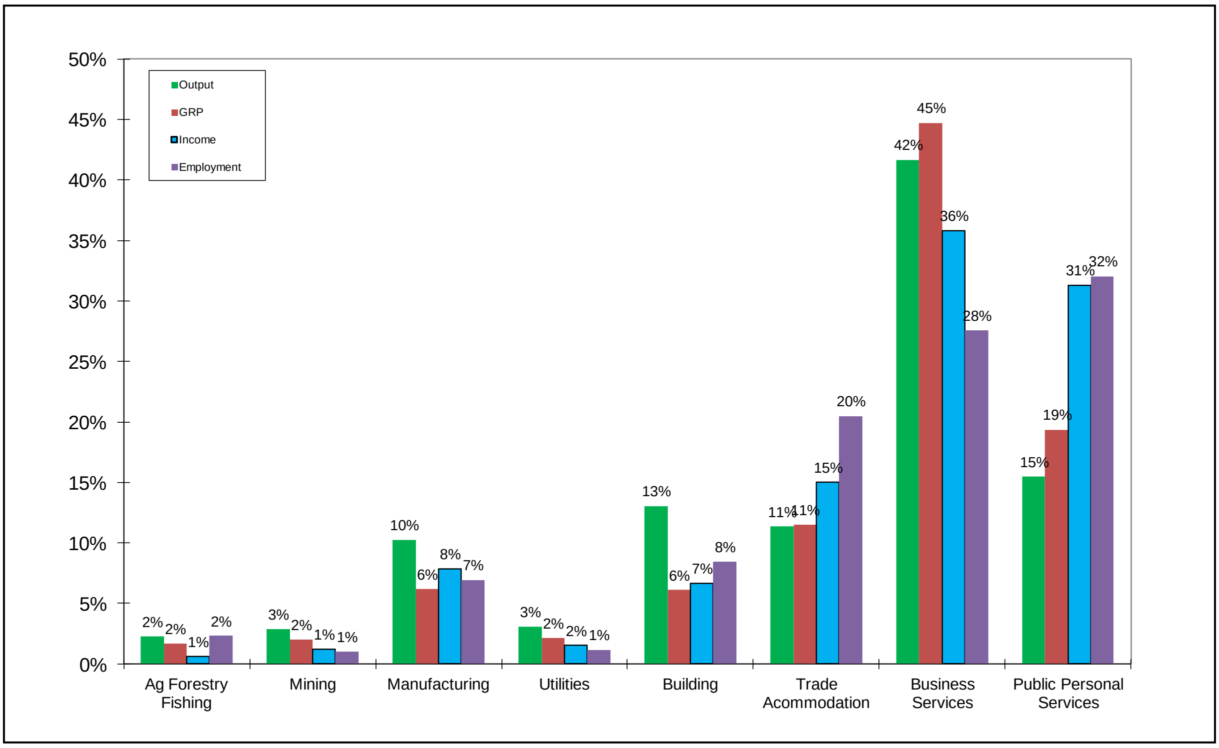
## Table 6.1 - Aggregated Transactions Table: Regional Economy 2015 ($M)

| | **Ag, forestry, fishing** | **Mining** | **Manuf.** | **Utilities** | **Building** | **Trade/ Accom** | **Bus. Srvcs** | **Public/ Pers. Srvcs** | **TOTAL** | **Household Expenditure** | **OFD** | **Exports** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ag, forestry, fishing | 17 | 0 | 66 | 0 | 0 | 3 | 1 | 1 | **87** | 3 | 26 | 28 | **143** |
| Mining | 0 | 3 | 11 | 0 | 1 | 0 | 0 | 0 | **16** | 0 | 12 | 77 | **105** |
| Manuf. | 2 | 1 | 20 | 0 | 20 | 11 | 4 | 5 | **65** | 23 | 77 | 173 | **339** |
| Utilities | 1 | 2 | 3 | 19 | 1 | 3 | 4 | 4 | **37** | 13 | 20 | 1 | **72** |
| Building | 4 | 6 | 2 | 2 | 94 | 5 | 20 | 9 | **142** | 1 | 229 | 1 | **374** |
| Trade/Accom | 5 | 3 | 10 | 1 | 10 | 10 | 14 | 15 | **68** | 195 | 28 | 51 | **342** |
| Bus.Srvcs | 10 | 7 | 28 | 3 | 28 | 46 | 102 | 48 | **273** | 256 | 114 | 95 | **738** |
| Public/Pers Srvcs | 1 | 2 | 4 | 0 | 4 | 3 | 15 | 16 | **45** | 153 | 392 | 17 | **607** |
| **TOTAL** | **40** | **24** | **144** | **25** | **159** | **82** | **160** | **98** | **732** | **644** | **899** | **443** | **2,719** |
| Household Income | 21 | 25 | 56 | 13 | 82 | 131 | 171 | 349 | **848** | - | - | - | **848** |
| OVA | 44 | 27 | 31 | 23 | 37 | 56 | 259 | 46 | **523** | 78 | 42 | 1 | **643** |
| Imports | 39 | 30 | 107 | 10 | 96 | 73 | 147 | 114 | **616** | 355 | 84 | 15 | **1,069** |
| **TOTAL** | **143** | **105** | **339** | **72** | **374** | **342** | **738** | **607** | **2,719** | **1,076** | **1,025** | **458** | **5,279** |
| **Employment (no.)** | **446** | **219** | **663** | **113** | **845** | **2,628** | **1,704** | **4,942** | **11,560** | | | | |

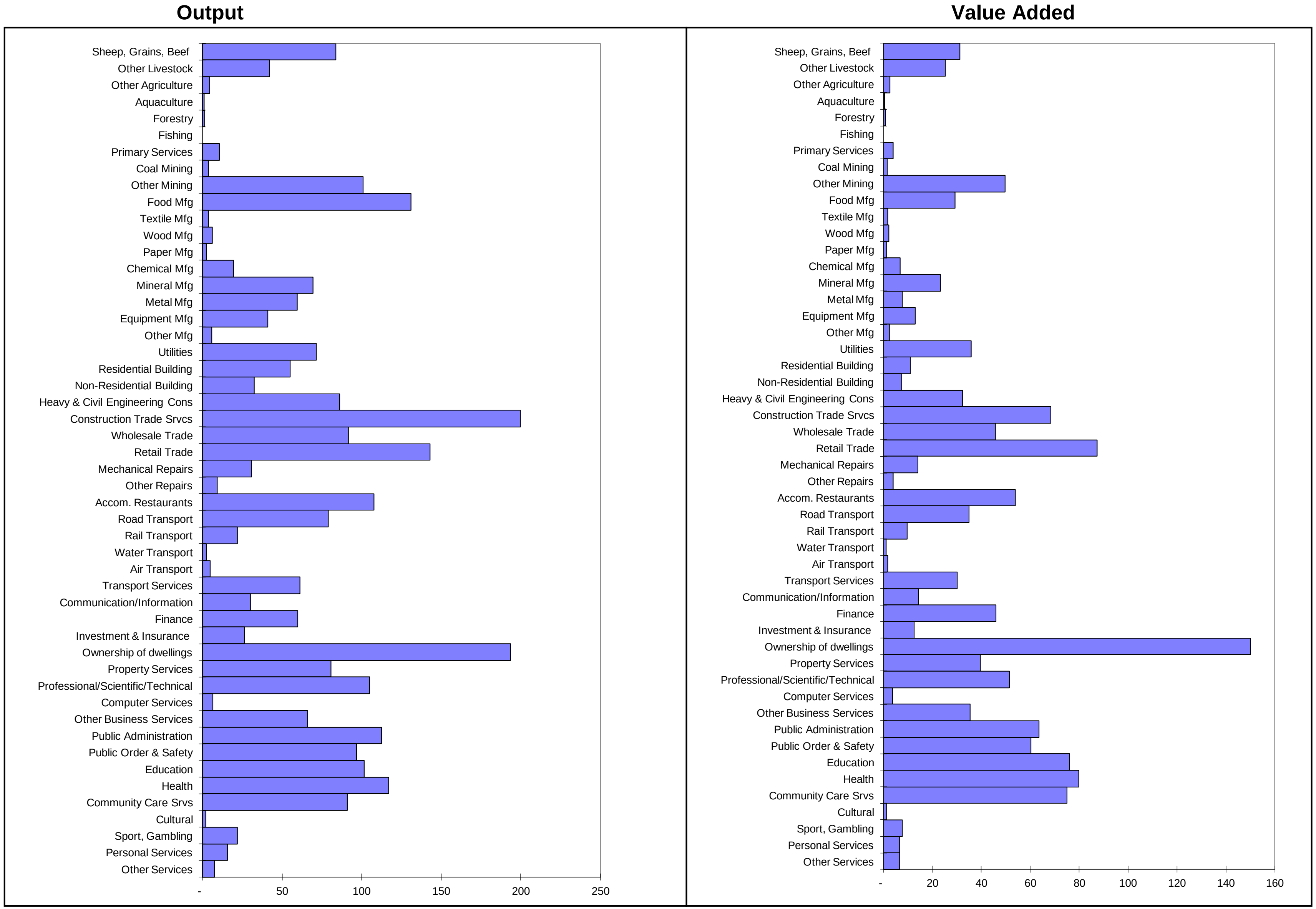
## Figure 6.1 - Summary of Aggregated Sectors: Regional Economy (2015)



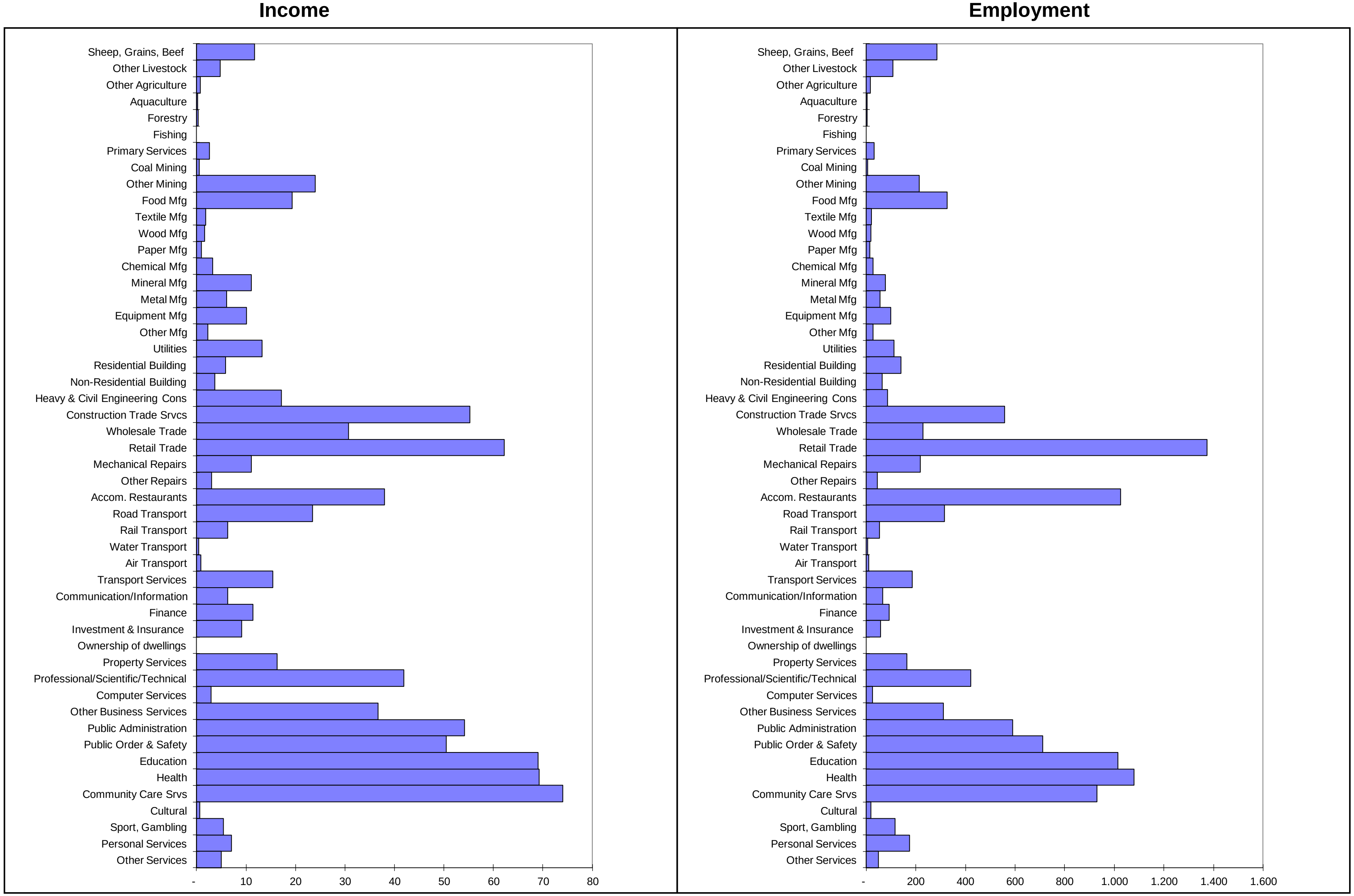
## Figure 6.2 - Summary of Aggregated Sectors: NSW Economy (2015)



## Figure 6.3 Sectoral Distribution of Gross Regional Output and Value Added ($M)



## Figure 6.4 Sectoral Distribution of Income ($M) and Employment (No.)



## Figure 6.5 Sectoral Distribution of Imports and Exports ($M)

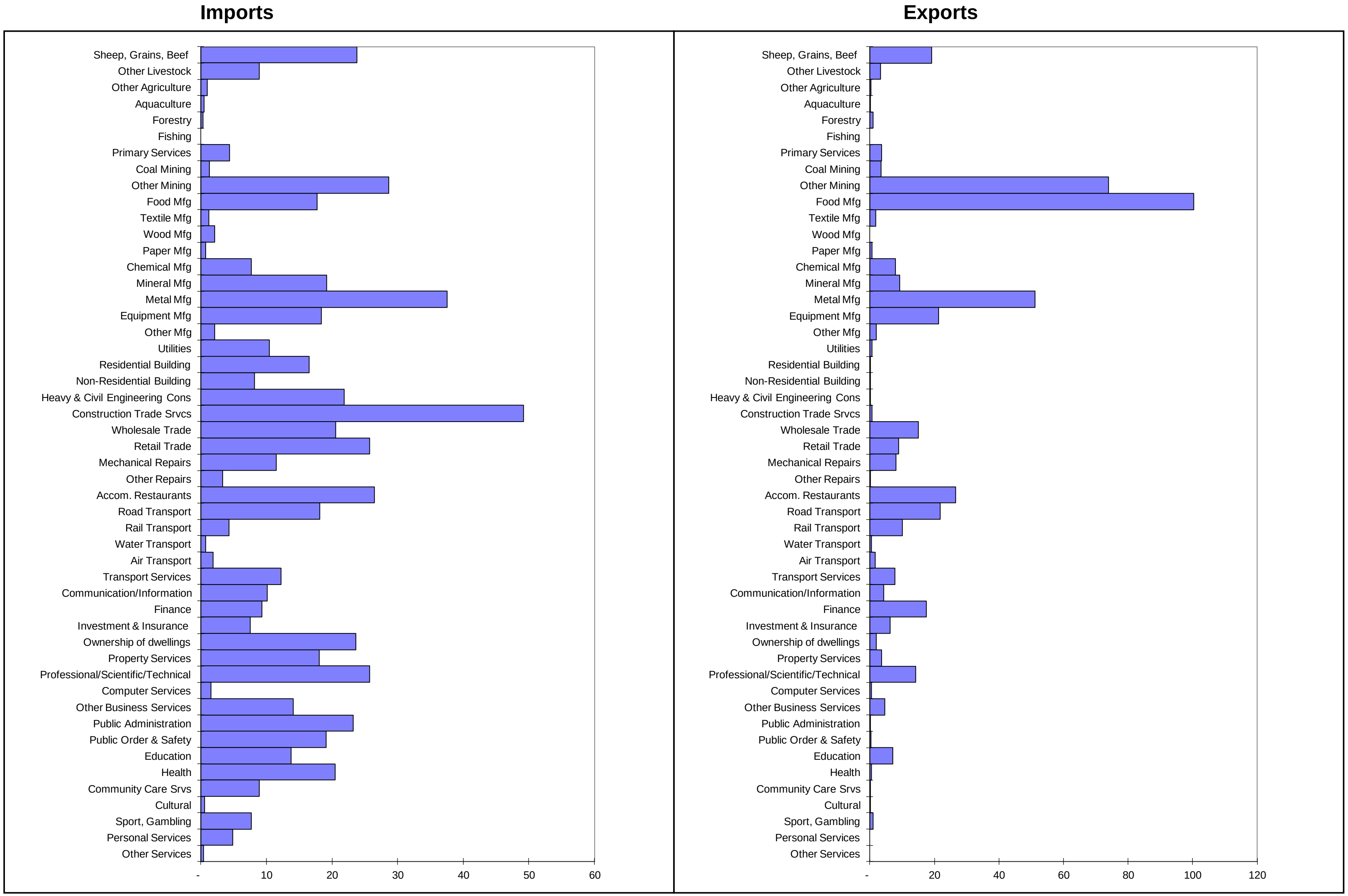
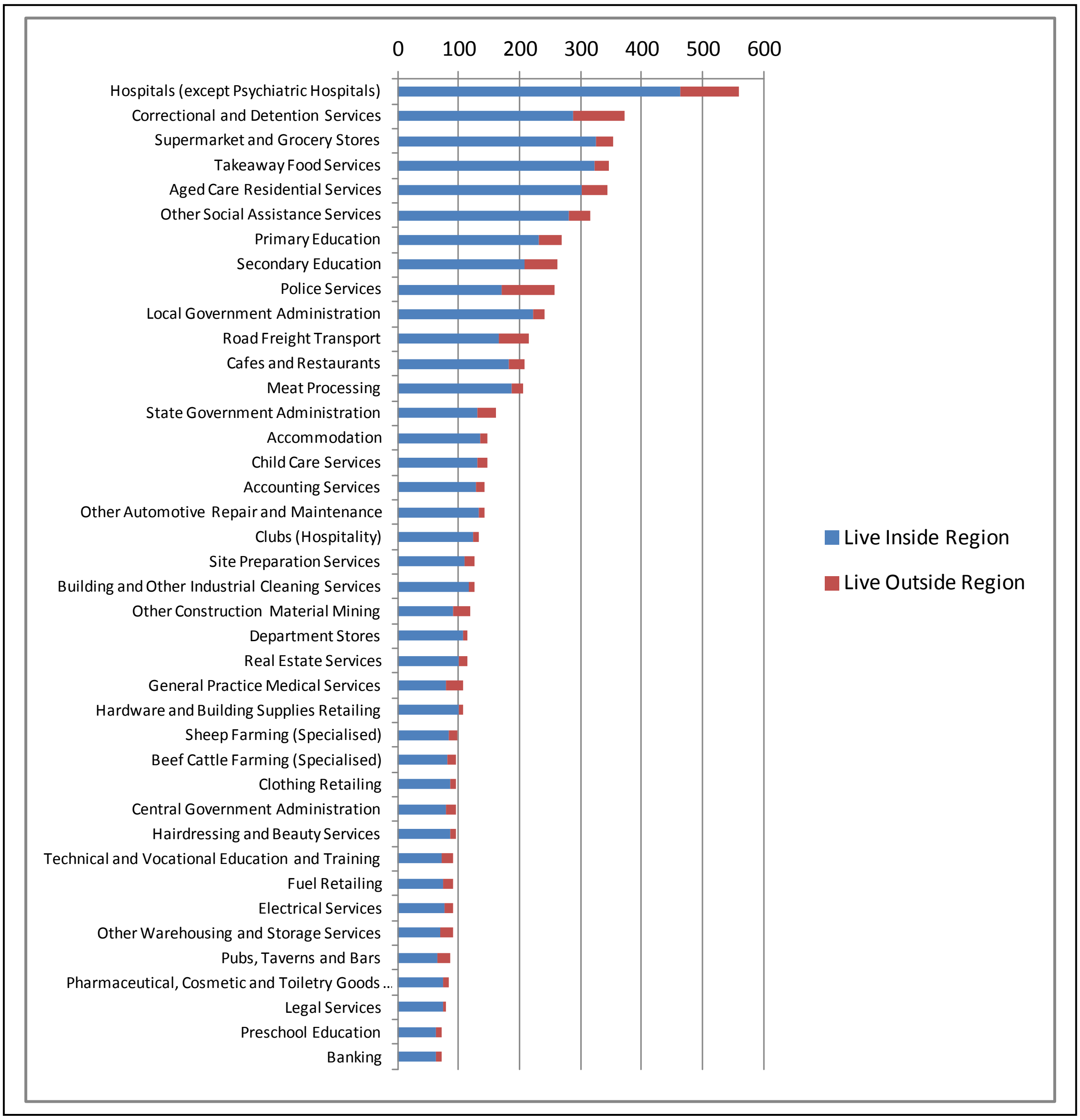


Figure 6.6 shows the top 40 individual industry sectors by employment number for the region. The five most significant employment providers in the region are the hospitals sector, correctional and detention services sector, supermarket and grocery stores sector, takeaway food services sector and aged care residential services sector. In the top 40 individual industry sectors by employment, 14% of the workforce resides outside the region.

**Figure 6.6 - Main Employment Sectors in the Region (Job Numbers)**



Source: Generated from ABS 2016 census 4 digit employment by industry by place of usual residence data.

## 6.3 Expenditure During Mine Operation

### *6.3.1 Introduction*

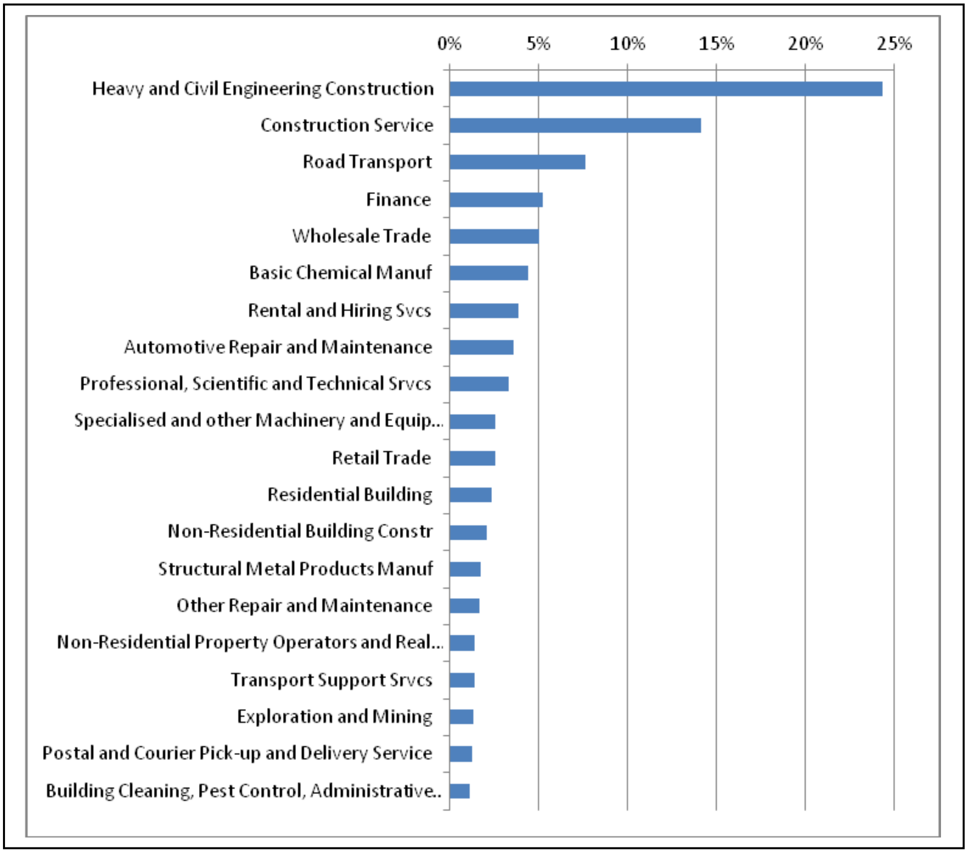
Mining projects provide direct economic activity to regional economies i.e. the output, value-added, income and employment associated with the mining operation. All other things being equal, the economic activity arising from a project will depend on:

- the expenditure profile in the regional economy that is associated with the project;
- the expenditure profile and residential location of the workforce;
- the size of the regional economy and the ability of local businesses to supply inputs to production demanded by mine proponents and the workforce.

### *6.3.2 Mine operation expenditure*

The Project is a continuation of an existing development. Some indication of the main sectors of the regional economy that may directly benefit from the Project operation can be obtained by examining the regional expenditure pattern of the non metallic mineral mining sector in the regional IO table. This has been developed based on the expenditure pattern of the non metallic mineral mining sector in a National IO table and the application of location quotients[25] to assess the ability of sectors in the regional economy to supply the goods and services demanded. Based on this approach the main sectors in the regional economy to benefit from direct operational expenditure are shown in Figure 6.7.

**Figure 6.7 - Percentage of Operational Expenditure in the Region by Sector**



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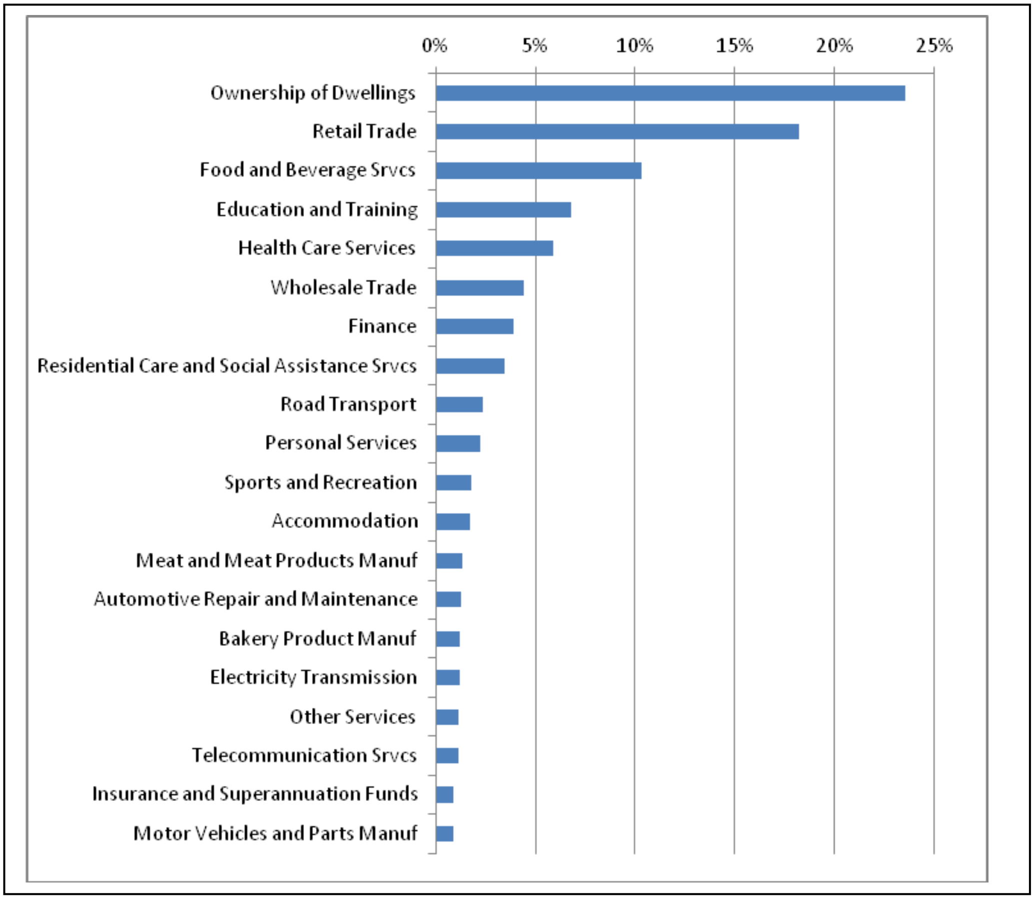
[25] Location quotients are a way of quantifying how "concentrated" an industry is in a region compared to a larger geographic area, in this case NSW. They are calculated by comparing the industry's share of regional employment with its share of NSW employment. A LQ of one indicates that the concentration of an industry's employment in a region is the same as for the state. A LQ of greater than one indicates the region has a greater concentration of employment in an industry compared to NSW and hence the likelihood of this sector in a region being able to provide the goods and services demanded by a Project are greater than where the concentration is less than one.

### *6.3.3 Mine employee expenditure*

Economic activity in the region will also arise from the expenditure of the mine workforce in the region. It is estimated that the Project will have 118 direct employees. Ninety two percent are estimated to live in the region. An indication of the main sectors of the regional economy that may benefit from employee expenditure can be obtained by examining the expenditure pattern of the household sector in the National IO table adjusted to the region using location quotients. Based on this approach the main sectors in the regional economy to benefit from direct expenditure of wages in the regional economy are shown in Figure 6.8. The main sectors benefitting from workforce expenditure are the ownership of dwellings sector (although this is an imputed value rather than actual expenditure), retail trade sector, food and beverage services sector and the education and training sector.

**Figure 6.8 - Percentage of Employee Expenditure in the Region by Sector**



## 6.4 Local Impact of the Project

### *6.4.1 Introduction*

There is no substantive construction phase associated with the Project and hence this assessment focuses on the revenue, expenditure and employment associated with the operation of the Project. This would provide economic activity for the regional economy, as well as for the NSW economy. The economic activity impacts are estimated for the indicators of output, value-added, income and employment.

### *6.4.2 Economic activity impacts*

#### Introduction

For the analysis of the operational phase of the Project, a new Project sector was inserted into the regional IO table reflecting average annual production levels and expenditure. The average annual revenue, operating costs, royalties and gross profit for the new sector was obtained from financial information provided by Boral. For this new sector:

- the estimated gross annual revenue from the region was allocated to the *Output* row;
- the estimated wage bill of employees residing in the region was allocated to the *household wages* row (92% live in the region) with the remainder allocated to a secondary household wages row that does not get incorporated into flow-on effects;
- non-wage expenditure was initially allocated across the relevant *intermediate sectors* in the economy, *imports* and *other value-added* based on expenditure information from Boral;
- allocation adjustment was then made between *intermediate sectors* in the regional economy and *imports* based on regional location quotients;
- purchase prices for expenditure in each sector in the region were adjusted to basic values and margins and taxes and allocated to appropriate sectors using relationships in the (2008-09) National Input-Output Tables;
- royalties, gross profit and depreciation were allocated to the *other value-added* row*;*
- direct employment by the Project in the region was allocated to the *employment* row.

#### Impacts

The total and disaggregated annual impacts of the Project on the regional economy (in 2018 dollars) are shown in Table 6.2.

**Table 6.2 - Economic Impacts of the Project on the Regional Economy ($2018)**

| | Direct Effect | Production Induced | Consumption Induced | Total Flow-on | TOTAL EFFECT |
|---|---|---|---|---|---|
| **OUTPUT ($M)** | 63 | 9 | 10 | 19 | 82 |
| *Type 11A Ratio* | 1.00 | 0.15 | 0.16 | 0.31 | 1.31 |
| **VALUE ADDED ($M)** | 38 | 4 | 6 | 10 | 48 |
| *Type 11A Ratio* | 1.00 | 0.11 | 0.17 | 0.27 | 1.27 |
| **INCOME ($M)** | 9 | 2 | 3 | 5 | 14 |
| *Type 11A Ratio* | 1.00 | 0.24 | 0.29 | 0.53 | 1.53 |
| **EMPL. (No.)** | 118 | 31 | 48 | 79 | 198 |
| *Type 11A Ratio* | 1.00 | 0.26 | 0.40 | 0.66 | 1.66 |

The Project is estimated to make up to the following annual contribution to the regional economy for 30 years:

- $82M in annual direct and indirect regional output or business turnover;
- $48M in annual direct and indirect regional value added;
- $14M in annual direct and indirect household income; and
- 198 direct and indirect jobs.

### Multipliers

Type 11A ratio multipliers summarise the total impact on all industries in an economy in relation to the initial own sector effect e.g. total income effect from an initial income effect and total employment effect from an initial employment effect, etc. The Type 11A ratio multipliers for the Project impact on the regional economy range from 1.27 for value added up to 1.66 for employment.

### Main Sectors Affected

Production induced and consumption induced flow-on impacts from the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- Other repairs and maintenance sector;
- Retail trade sector;
- Specialised and other Machinery and Equipment Manufacturing;
- Road transport sector;
- Food and beverage services sector; and
- Wholesale trade sector.

Examination of the estimated direct and flow-on employment impacts gives an indication of the sectors in which employment opportunities would be generated by the Project (Table 6.3).

**Table 6.3 - Sectoral Distribution of Employment Impacts on the Regional Economy**

| | Regional Economy | | | |
|---|---|---|---|---|
| **Sector** | **Average Direct Effects** | **Production-induced** | **Consumption-induced** | **Total** |
| Primary | 0 | 0 | 1 | 1 |
| Mining | 118 | 0 | 0 | 119 |
| Manufacturing | 0 | 3 | 2 | 5 |
| Utilities | 0 | 0 | 0 | 1 |
| Wholesale/Retail | 0 | 3 | 13 | 16 |
| Accommodation, cafes, restaurants | 0 | 1 | 8 | 9 |
| Building/Construction | 0 | 1 | 1 | 1 |
| Transport | 0 | 4 | 2 | 6 |
| Services | 0 | 19 | 21 | 40 |
| **Total** | **118** | **31** | **48** | **198** |

Note: Totals may have minor discrepancies due to rounding.

Table 6.3 indicates that direct, production-induced and consumption-induced employment impacts of the Project on the regional economy are likely to have different distributions across sectors. Production-induced flow-on employment would occur mainly in the services sectors, manufacturing sectors and transport sectors while consumption induced flow-on employment would be mainly in services sectors, wholesale/retail trade sectors and accommodation/cafes/restaurants sectors.

Businesses that can provide the inputs to the production process required by the Project and/or the products and services required by employees would directly benefit from the Project by way of economic activity. However, because of the inter-linkages between sectors, many indirect businesses also benefit.

Because the Project is a continuation of an existing mine, without approval 118 direct jobs (located within the region) will be lost, in a region with an unemployment rate in June 2018 of 6.0% (Department of Employment, 2018).

## 6.5 IMPACTS ON THE NSW ECONOMY

### *6.5.1 Introduction*

The NSW economic impacts of the Project were assessed by inserting a new sector in the NSW IO table in the same manner described in Section 6.5.2. The primary difference from the sector identified for the regional economy was that a greater level of expenditure was captured by NSW economy compared to the regional economy.

### *6.5.2 Economic Activity*

The total and disaggregated annual impacts of the Project on the NSW economy (in 2018 dollars) are shown in Table 6.4.

**Table 6.4 - NSW Economic Impacts of the Project**

| | Direct Effect | Production Induced | Consumption Induced | Total Flow-on | TOTAL EFFECT |
|---|---|---|---|---|---|
| **OUTPUT ($M)** | 63 | 39 | 35 | 74 | 137 |
| Type 11A Ratio | 1.00 | 0.62 | 0.55 | 1.17 | 2.17 |
| **VALUE ADDED ($M)** | 38 | 17 | 20 | 37 | 74 |
| Type 11A Ratio | 1.00 | 0.45 | 0.53 | 0.98 | 1.98 |
| **INCOME (M)** | 9 | 9 | 9 | 18 | 27 |
| Type 11A Ratio | 1.00 | 1.00 | 0.97 | 1.97 | 2.97 |
| **EMPL. (No.)** | 118 | 117 | 130 | 246 | 364 |
| Type 11A Ratio | 1.00 | 0.99 | 1.10 | 2.08 | 3.08 |

The Project is estimated to make up to the following total contribution to the NSW economy for 30 years:

- $137M in annual direct and indirect regional output or business turnover;
- $74M in annual direct and indirect regional value added;
- $27M in annual direct and indirect household income; and
- 364 direct and indirect jobs.

## 6.6 Potential Contraction in Other Sectors

Economic impacts for regional and State economies modelled using IO analysis represent only the gross or positive economic activity associated with the Project. Where employed and unemployed labour resources in the region are limited and the mobility of in-migrating or commuting labour from outside the region is restricted there may be competition for regional labour resources, as a result of the individual project, that drives up regional wages. In these situations, there may be some ‘crowding out’ of economic activity in other sectors of the regional economy.

‘Crowding out’ would be most prevalent if the regional/NSW economy was at full employment and it was a closed economy with no potential to use labour and other resources that currently reside outside the region. However, the regional and State economy are not at full employment and they each have access to external labour resources. Consequently, ‘crowding out’ of economic activity in other sectors as a result of the Project would not be expected to be significant, particularly at the regional level. "Crowding out" at the regional level would be less prevalent than at the NSW level, because the regional economy is more of an open economy than the NSW economy.

However, even where there is some ‘crowding out’ of other economic activities this does not indicate losses of jobs but the shifting of labour resources to higher valued economic activities. This reflects the operation of the market system where scarce resources are reallocated to where they are most highly valued and where society would benefit the most from them. This reallocation of resources is therefore considered a positive outcome for the economy not a negative.

### 6.7 Mine Cessation

As outlined in Section 6.4 and 6.5, the Project would provide direct and indirect economic activity in the regional and NSW economy for 30 years. Conversely, the cessation of the mining operations in the future would result in a contraction in regional and NSW economic activity.

The magnitude of the regional economic impacts of cessation of the Project would depend on a number of interrelated factors at the time, including:

- the movements of workers and their families;
- alternative development opportunities; and
- economic structure and trends in the regional economy at the time.

Ignoring all other influences, the impact of Project cessation on the regional economy would depend on whether the workers and their families affected would leave the area. If it is assumed that some or all of the workers remain in the region, then the impacts of Project cessation would not be as severe compared to a greater level leaving the region. This is because the consumption-induced flow-ons of the decline would be reduced through the continued consumption expenditure of those who stay (Economic and Planning Impact Consultants, 1989). Under this assumption, the regional economic impacts of Project cessation would approximate the direct and production-induced effects in Table 6.2. However, if displaced workers and their families leave the region then impacts would be greater and begin to approximate the total effects in Table 6.2.

The decision by workers, on cessation of the Project, to move or stay would be affected by a number of factors including the prospects of gaining employment in the regional economy compared to other regions, the likely loss or gain from homeowners selling, and the extent of "attachment" to the regional area (Economic and Planning Impact Consultants, 1989).

Ultimately, the significance of the economic impacts of cessation of the Project would depend on the economic structure and trends in the regional economy at the time. For example, if the Project cessation takes place in a declining economy, the impacts might be significant. Alternatively, if Project cessation takes place in a growing diversified economy where there are other development opportunities, the ultimate cessation of the Project may have little impact.

Nevertheless, given the uncertainty about the future prospects in the regional economy it is not possible to foresee the likely circumstances within which Project cessation would occur.

## 7 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The Secretary's Environmental Assessment Requirements for the Project refer to the need for an assessment of the likely economic impacts of the development, paying particular attention to:

- the significance of the resource;
- the economic benefits of the project for the State and region; and
- the demand for the provision of local infrastructure and services.

The first two points reflect heads of consideration in the now repealed sections of the *State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) Amendment (Resource Significance) 2013* (the Mining SEPP). Consequently, the sub-heads of consideration under the Mining SEPP are referred to when responding to these first two dot points.

A response to each of these is provided below.

### 7.1 Significance of the Resource

(a) the size, quality and availability of the resource

The Marulan South Limestone deposit lies within the Lachlan Geosynclinal Province and is estimated to have reserves totalling 640 million tonnes of high grade limestone. Boral proposes to continue mining limestone from the mine at a rate of up to 4 mtpa for a period of up to 30 years to a depth of 365m AHD, which is currently the floor of the South Pit.

The resource is able to be mined by Boral in a financially viable and environmentally sound manner through continuation and extension of the existing mine.

(b) the proximity and access of the land to which the application relates to existing or proposed infrastructure

The Project is a continuation and extension of an existing mine and as such will utilise the existing infrastructure at the mine including:

- the existing facilities for processing limestone including primary and secondary crushing, screening, conveying and stockpiling plant and equipment, tertiary crushing, screening, bin storage and despatch (rail and road) systems that form part of the main processing facilities;
- existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment;
- Boral's existing private rail line, including a 1.2km long rail passing line, which provides rail access from the mine and Peppertree Quarry to the Main Southern Railway; and
- Hume Highway via Marulan South Road.

The utilisation of existing infrastructure enables the resource to be mined at a considerable discount compared to if a new mine had to be established to mine the resource.

Boral will fund and provide additional infrastructure requirements identified in Section 4.4.1.

(c) the relationship of the resource to any existing mine

The Project is a continuation and extension of the existing mine. It will enable the continuation of employment for approximately 118 employees on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North Ryde that would otherwise not be employed if it weren't for the mine.

(d) whether other industries or projects are dependent on the development of the resource

The Project mine plan will enable continued mining of limestone at the mine. This will in turn enable continued employment for those currently working at the mine. Expenditure by Boral in the construction and operation of the Project and expenditure by employees would have flow-on effects (linkages) to other businesses in the regional and NSW economy.

Local and regionally based industries servicing the existing mine would have the opportunity to continue to provide services in support of the Project. This would have flow-on benefits for regional employment in businesses such as: construction, road transport, mine equipment maintenance firms, mining equipment supply firms, wholesale trade, rental and hiring services etc.

Ex-post surveys of businesses and households in relation to mining in other regions confirms the existence of flow-on economic activity to regional economies. In a survey of businesses and households in the Central West region of NSW, Gillespie Economics (2009)[26] found that:

- 71% of businesses surveyed considered that their business directly or indirectly benefit from mining;
- 93% of businesses surveyed considered that the local economy benefits from mining; and
- 93% of household respondents agreed or strongly agreed that the local economy benefits from the mining.

The Project will similarly provide linkages to other businesses in the regional and NSW economy.

An issue raised by the PAC in response to previous mining proposals is the extent of these flow-ons and the validity of methods for assessing them. This is discussed further below in relation to employment flow-ons. However, with respect to the existing mine, Boral identifies that 92% of the existing workforce live in the Goulburn Mulwaree Region and hence a material component of their expenditure would flow-on to local businesses. Similarly, Boral has identified that it spends considerable operational expenditure with local firms including, in 2014-2015 those listed in Table 7.1.

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[26] Gillespie Economics (2009c) *Cadia East Project Socio-Economic Assessment*.

**Table 7.1 – Firms in Goulburn Mulwaree LGA that Supply the Marulan South Limestone Mine 2014-2015**

| | |
|---|---|
| Kingston Industries Pty Ltd T/As Tutt Bryant Hire | Eastern Sand & Gravel Co Pty Ltd T/As Marulan Haulage |
| Goulburn Engineering Pty Ltd | St Vincent De Paul Society (Act) Inc |
| Mccallum Constructions | Endeavour Industries Goulburn Inc T/As Wollondilly Steam Laundry |
| Noack, Ed & Cn | Jamesjohn Pty Ltd T/As Bi-Rite Electrical |
| Goulburn Mulwaree Council | Allen's Training Pty Ltd |
| TCA Cooling & Heating Pty Ltd | Mcgrath Canberra Pty Ltd T/As New Goulburn Automotive |
| Goodyear & Dunlop Tyres (Aust) Pty Ltd T/As Beaurepaires For Tyres | Guymer's Glass Service |
| Gilmour Station Pty Ltd T/As Goulburn Produce & Rural Supplies | Kingston Industries Pty Ltd T/As Tutt Bryant Hire |
| White's Tractors Pty Ltd | Goulburn Engineering Pty Ltd |
| Goulburn Hydraulic & Plant Repairs Pty Ltd | Mccallum Constructions |
| Lee & Thomas | Noack, Ed & Cn |
| Hollingworths Crane Hiring Service Pty Ltd | Goulburn Mulwaree Council |
| A1 Septic Tank & Grease Trap Cleaning Services | TCA Cooling & Heating Pty Ltd |
| Denrith Pty Ltd T/As Divalls Bulk Haulage and Earthmoving | GCH Couriers Pty Ltd |

Notwithstanding, the **degree** to which individual businesses are “dependent” is unknown.

In addition, one operator, Aglime Fertilisers, located about 2km west of the mine is 100% dependent on the mine for the supply of raw materials for fertiliser manufacturing.

### 7.2 Economic Benefits

The now repealed Mining SEPP defines economic benefits in terms of employment generation, expenditure (including capital investment) and royalties. Each of these is addressed below. Attachment 2 provides a discussion of these Mining SEPP defined economic benefits in the context of economic theory and economic assessment methods.

#### (a) employment generation

The Project will continue to provide direct employment for up to 118 employees on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North Ryde that would otherwise not be employed if it weren’t for the mine.

Total (direct and flow-on) employment for the regional and NSW economy associated with the operation of the mining component of the Project, only, was estimated at 198 (a multiplier of 1. 66) and 364 people (a multiplier of 3.08), respectively, using IO analysis.

This level of flow-on employment is consistent with the level of flow-on employment reported in other studies of mining projects that use IO analysis. Refer to Attachment 9.

IO analysis which has been used in this report to estimate flow-on economic activity of the Project is not a discredited technique. Refer to Attachment 3 for a detailed consideration of the method and its alternatives, and a response to previous criticisms of the method.

Employment estimates using IO analysis provide decision-makers with information on the relative employment footprint/gross jobs of different projects, without going to the second and more complicated and contentious stage of trying to model wage rises and “crowding out” across all other sectors in the economy. The results of IO modelling can therefore be seen as representing an upper bound for the net economic activity associated with a project.

(b) expenditure, including capital investment

The incremental capital costs over the life of the mine are estimated at $111M. Capital costs of the Project primarily relate to annual sustaining capital but also includes an allowance for:

- construction of the Marulan Creek Dam Wall (including pump station and vehicle access track);
- construction of the Marulan South Road Realignment;
- widening of the pavement in the narrower sections of Marulan South Road to meet Goulburn Mulwaree Council's Development Control Plan requirements;
- construction of the new intersection and associated works in Marulan South Road adjacent the Road Sales Stockpile Area;
- construction of the relocated Stockpile Reclaim Area;
- construction of the Road Sales Stockpile Area (including wheel wash, weighbridge and noise bunds);
- the relocation of High Voltage powerlines; and
- construction of sediment basins and clean water dams and pumps.

Additional one-off costs include for:

- acquisition of biodiversity offsets and surface water and groundwater WAL; and
- preparation of required Management Plans e.g. Air Quality, Aboriginal Heritage, Historic Heritage etc.

This is the level of capital investment included in the CBA[27].

In addition, the Project will result in ongoing annual expenditure of $31M. The economic activity in the regional economy from the Project and its operational expenditure was estimated using IO analysis in the order of up to:

- $82M in annual direct and indirect regional output or business turnover;
- $48M in annual direct and indirect regional value added;
- $14M in annual direct and indirect household income; and
- 198 direct and indirect jobs.

(c) the payment of royalties to the State

The Economic Assessment of the Project estimated royalties at $44M in total or $15M present value using a 7% discount rate.

Royalties for limestone is a quantum royalty, levied at a flat rate of 40 cents per tonne[28]. The royalty calculation was based on average annual production of limestone of 4 Mtpa.

Additional sensitivity testing for royalty calculations are provided below for changes in production levels below maximum annual production i.e. 3.5 Mtpa of limestone and 3 Mtpa of limestone.

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[27] Note that higher capital costs reduce the net benefits of projects as measured using CBA.

[28] Although it is noted that estimated royalties vary slightly from this rate due to different royalty rates applying to different parts of the mine for historical reasons.

**Table 7.2 – Royalties to NSW Under Different Price and Exchange Rate Assumptions**

| | TOTAL (UNDISCOUNTED) | PRESENT VALUE ($M) AT DIFFERENT DISCOUNT RATES | | |
|---|---|---|---|---|
| | | **4%** | **7%** | **10%** |
| CENTRAL ASSUMPTION | $44 | $23 | $15 | $10 |
| 3.5 MTPA | $39 | $20 | $13 | $9 |
| 3 MTPA | $34 | $17 | $11 | $8 |

The sensitivity testing for royalties indicates that total royalties from the Project will be between $34M and $44M and at 7% discount rate the present value of royalties will be between $11M and $15M.

### 7.3 Demand for the Provision of Local Infrastructure and Services

Given that the Project is a continuation of an existing mining activity with no additional workforce there is not expected to be any additional demand for local community infrastructure.

In additional, there is not expected to be any change in demand for local infrastructure and services such as reticulated sewage and water etc.

There will continue to be demand for use of local and State roads, however as identified above, where the Project requires upgrades, relocation or maintenance of roads these will be funded by Boral.

## 8 CONCLUSION

A CBA of the Project indicated that it would have net social benefits to Australia of between $488M and $643M, and net social benefits to NSW of between $166M and $321M. Hence the Project is desirable and justified from an economic efficiency perspective. Environmental, social and cultural impacts of the Project have been minimised through Project design and mitigation, offset and compensation measures. The economic value of residual impacts are considered to be immaterial from an aggregated economic efficiency perspective.

Economic activity analysis, using IO analysis, estimated that the Project would make up to the following direct and indirect average annual contribution to the regional economy[29] for approximately 30 years:

- $82M in annual direct and indirect regional output or business turnover;
- $48M in annual direct and indirect regional value added;
- $14M in annual direct and indirect household income; and
- 198 direct and indirect jobs.

The Project is estimated to make up to the following direct and indirect average annual contribution to the NSW economy for 30 years:

- $137M in annual direct and indirect regional output or business turnover;
- $74M in annual direct and indirect regional value added;
- $27M in annual direct and indirect household income; and
- 364 direct and indirect jobs.

With regard to the SEARs heads of consideration:

- the resource proposed to be mined is part of an estimated in-situ resource of 640 million tonnes of high grade limestone.
- the Project is an extension and continuation of the existing Marulan South Limestone Mine and as such the Project can utilise infrastructure servicing the existing mine.
- numerous sectors in the regional economy have some dependence on the Project as 92% of the existing workforce live in the Goulburn Mulwaree LGA and hence a material component of their expenditure would flow-on to local businesses. Similarly, Boral has identified that it spends considerable operational expenditure with local firms.
- the Project will provide continued direct employment for approximately 191 full time personnel in connection with the mine, including lime manufacturing, administration and logistics. This includes 118 personnel on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North Ryde that would otherwise not be employed if it weren't for the mine. It will also provide indirect employment in the regional economy from employee and Project expenditure.
- the capital investment associated with the Project is estimated at $111M.
- the Project will generate royalties of $44M in total or $15M present value.

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[29] The Local Government Area of Goulburn Mulwaree.

- the Project is a continuation of an existing mining operation and hence no additional demand for NSW or local community infrastructure is expected.

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[30] Historic heritage places included in this study comprised: buildings (e.g. houses, shops and churches); pioneering huts, farms and shearing sheds; Aboriginal missions; designed gardens and parks; old mines, factories and other industrial sites; railways, roads, bridges and ports; ruins; places that show how people lived and worked; shipwrecks; monuments and memorials dedicated to important historic people and events; and historic streets, suburbs and towns.

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## ATTACHMENT 1 – LEGISLATIVE CONTEXT FOR ECONOMIC ANALYSIS IN EIA

### Environmental Planning and Assessment Act 1979 and Environmental Planning and Assessment Regulation

- The basis for economic analysis under the *Environmental Planning and Assessment* (EP&A) *Act 1979* emanates from:
  - the definition of the term “environment” in the EP&A Act which is broad and includes the social and **economic** environment, as well as the biophysical environment;
  - the “objects” of the EP&A Act which includes *“promoting the social and **economic welfare** of the community”*; and
  - Clause 7(1)(f) of Schedule 2 of the EP&A Regulations which requires environmental assessment to provide “*the reasons **justifying** the carrying out of the development, activity or infrastructure in the manner proposed, having regard to biophysical, **economic** and social considerations…”*
  - *Section 79C of the EP&A Act requires the following two matters to be taken into consideration by the consent authority in determining a development application:*
    - the public interest (taken as the collective public interest of households in NSW); and
    - the likely impacts of that development, including environmental impacts on both the natural and built environments, and social and ***economic impacts in the locality***.
- Objects of promoting economic welfare and requirements to justify a project having regard to economic considerations are consistent with the use of CBA. A Note to Clause 7 (1) (f) states that "A cost benefit analysis may be submitted or referred to in the reasons justifying the carrying out of the development, activity or infrastructure."
- A cost benefit analysis is consistent with the consideration of the public interest, although the limitation of public interest to NSW households requires consideration of the costs and benefits to NSW households, whereas CBA would normally be undertaken at the National level.
- Elements of CBA can provide information on the economic impacts in the locality, although CBA should not be undertaken at the local level. This can be supplemented by other forms of analysis to examine economic impacts in the locality such as the consideration of:
  - effects relating to local employment;
  - effects relating to non-labour project expenditure; and
  - environmental and social impacts on the local community.

### Secretary's Environmental Assessment Requirements

- The Project SEARs include a requirement for:
  - an assessment of the likely economic impacts of the development, paying particular attention to:
    - the significance of the resource;

    - the economic benefits of the project for the State and region; and
    - the demand for the provision of local infrastructure and services.

  - the reasons why the development should be approved having regard to biophysical, **economic** and social **considerations**, including the principles of ecologically sustainable development.

**Other Economic Guidelines**

- In 2015 the NSW Government prepared *Guidelines for the economic assessment of mining and coal seam gas proposals*. This provides an outline of how to undertake a CBA and local effects analysis of mining and coal seam gas proposals.

- NSW Treasury (2007) *NSW Government Guideline for Economic Appraisal*, provides guidance for Government agencies on how to undertake CBA of significant spending proposals, including proposed capital works, projects and new programs across all public sector agencies. However, many of the principles have broader application.

## ATTACHMENT 2 – INTRODUCTION TO ECONOMIC METHODS

### Benefit Cost Analysis

- Cost Benefit Analysis (CBA) is the primary way that economists evaluate projects and policies.

- CBA evaluates whether the well-being (**economic welfare**) of the community is in aggregate improved by a project. It does this by comparing the costs and benefits of a project to the community.

- The community whose welfare is included is broadly defined as anyone who bears significant costs and benefits of a project. However, in practice most CBA is undertaken at a national level. CBA at a sub-national level is not recommended however if undertaken at this level should provide decision-makers with estimates of all significant effects, including those to non-residents of the sub-national region.

- It is not possible to justify a project on economic grounds without doing a CBA.

### Economic Activity Analysis

- Economists also often provide information to decision-makers on the **economic activity** that a project will provide to the regional, state or national economy. This is particularly relevant at the regional level since many regions and towns are experiencing long term decline as a result of structural change in the economy. Additional economic activity can help the prosperity of these regions.

- **Direct** economic activity provided by a project can be estimated from financial and labour estimates for a project. Methods that can be used to estimate **direct** and **indirect** economic activity include IO analysis and CGE modelling. Refer to Attachment 3 for a comparison of these methods and their assumptions.

- While economic activity measures from IO analysis and CGE modelling e.g. direct and indirect output, value-added and income, are generally not measures of benefits and costs relevant to a CBA this information can be of interest to decision-makers[31].

### Economic Analysis and Decision-Making

- CBA and local effects analysis (including IO/CGE analysis) are not mechanised decision-making tools, but rather means of analysis that provide useful information to decision-makers.

- Decision-making is multi-dimensional. CBA is concerned with the single objective of **economic efficiency** (economic welfare) while IO analysis and CGE are concerned with the objective of **economic activity** (growth). They do not address equity and other objectives of government. Decision-makers therefore need to consider the economic efficiency and economic activity implications of a project, as indicated by CBA and IO/CGE analysis respectively, alongside the performance of a project in meeting other, often conflicting, government goals and objectives.

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[31] It should be noted that it is possible to analyse industry benefits and costs within a general equilibrium framework where impacts are of a sufficient scale that they flow through into multiple sectors in the economy. However, for individual projects a partial equilibrium framework is the preferred approach for the estimation of costs and benefits (US EPA (2010) Guidelines for Preparing Economic Analyses, US EPA).

## ATTACHMENT 3 – COMPARISON OF INPUT-OUTPUT ANALYSIS AND THE LEA METHOD

IO analysis begins with identification of the direct gross regional economic activity footprint of a project for the region. If a project provides 100 jobs at the mine site then all these jobs are counted in IO analysis as a direct effect i.e. direct employment in the region, because the jobs are located in the region. However, in IO analysis only the income of employees living in the region are counted as direct income effects since it is only wages expenditure of those living in the region that flows through the regional economy. In IO analysis, if 40% of a projects jobs are filled by people who already reside in the region then the **total** wages of these people is counted as a direct regional income effect of the project. Similarly, if 40% of the new jobs are taken by people who migrate into the region this is also counted as direct income for the region, as it is income that will accrue to people living in the region even though they are new residents. In IO analysis, the income of those residing outside the region is excluded as most of their income will be taken home after shift and spent where they live or elsewhere.

These direct employment and income effects for the region are those **associated** with the project i.e. the gross footprint, rather than specifically an assessment of **incremental** effects. This is partly because assessment of incremental effects becomes highly contentious and difficult. However, as will be shown below, these gross direct effects associated with a project can also be a reasonable approximation of incremental effects when "trickle down" or "job chain" effects are considered.

However, first is a comparison between how IO analysis treats direct employment and income effects (as explained above) and that in the NSW (2015) guideline.

The guideline splits labour into those ordinarily resident in the region and those not ordinarily resident in the locality. For those ordinarily resident in the region the guideline suggests calculation of incremental income as the difference between a mining (including quarrying) income and the average level of income in other industries in the region. Incremental direct employment is then calculated by dividing this incremental income by the average wage in mining.

The guideline ignores workers who migrate into the region to work. However, using the rationale of the guideline, workers who migrate into the region to take jobs in a project provide a greater level of incremental income and spending in the region than those to take jobs in a project and who already reside in the region. The entire wage of those migrating into the region is additive to regional income in comparison to wage increments for those already residing in the region.

Table 1 provides an example of incremental wages using the guideline method and when income from those migrating into the region is counted. If only the incremental wages of those who already reside in the region are counted the incremental impact is $1.4M in annual wages. However, if the incremental wages to the region from those who migrate into the region are included, this increases to $5.4M.

**Table 1 - Incremental Income when Immigrating Workforce is Included**

| Categories of Workers | Direct Empl | Current Wages @$65k | New Wages @$100k | Incremental New Wages for Workers | Incremental New Wages to the Region |
|---|---|---|---|---|---|
| Already Live in Region | 40 | 2,600,000 | 4,000,000 | 1,400,000 | 1,400,000 |
| Migrate into Region to Live | 40 | 2,600,000 | 4,000,000 | 1,400,000 | 4,000,000 |
| Commute from outside | 20 | 1,300,000 | 2,000,000 | 700,000 | 0 |
| **Total Direct Empl** | **100** | **6,500,000** | **10,000,000** | **3,500,000** | **5,400,000** |

Even for those already living in the region who are already employed, the incremental income estimated using the guideline will substantially understate additional regional income effects. This is because new jobs in a region create a chain of job opportunities (referred to in the literature as the "trickle down" effect or "job chain" - see Persky et al, 2004 What are jobs worth?, Employment Research Vol. 11 , p. 3).

An already employed person in the region moving into a mining (including quarrying) job, creates a job vacancy, which can be filled by those in the region (already employed, unemployed or attracted into the labour force) or by in-migration. Where this job is filled by those already employed in the region this in turn creates another vacancy etc. Following the entire chain through, the cumulative increase in wages to a region would approach the wages of the total direct mining jobs. It would only be discounted if the chain ends with employment of those from local residents in the unemployment pool (who are receiving an allowance and hence already are spending income in the region) or if jobs remain unfilled. In periods of higher unemployment rates, jobs along the job chain remaining unfilled is unlikely. If the chain ends with in-migrating employment or employment of those in the region that are new to the workforce then the incremental wages is equal to the total wages of the new jobs.

Table 2 demonstrates the "trickle down" effect in relation to 40 new mining jobs filled by already employed local workers. It shows that the total annual wages of the new mining jobs is $4M. Under the trickle down approach where all jobs are backfilled including ultimately by 40 local residents from the unemployment pool the incremental wages to the region are $3.5M. If some of these jobs filled from the unemployment pool are ultimately filled by in-migration the difference between the incremental wages to the region and the total annual mining jobs wages will lessen.

The guideline does not take account of the "trickle down" effect and essentially assumes that the previous jobs of "job movers" in the region remain vacant for the life of the Project.

Incorporation of consideration of the "trickle down" effect means that the direct incremental income to a region approximates that assumed in IO analysis (i.e. the gross footprint of economic activity estimated using IO analysis is also an indicator of the net effect).

**Table 2 - Demonstration of the Trickle Down Effect for 40 Jobs Filled by Locals Who are Already Employed in the Region**

| | **Total wages** | **Increment Wages Gain to Region** |
|---|---|---|
| 1. New mining wage for 40 workers @$100k | $4,000,000 | $1,400,000 (1-2) |
| 2. Current Wages for 40 workers @$65k | $2,600,000 | $1,000,000 (2-3) |
| 3. Wage of people filling above 40 positions @$40k | $1,600,000 | $800,000 (3-4) |
| 4. Wage of people filling above 40 positions @$20k | $800,000 | $ 255,664 (4-5) |
| 5. Wages of the unemployed filling above 40 positions (Newstart - single no children) | $544,336 | |
| **Total** | | **$3,455,664** |

## ATTACHMENT 4 – INPUT-OUTPUT ANALYSIS AND COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS

### Input-Output Analysis

- IO analysis is a cost effective and simple method for estimating the gross market economic activity i.e. financial transactions and employment, in a specified region that is associated with a project.
- IO analysis is the most widely used model for regional impact assessment (West and Jackson 2005).
- IO analysis can be undertaken at the LGA or aggregation of LGAs level.
- IO analysis can provide disaggregation of economic activity impacts across many sectors – 111 sectors based on current National IO tables.
- IO analysis was developed by Wassily Leontief for which he received the Nobel Prize in Economics.
- IO analysis is a static analysis that looks at economic activity impacts in a particular year e.g. a typical year of a projects operation.
- IO analysis has historically been applied at the regional level to assess the economic activity impacts of individual projects.
- IO analysis involves the development of an IO table representing the buying and selling of goods and services in the economy. These fixed average ratios are used to estimate the direct and indirect impacts of a change in expenditure in a region.
- IO analysis identifies the gross direct and indirect additional (positive) regional economic activity associated with a project in terms of a number of indicators of economic activity – output, income, value-added[32] and employment.
- Economic activity measures used in IO are not measures of benefits and costs relevant to a CBA.
- IO analysis does not attempt to examine non-market environmental, social or cultural impacts.
- IO analysis does not depend on the assumption *“that there is a ghost pool of highly skilled yet unemployed people”* in a region as suggested by a Land and Environment Court Judgement.
- The estimation of economic activity impacts in IO analysis are based on a number of simplifying assumptions – most notable is that the regional economy has **access to** sufficient labour and capital resources (from both **inside** and **outside** the region) so that an individual project does not result in any regional price changes e.g. wages in other industries or house rentals, which would lead to contractions (“crowding out”) of economic activity in other sectors in the region.
- For the assessment of the impacts of individual projects on small open regional economies, this is a reasonable assumption.
- Nevertheless, the results of IO modelling can be seen as representing an upper bound for the net economic activity associated with a project.

### Computable General Equilibrium Modelling

- CGE modelling is an alternative more expensive, complicated but theoretically more sophisticated method for estimating the economic activity associated with a project.

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[32] Value-added is the difference between the gross value of business turnover and the costs of the inputs of raw materials, components and services bought in to produce the gross regional output.

- CGE modelling can be dynamic or comparative static[33] and has historically been applied at the State and National level for determining the potential economic activity associated with the introduction of major government policy changes and investment in large infrastructure projects.
- CGE modelling can also be undertaken at a regional level but normally at no finer scale than the Statistical Subdivision level.
- CGE modelling estimates the additional net (positive and negative) economic activity associated with a project in terms of a number of economic indicators – including value-added and employment – but also real income, government tax revenue and components of value-added.
- Economic activity measures used in CGE modelling are not generally measures of benefits and costs relevant to a CBA, although CGE modelling can also be used to estimate market costs or market benefits, as part of a CBA, where the magnitude of a project will affect a large number of sectors and the effects will be spread more broadly throughout the economy.
- Economic activity impacts can be disaggregated by sector but this is not normally as disaggregated as in IO analysis.
- CGE modelling does not attempt to examine non-market environmental, social or cultural impacts.
- CGE modelling is underpinned by an IO database as well as a system of interdependent behaviour and accounting equations which are based on economic theory (but mostly without econometric backing at the regional level).
- The equations in CGE models ensure that any change in demand in a region, no matter how small, translates into some change in prices and hence there is always some ‘crowding out’ of other economic activity in the region.
- At the regional level, CGE results can be very sensitive to changes in these behavioural assumptions.
- ‘Crowding out’ of other economic activities estimated via CGE modelling does not reflect losses of jobs but the shifting of labour resources to higher valued economic activities.

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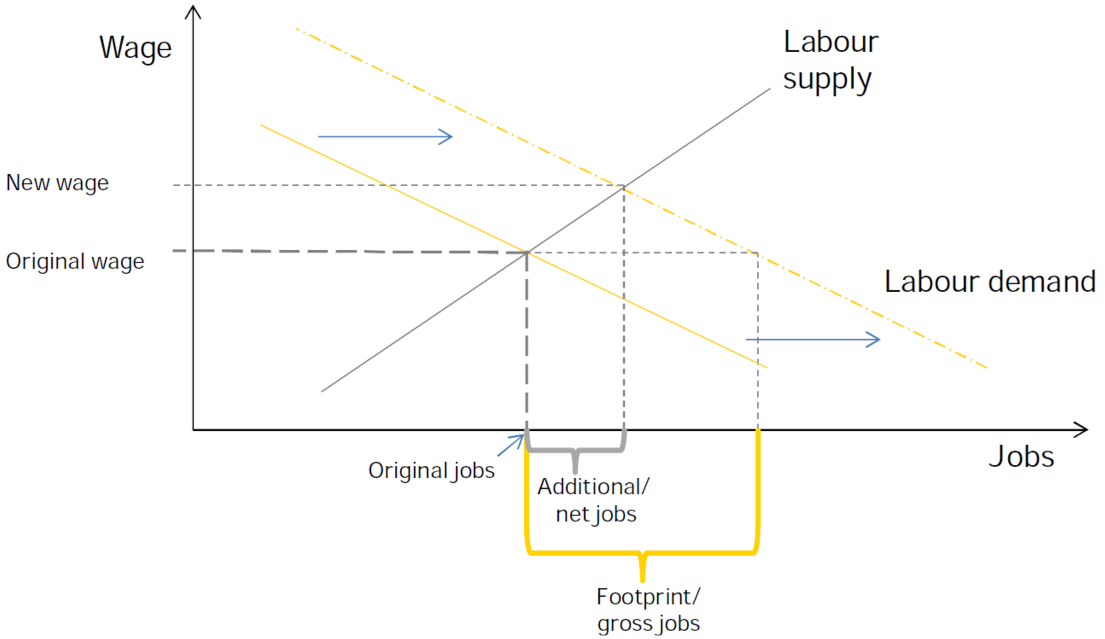
[33] Comparative static models compare one equilibrium point with another but do not trace the impact path along the way. Dynamic models give year by year impacts of a shock.

### Comparison of IO Analysis and CGE Modelling

### Figure A4.1 – Comparison of Employment Estimates in IO Analysis and CGE Modelling



Source: Ernst Young (2014) Capital Metro Job Creation Analysis, p. 30.

- Figure A4.1 illustrates the difference between the output of IO analysis and the output of CGE with respect to employment. IO analysis estimates the employment footprint or gross jobs from a project. It can also be taken as an indicator of net jobs from a project where there is no or little upward pressure on wages for the region in question as a result of the individual project and hence no or little crowding out of other economic activity[34]. CGE modelling assumes upward pressure on wages and hence some crowding out of other economic activity in the region. Under this assumption CGE estimates additional net jobs as being less than the employment footprint/gross jobs.
- Which modelling approach best represents the true situation depends on whether and to what extent price changes occur at a regional level as a result of individual projects. This is an empirical issue and would depend on the migration of labour into the region, commuting of labour and timely management of land releases by Councils. Few studies exist that examine this issue.
- IO analysis provides decision-makers with information on the relative employment footprint/gross jobs of different projects, without going to the second and more complicated stage of trying to model wage rises and "crowding out" across all other sectors in the economy.
- Regional economic activity, estimated by IO analysis or CGE modelling, is just one piece of information that decision-makers may take into account in considering a project.

### Guidelines

- Both IO analysis and CGE modelling are identified in the DP&I's *draft Guideline for Economic Effects and Evaluation in EIA* (James and Gillespie 2002) as appropriate methods for examining regional economic impacts i.e. impacts on economic activity – the size and structure of an economy.
- NSW Treasury (2009) *Guidelines for estimating employment supported by the actions, programs and policies of the NSW Government,* supports the use of IO for deriving estimates for

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[34] This is akin to the marginal assumption in CBA.

employment supported by NSW Government actions, programs and policies, and clarifies the interpretation of such estimates.

- Other guidelines to recognise the role of IO analysis include:
  - US Environment Protection Agency (2010) *Guidelines for Preparing Economic Analyses*;
  - Australian Bureau of Rural Science (2005) *Socio-economic Impact Assessment Toolkit: A guide to assessing the socio-economic impacts of Marine Protected Areas in Australia*.
- NSW Treasury (2007) identify that IO analysis is commonly used to assess the regional impacts of a project. However, IO analysis is concerned with measuring economic activity, and is not a tool for the evaluation of projects (in the way that CBA is).
- World Bank economist Mustafa Dinc (2015) Introduction to Regional Economic Development: Major Theories and Basic Analytical Tools, Edward Elgar, UK, identifies IO as one of the most widely used models around the world for undertaking regional economic impact analysis and a solid framework to analyse the interdependence of industries in an economy.

**Government Applications of IO Analysis**

- Applications of IO analysis commissioned by Government agencies include:
  - Department of Sustainability, Environment, Water, Population and Communities (2011) *Assessing the Socio-Economic Impacts of Sustainable Diversion Limits and Water for the Future Investments: An Assessment of the Short-Term Impacts at a Local Scale*
  - NSW Natural Resources Commission (2009) *River Red Gum Assessment: Socio-economic impact assessment*;
  - Victorian Environmental Assessment Council (2007) *River Red Gum Forests Investigation – Socio-Economic Assessment.*
  - Resource and Conservation Division of the NSW Department of Urban Affairs and Planning (1999) Regional Impact Assessments as part of the NSW Comprehensive Regional Assessments under the National Forestry Policy.
  - Reserve Bank of Australia (2012) *Industry Dimensions of the Resource Boom: An Input-Output Analysis.*
  - DECCW (2009) Economic benefits of national parks and other reserves in New South Wales - Summary report, reports the results of numerous studies it and its' predecessors have commissioned on the regional economic impacts of national parks and protected areas.
  - DECCW (2006) *Socio Economic Assessment of the Batemans Bay Marine National Park*
  - DECCW (2006) *Socio Economic Assessment of the Port Stephens – Great Lakes Marine Park*
  - National Parks Service, US Department of the Interior (2014) *2012 National Parks Visitor Spending Effects: Economic Contribution to Local Communities, States and the Nation*.

**Criticisms Misrepresented**

- The main concern that economists e.g. the Productivity Commission, NSW Treasury and ABS (as quoted by The Australia Institute in numerous submissions to mining projects in NSW) have with IO is its use as a substitute for CBA, not its use for estimating direct and indirect regional economic activity impacts.
  - NSW Treasury (2009) "*Model based economic impact assessment [such as IO analysis] is not a substitute for a thorough economic analysis of a policy. The appropriate method for analysing policy alternatives is benefit cost analysis (CBA)".*

- The main “abuse” reported by the Productivity Commission is using IO analysis to *“make the case for government intervention”* when CBA is the appropriate method for doing this.

- ABS’s concerns with IO being “*biased*” refer to it being a “*biased estimator of the benefits or costs of a project”*. IO does not estimate benefits and costs but economic activity.

- Concerns of the Warkworth Judgement with IO analysis being “deficient” related to the data (industry data from surveys undertaken in 2001 and assumptions used (see next dot point)), but more fundamentally for not *“assisting in weighing the economic factors relative to the various environmental and social factors, or in balancing economic, social and environmental factors”.* This is an inappropriate criticism of the IO method, since it does not pretend to do this.

- IO analysis does not depend on the assumption *“that there is a ghost pool of highly skilled yet unemployed people”* in a region as suggested in the Warkworth Judgement. It allows for labour to come from within or outside the region.

**Latest Use of IO Analysis**

- BAEconomics (2014) in its Economic Impact Assessment for Warkworth Continuation 2014 and Mt Thorley Operations 2014 justifies the use of IO analysis to estimate economic activity associated with the Project.

- Dr Brian Fisher, the Managing Director of BAEconomics is a highly respected resource economist who previously held the positions of Executive Director of the Australian Bureau of Agricultural and Resource Economics (ABARE) and Associate Commissioner of the Productivity Commission. He received an Order of Australia in the Queen’s Birthday Honours List in 2007.

## ATTACHMENT 5 – UNDERLYING ASSUMPTIONS AND INTERPRETATIONS OF INPUT-OUTPUT ANALYSIS AND MULTIPLIERS

1. “The *basic assumptions* in IO analysis include the following:

- there is a fixed input structure in each industry, described by fixed technological coefficients (evidence from comparisons between IO tables for the same country over time have indicated that material input requirements tend to be stable and change but slowly; however, requirements for primary factors of production, that is labour and capital, are probably less constant);
- all products of an industry are identical or are made in fixed proportions to each other;
- each industry exhibits constant returns to scale in production;
- unlimited labour and capital are available at fixed prices; that is, any change in the demand for productive factors will not induce any change in their cost (in reality, constraints such as limited skilled labour or investment funds lead to competition for resources among industries, which in turn raises the prices of these scarce factors of production and of industry output generally in the face of strong demand); and
- there are no other constraints, such as the balance of payments or the actions of government, on the response of each industry to a stimulus.

2. The multipliers therefore describe *average effects, not marginal effects*, and thus do not take account of economies of scale, unused capacity or technological change. Generally, average effects are expected to be higher than the marginal effects.

3. The IO tables underlying multiplier analysis only take account of one form of *interdependence**,*** namely the sales and purchase links between industries. Other interdependence such as collective competition for factors of production, changes in commodity prices which induce producers and consumers to alter the mix of their purchases and other constraints which operate on the economy as a whole are not generally taken into account.

4. The combination of the assumptions used and the excluded interdependence means that IO multipliers are higher than would realistically be the case. In other words, they tend to *overstate* the potential impact of final demand stimulus. The overstatement is potentially more serious when large changes in demand and production are considered.

5. The multipliers also do not account for some important pre-existing conditions. This is especially true of Type II multipliers, in which employment generated and income earned induce further increases in demand. The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons.

6. The most *appropriate interpretation* of multipliers is that they provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy which arises solely from purchases and sales of industry output based on estimates of transactions occurring over a (recent) historical period. Progressive departure from these conditions would progressively reduce the precision of multipliers as predictive device” (ABS 1995, p.24).

Multipliers indicate the total impact of changes in demand for the output of any one industry on all industries in an economy (ABS, 1995). Conventional output, employment, value-added and income multipliers show the output, employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

Components of the conventional output multiplier are as follows:

*Initial effect* - which is the initial output stimulus, usually a $1 change in output from a particular industry (Powell and Chalmers, 1995; ABS, 1995).

*First round effects* - the amount of output from all intermediate sectors of the economy required to produce the initial $1 change in output from the particular industry (Powell and Chalmers, 1995; ABS, 1995).

*Industrial support effects* - the subsequent or induced extra output from intermediate sectors arising from the first round effects (Powell and Chalmers, 1995; ABS, 1995).

*Production induced effects* - the sum of the first round effects and industrial support effects (i.e. the total amount of output from all industries in the economy required to produce the initial $1 change in output) (Powell and Chalmers, 1995; ABS, 1995).

*Consumption induced effects* - the spending by households of the extra income they derive from the production of the extra $1 of output and production induced effects. This spending in turn generates further production by industries (Powell and Chalmers, 1995; ABS, 1995).

The *simple multiplier* is the initial effect plus the production induced effects.

The *total multiplier* is the sum of the initial effect plus the production-induced effect and consumption-induced effect.

Conventional employment, value-added and income multipliers have similar components to the output multiplier, however, through conversion using the respective coefficients show the employment, value-added and income responses to an initial output stimulus (Jensen and West, 1986).

For employment, value-added and income, it is also possible to derive relationships between the initial or own sector effect and flow-on effects. For example, the flow-on income effects from an initial income effect or the flow-on employment effects from an initial employment effect, etc. These own sector relationships are referred to as ratio multipliers, although they are not technically multipliers because there is no direct line of causation between the elements of the multiplier. For instance, it is not the initial change in income that leads to income flow-on effects, both are the result of an output stimulus (Jensen and West, 1986).

A description of the different ratio multipliers is given below.

$$\text{Type 1A Ratio Multiplier} = \frac{\text{Initial + First Round Effects}}{\text{Initial Effects}}$$

$$\text{Type 1B Ratio Multiplier} = \frac{\text{Initial + Production Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11A Ratio Multiplier} = \frac{\text{Initial + Production Induced + Consumption Induced Effects}}{\text{Initial Effects}}$$

$$\text{Type 11B Ratio Multiplier} = \frac{\text{Flow-on Effects}}{\text{Initial Effects}}$$

Source: Centre for Farm Planning and Land Management (1989).

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Powell, R. and Chalmers, L. (1995) *The Regional Economic Impact of Gibraltar Range and Dorrigo National Park*. A Report for the NSW National Parks and Wildlife Service.

## ATTACHMENT 6 – CBA AND ASSESSMENT OF EXTERNALITIES

### Consideration of Externalities in the Economic Assessment

#### *Introduction*

- The “perfect” CBA is an ideal. Different situations call for different styles and depths of analysis.

- Valuation of all environmental impacts is neither practical nor necessary.

- In attempting to value impacts, there is the practical principle of materiality. Only those impacts which are likely to have a material bearing on the decision need to be considered in CBA (NSW Government 2012). The guideline gives an example of impacts of less than $1M being immaterial for a project with an estimated net present value of $20M.

- The CBA of the Project took three approaches to the consideration of environmental costs:

  - Threshold value analysis;
  - Qualitative consideration of impacts and valuation of the main impacts based on market data and benefit transfer; and
  - Additional threshold value analysis to recognise that some impacts may not have been fully valued and incorporated into the analysis.

#### *Threshold Value Analysis*

- The first approach used to consider the environmental impacts of the Project was the threshold value method.

- Threshold value analysis is a recognised approach to CBA where it is not possible or pragmatic to attempt to value potential external impacts.

- Threshold value analysis was developed by Krutilla and Fisher (1975)[35]. It is specifically referred to as an appropriate approach in the DP&I's (2002) *Draft Guideline for Economic Effects and Evaluation in EIA,* and is a widely recognised approach.

- Threshold value analysis avoids the sometimes contentious matter of physically quantifying environmental impacts and then placing dollar values on them.

- Threshold value analysis leaves the trade-off between quantified economic benefits and unquantified environmental costs for the decision-maker.

- In the Economic Assessment of the Project, the estimated net production benefits provides a threshold value or reference value against which the relative value of the residual environmental, social and cultural impacts of the Project, after mitigation, offset and compensation, may be assessed. The threshold value indicates the price that the community must value any residual environmental impacts of the Project (be willing to pay) to justify in economic efficiency terms the ‘no development’ option.

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[35] Krutilla, J.V. and A.C. Fisher (1975) *The Economics of Natural Environments*, Johns Hopkins University Press, Baltimore.

### *Qualitative consideration of impacts and valuation of the main impacts based on market data and benefit transfer*

- The second approach used was to qualitatively consider, and where possible value, the main environmental, cultural and social impacts of the Project for the well-being of people.

- Qualitative consideration of potential impacts and any subsequent valuation of impacts relied on the assessment of biophysical impacts provided in the Project EIS by technical specialists.

- The approach to valuing environmental impacts in the Economic Assessment of the Project is summarised in Table A6.1.

**Table A6.1 – Method for Valuing Environmental Impacts in the Economic Assessment of the Project**

| Impact | Potential Valuation Method | Comment |
|---|---|---|
| Greenhouse gas emissions | Damage cost method | Estimate of global social damage cost of carbon from literature and govt policy, adjusted to Australian and NSW damage cost. |
| Agricultural impacts | Property valuation method | Foregone agricultural production is reflected in land values. So opportunity costs of land reflect, among other things, foregone agriculture. |
| Noise impacts | | |
| *Significant* | Property valuation method | Cost of acquiring properties encompasses property value impacts due to noise - but no impacts of the Project |
| *Moderate and low* | Defensive expenditure | Noise mitigation costs at properties - but no impacts of the Project. |
| Blasting | | Vibration and air blast limits for human comfort and structural damage are met, minimal impact is likely to occur to humans or structures. |
| Significant air quality impacts | Property valuation method | Cost of acquiring properties encompasses property value impacts due to air quality impacts. However, no properties impacted by exceedances. |
| Use of surface water | Market value of water | Cost of Water Access Licences reflects marginal value product of water. |
| Use of groundwater | Market value of water | Cost of Water Access Licences reflects marginal value product of water. |
| Groundwater drawdown | Defensive expenditure | No material impacts on private bores predicted. |
| Water discharges | | Regulated under the Protection of Environment Operations Act 1997. |
| Ecology | Replacement cost | Capital and operating costs of offsets included in capital and operating costs. Assumes that offsets levels are sufficient to compensate the community for values lost. This is a requirement of Govt. Policy. |
| Road transport impacts | Defensive expenditure | Cost of road investment required as a result of the Project included in capital costs of project. |
| Aboriginal heritage | Defensive expenditure | A number of sites impacted. Cost of preparation and implementation of an Aboriginal Heritage Management Plan included in the costs of the Project. Residual impacts unquantified. |
| Historic heritage | Defensive expenditure<br>Benefit transfer of CM data | Impacts valued using benefit transfer from a National Study of community willingness to pay to prevent impacts on heritage sites. |
| Visual | Defensive expenditure | Costs of mitigation measures included in the economic analysis. No material impacts likely. |

### *Additional Threshold Value Analysis*

- To the extent that there may be some disagreement about the estimated economic values of the environmental impacts of the Project, the estimated net benefits of the Project provides another threshold value that the residual environmental impacts of the Project after mitigation, compensation and offset would need to exceed to make the Project questionable form and economic efficiency perspective. This again allows the decision-maker to consider any material impacts that it identifies in the course of its consideration that were not valued in the Economic Assessment.

## ATTACHMENT 7 – NON-MARKET BENEFITS OF EMPLOYMENT

- In standard CBA, the wages associated with employment are considered an economic cost of production with this cost included in the calculation of net production benefits (producer surplus).

- Where labour resources used in a project would otherwise be employed at a lower wage or would be unemployed a shadow price of labour is included in the estimation of producer surplus rather than the actual wage (Boardman et al. 2005[36]). The shadow price of labour is lower than the actual wage and has the effect of increasing the magnitude of the producer surplus benefit of a project. The analysis included consideration of the magnitude of these additional benefits if 50% of the direct labour force would otherwise be unemployed for three years. Results are reported with and without this value.

- These treatments of employment in CBA relate to the market value or opportunity cost of labour resources.

- However, CBA also includes non-market values i.e. the values that individuals in a community hold for things even though they are not traded in markets. For example, people have been shown to value environmental resources even though they may never use the resource. These are referred to as existence values and are underpinned by the view in neoclassical welfare economics that individuals are the best judge of what has value to them.

- As identified by Portney (1994[37]), the concept of existence values should be interpreted more broadly than just relating to environmental resources.

  *"If I derive some utility from the mere existence of certain natural environments I never intend to see (which I do), might I not also derive some satisfaction from knowing that refineries provide well-paying jobs for hard-working people, even though neither I nor anyone I know will ever have such a job?. I believe I do. Thus, any policy change that "destroys" those jobs imposes a cost on me – a cost that, in principle, could be estimated using the contingent valuation method.... Since regulatory programs will always impose costs on someone – taking the form of higher prices, job losses, or reduced shareholder earnings – lost existence values may figure every bit as prominently on the cost side of the ledger as the benefit side (Portney 1994, p. 13).*

- The utility (welfare) of individuals may therefore be affected by changes in their own well-being as well as changes in the well-being of others (Rolfe and Bennett 2004[38]). This is consistent with the observed behaviour of altruism (Freeman III 2003[39]).

- Whether people have existence values for the employment of others, as hypothesised by Portney, is an empirical issue. A number of non-market valuation studies have found evidence that people hold existence values for the employment of others:

  - Johnson, F. and Desvouges, W. (1997) Estimating Stated Preferences with Rated-Pair Data: Environmental, Health and Employment Effects of Energy Programs. Journal of Environmental Economics and Management, 34, 75-99, estimated the non-market value of employment effects of energy programs.

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[36] Boardman, A., Greenberg, D., Vining, A. and Weimer, D. (2001) *Cost-benefit analysis: concepts and practice*, Prentice Hall, New Jersey.

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  - Adamowicz, W., Boxall, P., Williams, M. and Louviere, J. (1998) Stated Preference Approaches to Measuring Passive Use Values: Choice Experiments Versus Contingent Valuation, American Journal of Agricultural and Economics, 80, 64-75, in a study on the protection of old growth forests included an attribute for forest industry employment losses.
  - Morrison, M., Bennett, J. and Blamey, R. (1999) Valuing improved wetland quality using choice modelling, Water Resources Research ( Vol. 35, No. 9, pp. 2805-2814) valued irrigation related employment losses as a result of wetland protection.
  - Blamey, R., Rolfe, J., Bennett, J., and Morrison, M., (2000) Valuing remnant vegetation in Central Queensland using choice modelling, The Australian Journal of Agricultural and Resource Economics(44(3): 439-56) in a study of broadscale tree clearing in the Desert Uplands of Queensland, Australia included an attribute for jobs lost to the region.
  - Do, T.N. and Bennett, J. (2007) Estimating Wetland Biodiversity Values: A Choice Modeling Application in Vietnam’s Mekong River Delta, Australian National University, Economics and Environmental Network Working Paper estimated values for the number of farmers affected by a change in wetland management of Tram Chim.
  - Othman, J., Bennett, J., Blamey, R. (2004) Environmental values and resource management options: a choice modelling experience in Malaysia, Environ. Dev. Econ. 9, 803–824, valued local employment losses from different conservation management strategies for the Matang Mangrove Wetlands in Perak State, Malaysia.
  - Marsh, D. (2010) Water Resource Management in New Zealand: Jobs or Algal Blooms? Presented at the Conference of the New Zealand Association of Economists Auckland 2 July 2010, valued employment losses as a result of improvements in water quality in a dairy catchment in Waikato region of New Zealand the catchment.
  - Longo A, Markandya A, Petrucci M (2008) The Internalization of Externalities in the Production of Electricity: Willingness to Pay for the Attributes of a Policy for Renewable Energy, Ecological Economics 67:140-152, in the context of renewable energy projects valued additional electricity sector jobs.
  - Colombo, S., Hanley, N., and Requena, J.C. (2005) Designing Policy for Reducing the Off-farm Effects of Soil Erosion Using Choice Experiments, Journal of Agricultural Economics, 56(1), 81-96, valued local employment generated from watershed policies to reduce soil erosion.
  - Caparrós A, Oviedo JL, Campos P (2008) Would you choose your preferred option? Comparing choice and recoded ranking experiments. Am J Agricult Econ 90(3):843–855, valued increases in local employment from a NP reforestation program.
  - Windle, J. and Rolfe, J. (2014) Assessing the trade-offs of increased mining activity in the Surat Basin, Queensland: preferences of Brisbane residents using non-market valuation techniques, Australian Journal of Agricultural and Resource Economics, 58, pp. 111-129, valued jobs generated by mining developments in the Surat Basin, as well as social impacts of mining developments such as increased housing prices and increase wages in non-mining sectors.

- Three non-market valuation studies have found evidence that people in NSW hold existence values for the employment of others in coal mining projects:

  - Gillespie, R. (2009) Bulli Seam Operations Socio-Economic Assessment, prepared for Illawarra Coal Holdings Pty Ltd.
  - Gillespie, R. and Kragt, M. (2012) Accounting for non-market impacts in a benefit-cost analysis of underground coal mining in New South Wales, Australia, Journal of Benefit Cost Analysis, 3(2): article 4.
  - Gillespie, R. and Bennett, J. (2012) Valuing the Environmental, Cultural and Social Impacts of Open Cut Coal Mining in the Hunter Valley of NSW, Australia, Journal of Environmental Economics and Policy, Volume 1, Issue 3, 1-13.

- The values from these studies are summarised in Table A7.1.

**Table A7.1 – Existence Values for Mine Employment**

| | Mean Implicit Price ($) (95% CI) | Aggregate WTP per Job Year ($) (95% CI) | Coal Mine | Reference |
|---|---|---|---|---|
| WTP per household per year for 20 years for each year the mine provides 320 jobs | $5.94<br>$4.96 to $7.22 | $8,157<br>$3,659 to $5,326 | Metropolitan Colliery | Gillespie (2009) |
| WTP per household (once-off) for each year the mine provides 1,170 jobs | $36.21<br>$29.89 to $43.97 | $1,299<br>$1,037 to $1,578 | Bulli Seam Operations | Gillespie and Kragt (2012) |
| WTP per household (once-off) for each year the mine provides 975 jobs | $27.45<br>$17.52 to $36.95 | $3,546<br>$2,263 to $4,773 | Warkworth | Gillespie and Bennett (2012) |

*Implicit prices are aggregated to 50% of NSW households.

- These values are public good values i.e. they are the sum of values held by individual households in NSW. Comparison of public good values to private good values such as wages are meaningless.

- The motivation behind people's willingness to pay for the employment of others is unknown. Split sample analysis undertaken by Gillespie (2009) providing different information to survey respondents on the re-employment prospects of impacted workers did not impact household willingness to pay for the employment provided by the mine. It is possible that respondents were not concerned so much with the prospects of re-employment elsewhere in the economy or net employment impacts but with the 'forced' change to other people's employment. However, further investigation is required to unpack respondent motivations in relation to attributes representing employment.

- Notwithstanding the above justification for the inclusion of non-market employment values in CBA, it is recognised that some people view this as contentious and so the results of the CBA for the Project are reported "with" and "without" the non-use values for employment being included.

## ATTACHMENT 8 – THE GRIT SYSTEM FOR GENERATING INPUT-OUTPUT TABLES

The Generation of Regional Input-Output Tables (GRIT) system was designed to:

- combine the benefits of survey based tables (accuracy and understanding of the economic structure) with those of non-survey tables (speed and low cost);
- enable the tables to be compiled from other recently compiled tables;
- allow tables to be constructed for any region for which certain minimum amounts of data were available;
- develop regional tables from national tables using available region-specific data;
- produce tables consistent with the national tables in terms of sector classification and accounting conventions;
- proceed in a number of clearly defined stages; and
- provide for the possibility of ready updates of the tables.

The resultant GRIT procedure has a number of well-defined steps. Of particular significance are those that involve the analyst incorporating region-specific data and information specific to the objectives of the study. The analyst has to be satisfied about the accuracy of the information used for the important sectors; in this case the other mining sector. The method allows the analyst to allocate available research resources to improving the data for those sectors of the economy that are most important for the study.

An important characteristic of GRIT-produced tables relates to their accuracy. In the past, survey-based tables involved gathering data for every cell in the table, thereby building up a table with considerable accuracy. A fundamental principle of the GRIT method is that not all cells in the table are equally important.  Some are not important because they are of very small value and, therefore, have no possibility of having a significant effect on the estimates of multipliers and economic impacts. Others are not important because of the lack of linkages that relate to the particular sectors that are being studied. Therefore, the GRIT procedure involves determining those sectors and, in some cases, cells that are of particular significance for the analysis. These represent the main targets for the allocation of research resources in data gathering. For the remainder of the table, the aim is for it to be 'holistically' accurate (Jensen, 1980). This means a generally accurate representation of the economy is provided by the table, but does not guarantee the accuracy of any particular cell. A summary of the steps involved in the GRIT process is shown in Table A8.1 (Powell and Chalmers, 1995).

## Table A8.1
## The GRIT Method

| Phase | Step | Action |
|---|---|---|
| PHASE I | | ADJUSTMENTS TO NATIONAL TABLE |
| | 1 | Selection of national input-output table (106-sector table with direct allocation of all imports, in basic values). |
| | 2 | Adjustment of national table for updating. |
| | 3 | Adjustment for international trade. |
| PHASE II | | ADJUSTMENTS FOR REGIONAL IMPORTS |
| | | (*Steps 4-14 apply to each region for which input-output tables are required*) |
| | 4 | Calculation of 'non-existent' sectors. |
| | 5 | Calculation of remaining imports. |
| PHASE III | | DEFINITION OF REGIONAL SECTORS |
| | 6 | Insertion of disaggregated superior data. |
| | 7 | Aggregation of sectors. |
| | 8 | Insertion of aggregated superior data. |
| PHASE IV | | DERIVATION OF PROTOTYPE TRANSACTIONS TABLES |
| | 9 | Derivation of transactions values. |
| | 10 | Adjustments to complete the prototype tables. |
| | 11 | Derivation of inverses and multipliers for prototype tables. |
| PHASE V | | DERIVATION OF FINAL TRANSACTIONS TABLES |
| | 12 | Final superior data insertions and other adjustments. |
| | 13 | Derivation of final transactions tables. |
| | 14 | Derivation of inverses and multipliers for final tables. |

Source: Bayne and West (1988).

## REFERENCES

Bayne, B. and West, G. (1988) *GRIT – Generation of Regional Input-Output Tables: Users Reference Manual*. Australian Regional Developments No. 15, Office of Local Government, Department of Immigration, Local Government and Ethnic Affairs, AGPS.

Jensen, G. (1980) The concept of accuracy in regional input-output models. *International Regional Science Review*, 5:2, pp.139-54.

Powell, R. and Chalmers, L. (1995) *The Regional Economic Impact of Gibraltar Range and Dorrigo National Park*. A Report for the NSW National Parks and Wildlife Service.

# ATTACHMENT 9 – STUDIES ON THE FLOW-EMPLOYMENT OF THE MINING (INCLUDING QUARRYING) INDUSTRY

Mining and quarrying projects provide direct employment opportunities in regional economies. In addition, expenditure on inputs to production and by employees can provide flow-on employment in other sectors of the economy.

All other things being equal, the flow-on employment arising from a project will depend on:

- the expenditure profile associated with a project;
- the size of the regional economy and the ability of local businesses to supply inputs to production demanded by mine proponents;
- the residential location of employees and whether they migrate into the region or already live there and were previously employed or unemployed.

Estimated flow-on employment will also vary based on the modelling approach used i.e. whether primary IO analysis has been undertaken or whether multipliers have been obtained from other studies, and which type of multiplier has been used e.g. Type 1A, Type 1B, Type 11A or Type 11B.

A number of studies have examined the flow-on impacts of mining projects on regional economies and the NSW economy. The results are summarised in Table A9.1.

These studies indicate that:

- for every direct job in mine construction total regional employment impacts range from 1.5 to 1.89; and
- for every operational job total regional impacts range from 1.70 to 4.79.

## Table A9.1 – Flow-on Employment of Mining Projects

| Construction or operation | Full-time equivalents or Full-time/part time | IIA Multi plier | Method | Region | Project | Reference |
|---|---|---|---|---|---|---|
| Construction | Unspecified | 2.73 | Borrowed | NSW | Angus Place | Aegis Group (2014) |
| Construction | Unspecified | 4.71 | Borrowed | NSW | Bulga Optimisation | Economic Consulting Services (2012) |
| Construction | Unspecified | 1.59 | Borrowed | Broke/Bulga | Bulga Optimisation | Economic Consulting Services (2012) |
| Construction | Unspecified | 1.89 | Borrowed | Newcastle, Maitland, Cessnock, Singleton, Muswellbrook | Bulga Optimisation | Economic Consulting Services (2012) |
| Construction | FTE | 1.50 | IO | Hunter Region | Warkworth Extension Project | Hunter Valley Research Foundation (2009) |
| Construction | FTE | 1.62 | IO | Hunter Region | Warkworth Extension Project | Hunter Valley Research Foundation (2009) |
| Operation | FTE | 6.05 | IO | NSW | Warkworth and Mount Thorley | BAE (2014) |
| Operation | Unspecified | 3.50 | Borrowed | NSW | Bulga Optimisation | Economic Consulting Services (2012) |
| Operation | Unspecified | 3.98 | Borrowed | NSW | Angus Place | Aegis Group (2014) |
| Operation | FTE | 4.79 | IO | Upper and Mid Hunter | Warkworth and Mount Thorley | BAE (2014) |
| Operation | FTE | 2.37 | IO | Singleton LGA | Warkworth and Mount Thorley | BAE (2014) |
| Operation | Unspecified | 1.49 | Borrowed | Broke/Bulga | Bulga Optimisation | Economic Consulting Services (2012) |
| Operation | Unspecified | 1.70 | Borrowed | Newcastle, Maitland, Cessnock, Singleton, Muswellbrook | Bulga Optimisation | Economic Consulting Services (2012) |
| Operation | FTE | 4.27 | Borrowed | Hunter Region | Warkworth Extension Project | Hunter Valley Research Foundation (2009) |
| Operation | FTE | 3.94 | IO | Hunter Region | Warkworth Extension Project | Hunter Valley Research Foundation (2009) |
| Operation | FTE | 2.94 | IO | Hunter Region | Bloomfield Collieries | Hunter Valley Research Foundation (2008) |

References:

Aegis Group (2014) Angus Place Colliery Extension Project, Economic Impact Assessment
Economic Consulting Services (2012) BCM Optimisation Project: Economic Impacts.
Hunter Valley Research Foundation (2009) An Economic Assessment of the Warkworth Coal Resource.
BAE (2014) Economic Impact of Warkworth Continuation 2014 and Mount Thorley Operations 2014,
Hunter Valley Research Foundation (2008) Client briefing: An economic assessment of Bloomfield Collieries, Hunter Region, NSW

## ATTACHMENT 10 - PROPERTY VALUE IMPACTS

The value of land is a function of the attributes of the property including structural, access and environmental attributes (Abelson, 1996). For remote rural properties there is a simple relationship between the agricultural income earning potential of the land and the capital value of the property i.e.

$CV = A/I$,

where
CV = Capital Value;
A = average annual net income received in perpetuity; and
I = the interest or discount rate expressed as a decimal.

While income earning potential may be a dominant determinant of land value for some properties other attributes such as location, house characteristics and environmental characteristics may also be important.

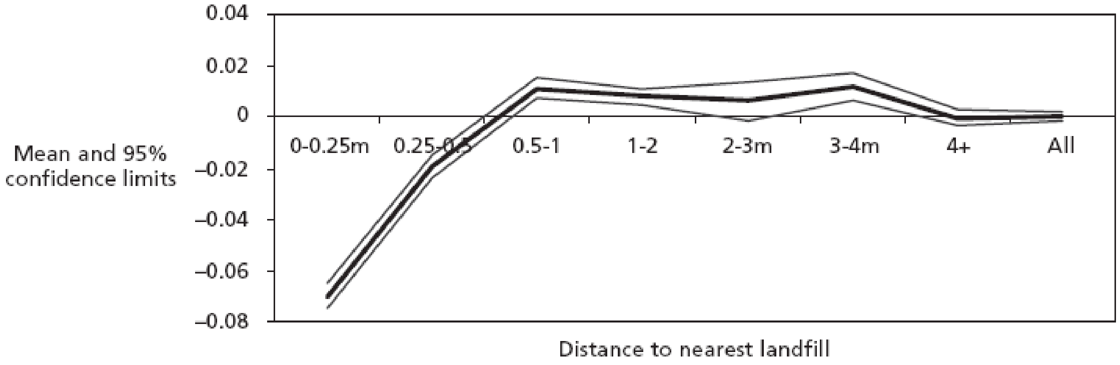
Where properties are located close to an urban or industrial zone, the property value will increasingly reflect potential urban or industrial values until such time as they are absorbed by those zones.

There has been much conjecture about the impact of mines on surrounding property values but little rigorous study. Conceptually, if surrounding properties are likely to be impacted by noise, odour, vibration or visually, then there would be some impact on property values with the greatest impact on property values being felt by properties experiencing the greatest impacts from the mine. Logically, where impacts exist or are expected to exist they are likely to be greatest with closer proximity to the mine and therefore there is likely to be some gradient of property value impact that decreases with distance from the mine.

There are few statistically based studies in this respect for mining in Australia, although some guidance may be obtained from overseas studies that have examined the property value impacts of major development such as landfills, albeit largely in an urban context.

The UK-based Department for Environment, Food and Rural Affairs (DEFRA 2003) analysed 11,300 landfill sites (6,100 of which were operational) in association with 592,000 housing transactions from 1991-2000 inclusive. The results are summarised in Figure 10.1 and Table 10.1 and generally indicate that on average there are negative impacts of about seven percent within 0.25 miles (0.4 km) of landfills, and two percent within 0.5 miles (0.8 km) of landfills, and no impact beyond those distances.

**Figure 10.1: Residual Relative Change in House Prices – Great Britain**



Source: DEFRA (2003, Chart 5.1)

**Table 10.1: The Effect of Proximity to Landfill on Property Price**

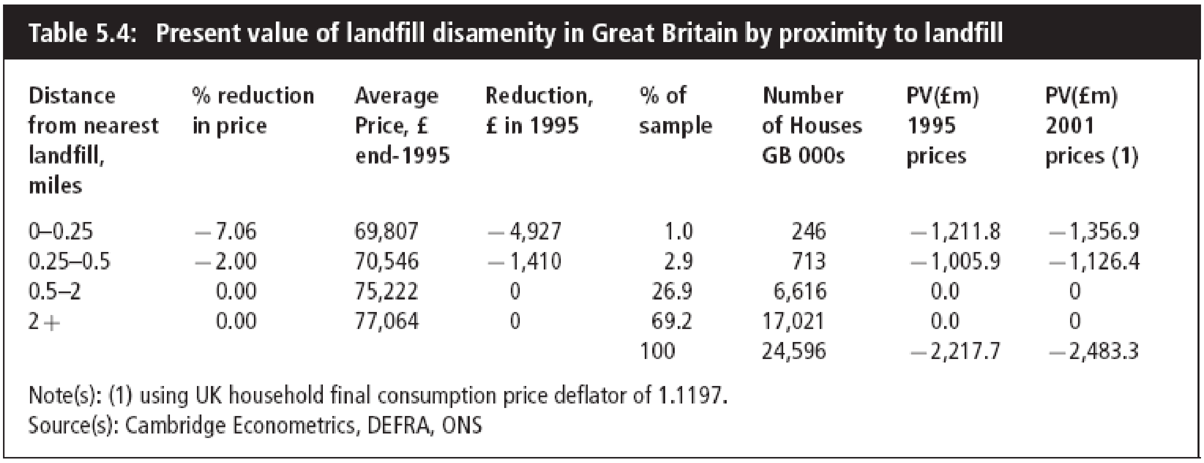


**Table 5.4: Present value of landfill disamenity in Great Britain by proximity to landfill**

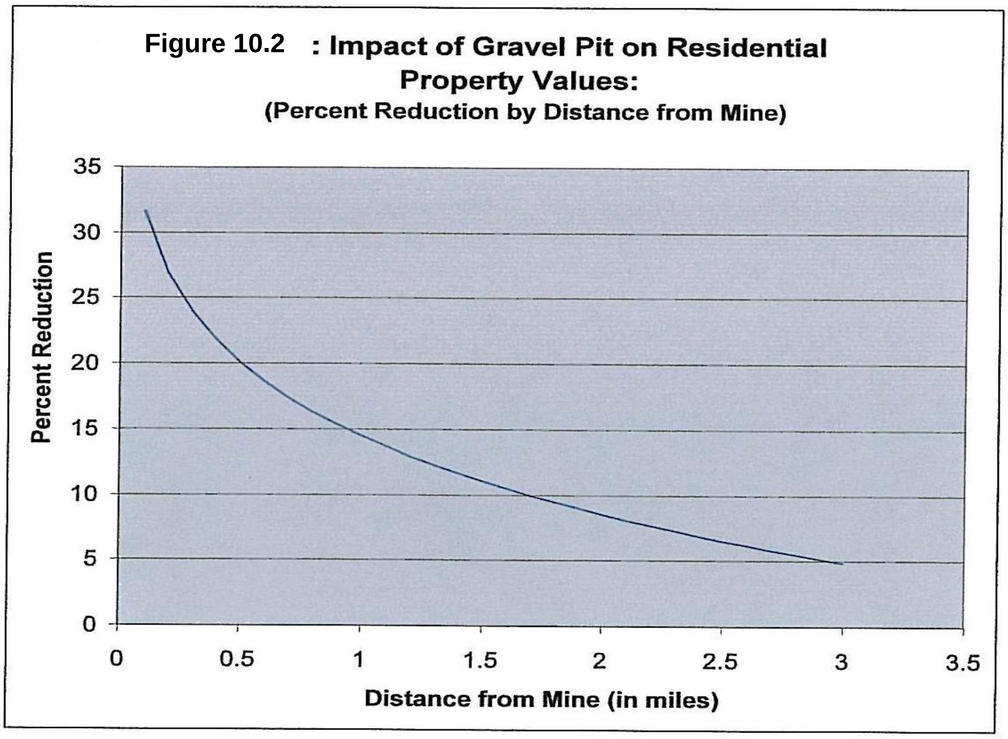
| Distance from nearest landfill, miles | % reduction in price | Average Price, £ end-1995 | Reduction, £ in 1995 | % of sample | Number of Houses GB 000s | PV(£m) 1995 prices | PV(£m) 2001 prices (1) |
|---|---|---|---|---|---|---|---|
| 0–0.25 | −7.06 | 69,807 | −4,927 | 1.0 | 246 | −1,211.8 | −1,356.9 |
| 0.25–0.5 | −2.00 | 70,546 | −1,410 | 2.9 | 713 | −1,005.9 | −1,126.4 |
| 0.5–2 | 0.00 | 75,222 | 0 | 26.9 | 6,616 | 0.0 | 0 |
| 2+ | 0.00 | 77,064 | 0 | 69.2 | 17,021 | 0.0 | 0 |
| | | | | 100 | 24,596 | −2,217.7 | −2,483.3 |

Note(s): (1) using UK household final consumption price deflator of 1.1197.
Source(s): Cambridge Econometrics, DEFRA, ONS

Source: DEFRA (2003, Table 5.4)

A similar result was found by Nelson, Genereux and Genereux (1992) in relation to one landfill site in Ramsey, Minnesota USA, again in an urban context. The study found a 12% reduction in house prices at the landfill boundary, a 6% reduction in house prices at 1 mile and no statistically significant reduction in land price beyond 2 to 2.25 miles

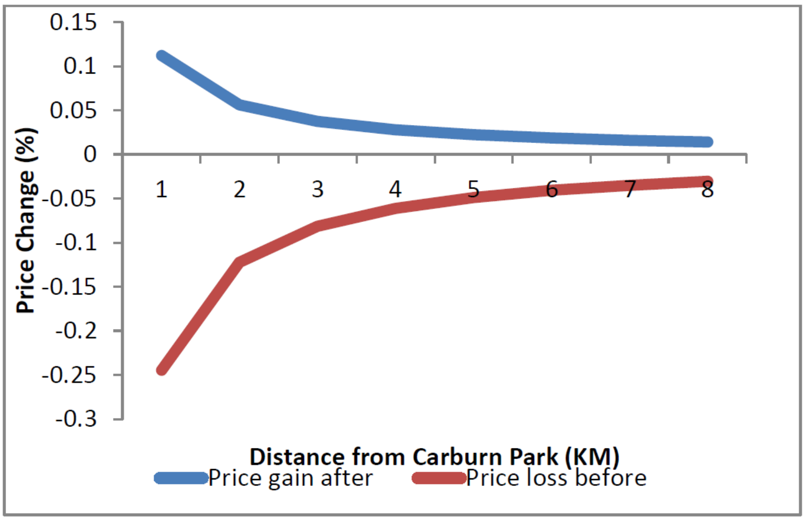
In relation to a 250 acre gravel mine in Delaware County, Ohio, Hite (2006) found that within a 0.5 mile radius from a mine, there was a 36% decrease in property values and a 25% decrease for those within 1.5 miles. Hite reports an elasticity of house price with respect to distance from a gravel mine of 0.097, implying that a 10 % increase in distance from the gravel mine is associated with a slightly less than 1% increase in home value. Figure 10.2 displays the estimated effects of distance from the gravel pit on home prices. A residential property located a half mile from the gravel mine would experience an estimated 20% reduction in value; one mile from the mine, a 14.5% reduction; 2 miles from the mine an 8.9% reduction; and 3 miles from the mine a 4.9% reduction (Erickcek, 2006).



Source: Erickcek (2006)

Campbell (2014) found some indication of downward pressure on property values for those households surrounding a gravel mine in Canada (refer to Figure 10.3). However, this impact was not robust and became insignificant when time fixed effects were included in the analysis. In contrast, the study consistently provided a positive and significant impact to property values generated from reclamation of the site (as a park). The results did not align with the results found in the hedonic literature which find consistent negative impacts as a result of industrial activities. The results also conflict with those reported by Erickcek (2009) who stated that negative impacts on property values from aggregate extraction exist indefinitely. They further do not support the theory of stigmatization effects produced by Messer et al (2006).

**Figure 10.3 - % Price change of Properties Across Varying Distances from Carbun Park Quarry/Park**



Source: Campbell (2014)

Kiel and Williams (2007) point out that while published studies do indicate that Superfund sites (a name given to the environmental program established to address abandoned hazardous waste sites in the United States) lower local house prices, it is possible that studies are only published if they find the 'expected' results. Or it is possible that researchers choose to examine sites that are more notorious, and thus are likely to be regarded as negative externalities in the community, leading again to the 'expected' results.

Kiel and Williams (2007) avoid these possible biases by examining all Superfund sites in the counties being studied to see whether the sites had the impacts reported in previous studies. They found that of the 57 regressions for Superfund sites, 18 produce statistically significant (Chi2 < 0.05) and positive correlations between LNDISTANCE and sale price, that is, increases in the log of distance from the site increased the homes' value after the site was listed on the National Priorities List. Seven produce significantly negative correlations, and the remaining 32 are not statistically significant at the 5% level.

In conclusion they find that some Superfund sites do have a negative effect on local property values, while others do not. Via a meta analysis they find that the larger the site, the more likely it is to have a negative influence on local sales prices.

A Report prepared by Taylor Byrne Valuers on behalf of Boral in January 2010 to assess the impact of the West Burleigh Quarry on the surrounding residential property values, concluded that there was insufficient evidence to determine if the West Burleigh Quarry has had an impact on the value of nearby properties (Norling Consulting 2013).

Norling Consulting (2013)[40] when examining sales data of properties surrounding the existing Nerang Quarry and designated haulage road (Hymix Road) reported property value impacts dissipating with distance (i.e. the more removed a property was from the quarry the lower the impact), with properties located beyond 500m of the quarry operations and haulage road recording no impact recorded on property prices as summarised in the following Table.

**Table 10.2: Estimated Percentage Impact of Nerang Quarry on Nearby Properties**

| Distance from Quarry and Haulage Road | Estimated Percentage Impact |
|---|---|
| 0 – 100m | -8.0% |
| 101 – 200m | -7.5% |
| 201 – 300m | -6.0% |
| 301 – 400m | -3.0% |
| 401 – 500m | 0.0% |
| 500m | + 0.0% |

Source: Norling Consulting (2013)

**Conclusion:** The existence of property value impacts and the distance gradient of these impacts are expected to be related to actual or expected physical impacts from the site rather than a simple distance relationship. Where noise, dust, vibration, odour and visual impacts are contained, no impacts would be expected to occur. Where impacts are significant, larger property value impacts would likely occur. Older studies undertaken when less stringent environmental regulations applied are likely to show greater property value impacts than those undertaken under stricter and more modern regulations.

---

[40] No information is provided on how the results were determined e.g. the statistical analysis undertaken, the statistical significance of results etc and so the results should be treated with caution.

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Abelson, P. (1996) *Project Appraisal and Valuation of the Environment: General Principles and Six Case-Studies in Developing Countries*, Overseas Development Institute, Macmillan Press Ltd, London.

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Kiel, K.A. and Williams, M. (2007). The impact of Superfund sites on property values: are all sites the same? *Journal of Urban Economics* 61, 170–192.

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# Appendix V

## Social Impact assessment

## VOLUME 7

Marulan South Limestone Mine Continued Operations SSD

# SOCIAL IMPACT ASSESSMENT

Prepared for Boral Cement Limited | 1 December 2018

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# Marulan South Limestone Mine Continued Operations

## STATE SIGNIFICANT DEVELOPMENT | SOCIAL IMPACT ASSESSMENT

Prepared for Boral Cement Limited
December 2018

PR17

| | Prepared by | Reviewed by |
|---|---|---|
| Name | Jamie Seaton | Neville Hattingh |
| Company | Element Environment | Element Environment |
| Position | SIA and Community Engagement Lead | Director |
| Project Role | Lead SIA Author | Project Director |
| Signature | | |
| Date | 13 December 2018 | 17 December 2018 |

## DOCUMENT CONTROL

| Revision | Date | Description | Prepared by | Reviewed by |
|---|---|---|---|---|
| 0 | 12 December 2018 | For Boral Cement review | Element Environment | Boral Cement Limited |
| 1 | 18 December 2018 | For submission to DP&E | Element Environment | Boral Cement Limited |
| 2 | 4 February 2019 | For resubmission to DP&E following adequacy review | Element Environment | Boral Cement Limited |

# Certification Page

**Lead author declaration**

I, Dr Jamie Seaton, certify that the SIA component of the EIS contains all information relevant to the SIA for the Project, and that the information is not false or misleading. My qualifications and experience are listed below.

Qualifications:

1. Bachelor of Science Hons. (Human Geography)
2. Community Development Diploma
3. Doctorate of Philosophy (Human Geography).

Experience:

The author is trained in social science methodologies and has demonstrated SIA skills in government, private and education settings. He has managed SIAs for extractive industry projects in NSW and Queensland.

Date: 12 December 2018

Jamie Seaton - SIA and Community Engagement Lead

# Contents

# Tables

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# 1 INTRODUCTION

This Social Impact Assessment (SIA) has been prepared to support the State Significant Development application (SSD) by Boral Cement Limited (Boral), for continued operations of the Marulan South Limestone Mine (the mine). The SIA adopts the framework set out in the Social Impact Assessment Guideline (the Guideline), published in September 2017 by the NSW Department of Planning and Environment (DPE).

The first chapter of this report provides a Project overview, objectives of the SIA, the Secretary's environmental assessment requirements (SEARs), and a structural outline of this report.

## 1.1 OVERVIEW

Boral owns and operates the mine. It is a long-standing open cut mine that has produced up to 3.38 million tonnes of limestone based products per year for the cement, steel, agricultural, construction and commercial markets.

The mine is a strategically important asset for Boral, as it supplies the main ingredient for the manufacture of cement at Boral's Berrima Cement Works. This is also a strategically important operation for Sydney based consumers of these products as this represents around 60% of the cement sold in New South Wales (NSW) and feeds into more than 30% of concrete sold in Sydney.

The mine operates under Consolidated Mining Lease No. 16 (CML 16), Mining Lease No. 1716, Environment Protection Licence (EPL) 944 and a combination of development consents issued by Goulburn Mulwaree Council (GMC) and continuing use rights.

Due to changes between the Mining Act 1992 and the Environmental Planning & Assessment Act 1979 (EP&A Act), when mining moves beyond the area covered by the current Mining Operations Plan, a development consent under the EP&A Act will need to be in place.

An Environmental Impact Statement (EIS) has been prepared by Element Environment Pty Ltd on behalf of Boral for submission to the DPE to satisfy the provisions of Part 4 of the EP&A Act. Boral is seeking approval for continued operations at the site through a SSD including a 30 year mine plan, associated overburden emplacement areas and a mine water supply dam (hereafter referred to as 'the Project').

## 1.2 SITE DESCRIPTION

### Site Location

The mine is in Marulan South, 10 km southeast of Marulan village and 35 km east of Goulburn, within the Goulburn Mulwaree Local Government Area in the Southern Tablelands of NSW (**Figure 1**). Access is via Marulan South Road, which connects the mine and Boral's Peppertree Hard Rock Quarry (Peppertree Quarry) with the Hume Highway approximately 9 km to the northwest (**Figure 2**). Boral's private rail line connects the mine and Peppertree Quarry with the Main Southern Railway approximately 6 km to the north.

### Land Use and Ownership

CML 16 (which encompasses ML 1716) covers an area of 616.5 hectares (ha), which includes land owned by Boral (approximately 475 ha), Crown Land (adjoining to the south and east) and five privately owned titles. There is also Boral owned land surrounding the mine that does not fall within CML 16.

Land use surrounding the mine is a mixture of extractive industry, grazing, rural residential, commercial/industrial and conservation.

The mine is separated from the Bungonia State Conservation Area to the south by Bungonia Creek and is separated from the Shoalhaven River and Morton National Park to the east by Barbers Creek.

Peppertree Quarry, owned by Boral Resources (NSW) Pty Limited, borders the mine to the north. The site of the former village of Marulan South is between the mine and Peppertree Quarry on land owned by Boral. The village was established principally to service the mine but has been uninhabited since the late 1990’s. The majority of the village’s infrastructure has been removed and only a village hall and former bowling club remains. The bowling club has been converted into administration offices for the mine and the hall is used by the mine services team.

A small number of rural landholdings surround the Boral properties to the north and west, including an agricultural lime manufacturing facility, fireworks storage facility, turkey farm and rural residential (a number of these properties are actively grazed). The main access for these properties is via Marulan South Road. Rural residential properties are also located to the northeast of the mine along Long Point Road. These properties are separated from the mine by the deep Barbers Creek gorge. Sensitive receivers are shown in **Figure 2**.

## Zoning

The majority of the site is zoned RU1 - Primary Production zone under the Goulburn Mulwaree Local Environmental Plan (LEP) 2009. Mining and extractive industries are permissible in this zone with consent.

The remaining area is zoned E3 - Environmental Management. Under this zone mining and extractive industries are prohibited development, although historically mining has occurred within these areas under “existing use rights” as mining and processing operations commenced well before the commencement of the Mulwaree Planning Scheme Ordinance (PSO) on 15 May 1970. Notwithstanding that both mining and extractive industries are prohibited in the E3 zone these activities are permissible pursuant to State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007. In accordance with Clause 7(1)(b)(i) of this SEPP mining can be carried out with consent in any zone which has agriculture as a permissible land use (with or without consent). Agriculture is permitted with consent in the E3 - Environmental Management zone under the Goulburn Mulwaree LEP 2009. Similarly, Clause 7(3)(a) of this SEPP makes it clear that extractive industries can be carried out with consent in any zone which has agriculture as a permissible land use (with or without consent). Therefore, both mining and extractive industries are land uses which can be carried out provided development consent is granted.

Boral operates the mine pursuant to Section 109 of the EP&A Act and the continuance of an existing use and its expansion is possible provided the necessary approvals are in place. Therefore, there are no environmental planning issues that would prohibit approval of expanded operations at the mine.

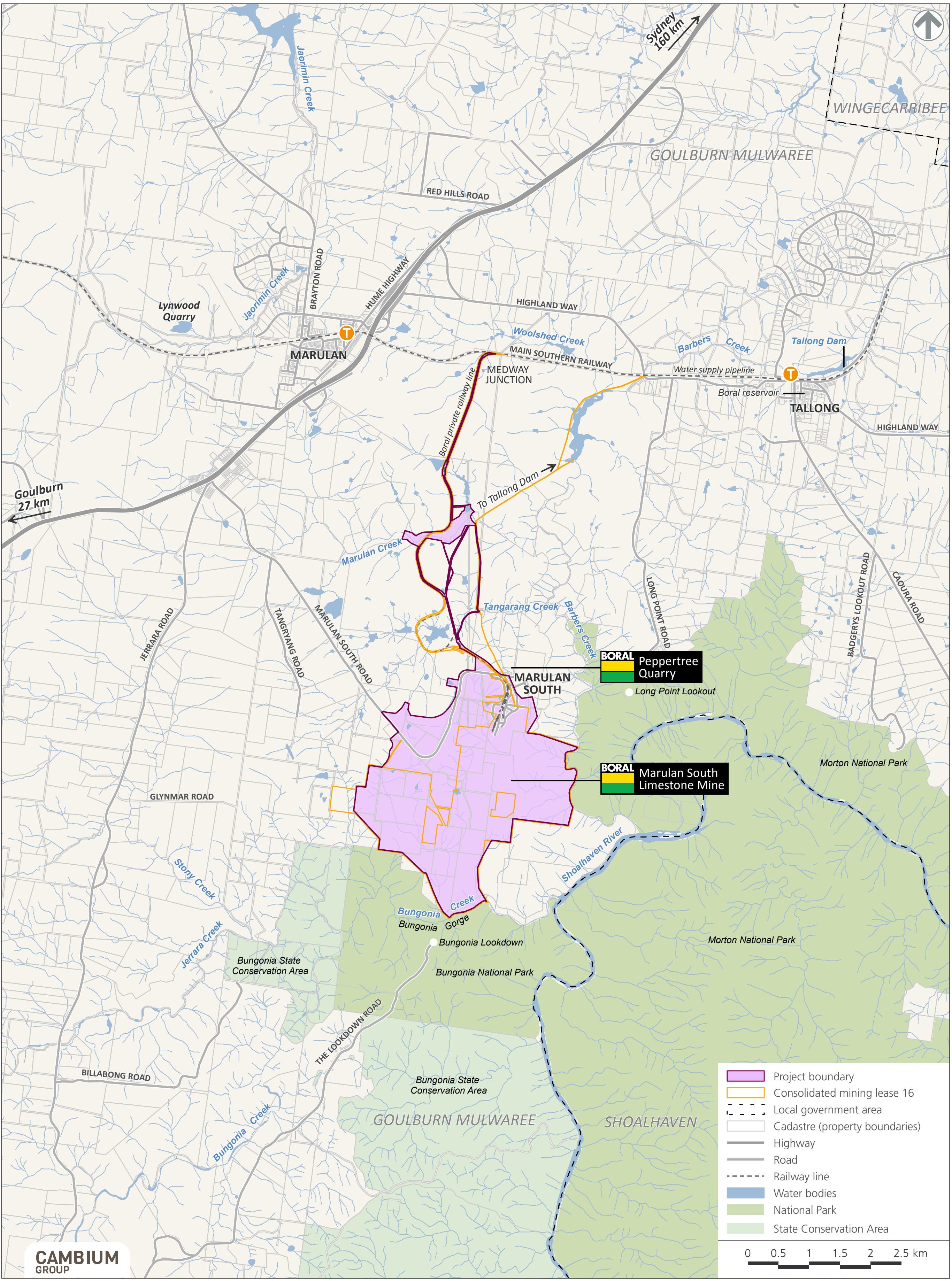
Importantly, the Project aims to improve the stability of existing overburden emplacements and improve rehabilitation outcomes over the entire site.

## Topography and Hydrology

The Southern Highlands, similar to the Blue Mountains to the north-west, are predominantly comprised of a level plateau with the occasional high intrusive volcanic remnant mountains, such as Mount Jellore, Mount Gibraltar and Mount Gingenbullen. On the seaward side they decline into a steep escarpment that is heavily divided by the headwaters of the Shoalhaven River.

Figure 1

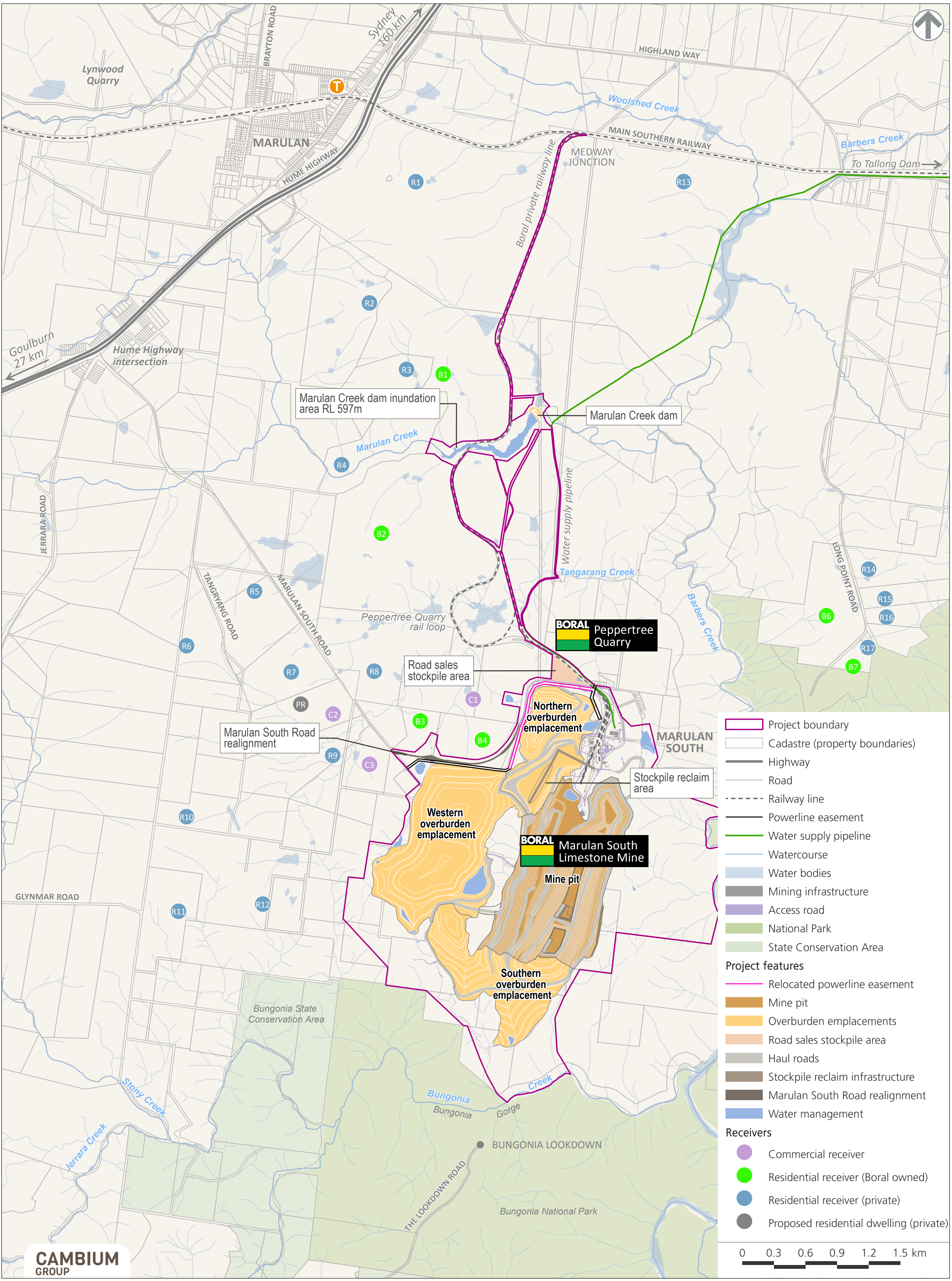
**Regional context**



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

Figure 2
## The Project

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
**ENVIRONMENTAL IMPACT STATEMENT**



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Cambium Group (2018).

The Project site and surrounds is characterised by the rolling hills of pasture and grazing lands interspersed with woodland to the west, contrasting with the heavily wooded, deep gorges that begin abruptly to the east of the mine, forming part of the Great Escarpment and catchment of the Shoalhaven River. As such, local relief of Marulan South ranges from around 130 m Australian Height Datum (AHD) to over 630 m AHD.

The Project site is drained by a number of minor ephemeral drainage lines into Barbers Creek to the east and Bungonia Creek to the south. These creeks are tributaries of the Shoalhaven River, which is 1.5 km from the mine (at its closest point) and flows eastwards into Lake Yarrunga, approximately 20 km downstream and enters the Pacific Ocean approximately 15 km east of Nowra (approximately 100 km downstream).

## Geology

The Marulan South limestone deposit lies within the Lachlan Geosynclinal Province. During the Palaeozoic Era (500 to 300 million years ago) thick sedimentary formations were laid down in the region. The formations included sediments, volcanic lavas and ash, and limestone reefs.

A reef complex formed the Bungonia Limestone Group, which was later folded and faulted by crustal collisions and then subsequently levelled by substantial erosion. About 65 million years ago the area was again uplifted giving way to a rejuvenated river system leading to the landscape of today.

The Bungonia Limestone formations at Marulan South consist of a number of generally parallel and north-south striking beds dipping to the west. The Bungonia Limestone includes:

- eastern Limestone, which is the oldest, easternmost and thickest unit; and
- Mt. Frome Limestone, which is the younger unit that lies to the west of the Eastern Limestone and is made up of three sub-parrallel sub-units including the Upper Limestone (furthest west), Middle Limestone and Lower Limestone (furthest east).

Separating the limestone units are fine grained sediments including shales, mudstones, siltstones and minor fine sandstones.

The total horizontal width of the Bungonia Limestone is approximately 670m east-west. The true depth of the Bungonia Limestone is not known as the termination of the limestone is not visible either in the mine or at the bottom of the Bungonia gorge to the south. To date even the deepest drill holes (approximately 300 m) in the mine have ended in limestone.

The Eastern Limestone has the highest grade and was therefore selected for the commencement of mining. The Eastern Limestone is still the focus of current mining operations, however mining of Mt. Frome Middle Limestone commenced in approximately 2016.

The Bungonia Limestone Group is bound to the east by the older Tallong shale beds and in the west by the Tangarang Volcanics (younger shales, volcanic and associated sedimentary rocks). A north-south and various east-west dolerite dykes penetrate the limestone from beneath and the limestone bed is cut off in the north by the Glenrock Granodiorite intrusion, which is extracted by Peppertree Quarry.

## Climate

The mine is in Australia’s cool temperate climatic region, which is characterised by mild to warm summers and cold winters, with common frost and occasional snow fall.

Long term climatic data was obtained from the Bureau of Meteorology (BoM) automatic weather station at Goulburn Airport, approximately 25 km west-southwest of the mine.

The BoM weather station shows that January is the hottest month with a mean maximum temperature of 27.9 degrees Celsius (ºC) and July is the coldest month with a mean minimum temperature of 0.3ºC.

Average annual rainfall is 551.9 mm. Rainfall peaks during the summer and the month of June. June is the wettest month with an average rainfall of 60.9 mm over 7.0 days and April is the driest month with an average rainfall of 25.6 mm over 4.0 days.

Relative humidity levels exhibit variability and seasonal flux across the year. Mean 9am relative humidity levels range from 65% in October and December to 88% in June. Mean 3pm relative humidity levels vary from 39% in December to 63% in June. Wind direction is predominantly from the west in winter and from the east in summer.

Wind speeds have a generally similar spread between the 9am and 3pm conditions. The mean 9am wind speeds range from 12.2 km/h in March to 19.8km/h in September. The mean 3pm wind speeds vary from 19.8km/h in April to 26.5km/h in August.

## 1.3 EXISTING OPERATIONS

The mine is sited on a high grade limestone resource. Subject to market demand the mine has typically produced up to 3.38 million tonnes of limestone and up to 200,000 tonnes of shale per annum.

The mine currently produces a range of limestone products for internal and external customers in the Southern Highlands/Tablelands, the Illawarra and Metropolitan Sydney markets for use primarily in cement and lime manufacture, steel making, agriculture and other commercial uses. Products produced at the mine are despatched by road and rail, with the majority despatched by rail.

Historically limestone mining was focused on the approximately 200-300 m wide Eastern Limestone and was split between a North Pit and a South Pit. A limestone wall (referred to by the mine as the ‘centre ridge’) rising almost to the original land surface, divided the two pits. The North and South Pits were recently joined in 2016/2017 by mining the centre ridge to form a single contiguous pit, approximately 2 km in length. However, the North Pit/South Pit nomenclature remains important as current mining operation locations continue to be reported with respect to one or other of the old pits.

Limestone and shale are extracted using open-cut hard rock drill and blast techniques. Material is loaded using front end loaders and hauled either to stockpiles or the processing plant using haul trucks. Oversized material is stockpiled and reduced in size using a hydraulic hammer attached to an excavator.

Limestone processing facilities including primary and secondary crushing, screening, conveying and stockpiling plant and equipment are in the northern end of the North Pit. Kiln stone grade limestone is also processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment. Overburden from stripping operations is emplaced in the Western Overburden Emplacement, west of the open cut pits.

The current operations are 24 hour, 7 days per week with personnel employed on a series of 8, 10 and 12 hour shifts to cover the different operational aspects of the mine. Blasting is restricted to daylight hours and on weekdays, excluding public holidays.

# 1.4 THE PROPOSED PROJECT

## Mining Operations

Boral proposes to continue mining limestone from the mine at a rate of up to 4 million tonnes per annum (mtpa) for a period of up to 30 years. This represents an increase in extraction rate from historic levels (peak of 3.38 mtpa) due to forecast increased demand from the construction industry. Shale will continue to be extracted at a rate of up to 200,000 tonnes per annum (tpa).

The proposed 30 year mine plan accesses approximately 120 million tonnes of limestone down to a depth of 335 m AHD. The mine footprint focuses on an expansion of the North Pit westwards to mine the Middle Limestone and to mine deeper into the Eastern Limestone. As the Middle Limestone lies approximately 70 m to 150 m west of the Eastern Limestone, the 30 year mine plan avoids mining where practical the interburden between these two limestone units thereby creating a smaller second, north-south oriented West Pit with a ridge remaining between. The North Pit will also be expanded southwards, encompassing part of the South Pit, leaving the remainder of the South Pit for overburden emplacement and a visual barrier (refer **Figure 2**).

In addition to mining approximately 5 million tonnes of shale, the extraction of the limestone requires the removal of approximately 108 million tonnes of overburden over the 30 year period. This material will be emplaced within existing and proposed overburden emplacement areas (refer **Figure 2**).

Limestone will continue to be mined using drilling and blasting methods. Shale will continue to be mined by excavator/front end loader. Limestone, shale and overburden will be transported to the primary crusher, stockpile areas and overburden emplacements respectively, using the load and haul fleet of trucks.

Products produced at the mine will continue to be despatched by road and rail, with the majority despatched by rail.

The limestone sand plant, produces a crushed and air classified limestone sand for use in concrete. The mine currently produces 500,000 tpa for Peppertree Quarry and propose to increase production of manufactured sand to approximately 1 million tpa.

Boral’s adjoining Peppertree Quarry currently has approval to emplace some of its overburden in the South Pit mine void. As the South Pit is required for the emplacement of over 30 million tonnes of overburden from the mine after the removal of accessible limestone, Boral proposes to emplace up to 15 million tonnes of overburden from Peppertree Quarry within the Northern Overburden Emplacement (refer **Figure 2**).

## Associated Infrastructure

### *Processing*

The existing facilities for processing limestone will continue to be utilised to produce a series of graded and blended limestone products that are despatched from site for use primarily in cement manufacture, steel making, commercial and agricultural applications.

Limestone processing facilities include primary and secondary crushing, screening, conveying and stockpiling plant and equipment located north-west of the North Pit and extending to the tertiary crushing, screening, bin storage and despatch (rail and road) systems that form part of the main processing facilities.

Kiln stone grade limestone will also continue to be processed on site through the existing lime plant comprising kiln stone stockpiles, rotary lime kiln, hydration plant and associated auxiliary conveying, processing, storage, despatch plant and equipment.

Processing infrastructure and the reclaim and stockpile area at the northern end of the North Pit will be relocated during the life of the 30 year pit to enable full development of the mine plan. The timing and location of this is presented in the EIS.

Shale and white clay will not be processed and will be stockpiled directly from the pit, ready for dispatch by road to the Berrima and Maldon cement operations.

### *Water Supply*

Water supply for the Project, including dust suppression, processing activities and some non-potable amenities will be from existing and new on-site dams and a proposed new water supply dam on Marulan Creek (refer **Figure 2**). This dam would be located on Boral owned land north of Peppertree Quarry and utilises Boral's adjoining Tallong water pipeline to transfer water to the mine. This dam would require the purchase of water entitlements.

Mine water demand will also be supplemented by Tallong Weir via the Tallong water pipeline.

### *Rail*

No changes are proposed to the existing rail infrastructure. A 1.2 km long passing line was constructed at Medway Junction during construction of the Peppertree Quarry, which will also be used by the mine to enhance access to the Main Southern Railway.

### *Road*

Road access from the mine to the Hume Highway is via Marulan South Road. The proposed Western Overburden Emplacement extends northwards over Marulan South Road. Boral propose to realign a section of Marulan South Road, to accommodate the northern portion of the proposed Western Overburden Emplacement (refer **Figure 2**).

All public roads within the former village of Marulan South as well as the section of Marulan South Road between Boral's operations and the entrance to the agricultural lime manufacturing facility will be de-proclaimed.

### *Power*

Power supply to the mine is via a high voltage power line that commences at a sub-station on the southern side of Marulan South Road, immediately west of the Project boundary. A section of this power line will be relocated to accommodate the proposed Northern Overburden Emplacement.

### *Transport*

The majority of limestone products will continue to be transported to customers by rail for cement, steel, commercial and agricultural uses. Boral seeks no limitation on the volume of products transported by rail.

Manufactured sand will continue to be transported by truck along a dedicated internal road, across Marulan South Road and into Peppertree Quarry for blending and dispatch by rail.

Agricultural lime, quick lime and fine limestone products will continue to be transported by powder tanker, bulk bags on trucks or open tipper trucks along Marulan South Road.

Shale, limestone aggregates, sand and tertiary crushed products will be transported by predominantly truck and dog along Marulan South Road.

The adjoining Peppertree Quarry is currently approved to transport all products by rail. Boral will seek to transport approximately 150,000 tpa of Peppertree Quarry's products from the mine to customers via Marulan South Road. This could be achieved by back loading to a new shared road sales product stockpile area by the trucks carrying the limestone sand to Peppertree Quarry. A new shared road sales product stockpile area is proposed on the northern side of Marulan South

Road, immediately west of the mine and Peppertree Quarry entrances. This shared finished product stockpile area, includes a weighbridge and wheel wash and will service both the mine and Peppertree Quarry.

In total, Boral is seeking to transport up to 600,000 tpa of limestone and hard rock products along Marulan South Road to the Hume Highway, as well as 120,000 tpa of limestone products to the agricultural lime manufacturing facility.

### Background to the mine planning approach for the Project

The development of the 30-year mine plan for continued operations at the mine commenced around 2013 with the SSD process commencing in August 2014. The overarching goal of most open cut mine plans is to:

- target the most easily accessible and highest grade resource;
- achieve the best overburden to limestone ratio i.e. minimise overburden extraction and maximise limestone extraction;
- minimise out-of-pit overburden emplacements;
- minimise haul distances of limestone to processing infrastructure and overburden to emplacements;
- minimise environmental and social impacts; and
- minimise capital and operating costs.

An exploration drilling program was carried out in 2005 to meet the needs of the mining operation at the time as well as to better define the limestone resource. This work proved to be the basis for further exploration carried out between 2014 and 2017.

The original mine plan (known as MP 1) was developed to target the eastern limestone and some of the Mt Frome limestone. MP 1 was developed on the understanding of the limestone geology extent (vertical and horizontal), configuration (angle of vertical dipping) and quality in 2014/2015. Earlier stakeholder consultation, technical studies and EIS preparation was based on MP 1 and the EIS prepared for MP 1 was due for lodgement with DP&E in mid-2016.

Drilling undertaken in 2016 started to show that the extent and configuration of the various limestone bodies were different to the mines previous understanding. The results of the drilling were significant enough for Boral to cease the SSD process, commission further drilling and revisit the mine plan. Further drilling was completed in early 2017 which filled knowledge gaps, especially on the northern extent of the limestone bodies and a revised mine plan (known as MP 2) was developed.

## 1.5 Objectives of the social impact assessment

The release of the Guideline by DPE in 2017, significantly increased the prominence of SIA in the broader NSW EIS process. Upon its release, the Guideline applied to all SSD for resource projects, where the SEARs were issued after the publication date.

The Guideline outlined some new mandatory requirements to be met by SIA practitioners in NSW. It established objectives applicable to NSW state significant resource projects (i.e. state significant mining, petroleum production and extractive industry projects), outlined best practice engagement techniques, and provided a process for assessing, determining and responding to social impacts. The objectives contained in the Guideline have been adopted for this SIA and include:

- providing a clear, consistent and rigorous framework for identifying, predicting, evaluating and responding to the social impacts of state significant resource projects, as part of the overall EIA process;

- facilitating improved project planning and design through earlier identification of potential social impacts;
- promoting better development outcomes through a focus on minimising negative social impacts and enhancing positive social impacts;
- supporting informed decision-making by strengthening the quality and relevance of information and analysis provided to the consent authority;
- facilitating meaningful, respectful and effective community and stakeholder engagement on social impacts across each EIA phase, from scoping to post-approval; and
- ensuring that the potential social impacts of approved projects are managed in a transparent and accountable way over the project life cycle through conditions of consent and monitoring and reporting requirements.

## 1.6 Secretary's environmental assessment requirements

SEARs were issued for the Project by DPE in 2015 prior to the publication of the Guideline. In June 2018 DPE renewed the SEARs and confirmed that a SIA would be required in accordance with Guideline.

## 1.7 Structure of this report

The structure of this report is influenced by requirements in the Guideline. Once the legislative and social policy context of the study is established (Chapter 2), the methodology for scoping and preparing the SIA is described (Chapter 3). Results of the SIA data collection is presented in chapters titled Scoping Exercise Outcomes, Further Engagement Outcomes, and Existing Social Baseline (Chapter 4, Chapter 5 and Chapter 6 respectively). An analysis of the results, structured according to the social impact categories outlined in section 1.1 of the Guideline (see Appendix A), is provided in Chapter 7, followed by conclusions and recommendations in Chapter 8.

The structure of this report also observes the 'Review Questions' contained in Appendix D of the Guideline. The Review Questions are essentially a checklist for the author to confirm that the SIA Guideline has been complied with in undertaking the assessment and preparing this report. A compliance matrix is presented in **Table 1** to identify where the Review Questions are addressed in this report.

**Table 1: Compliance matrix**

| Review Question (Appendix D of Guideline) | Location in this report |
|---|---|
| ***General*** | |
| 1) Has the applicant applied the principles in Section 1.3? How? | Chapter 3, 7 and 8 |
| 2) Does the lead author of the Scoping Report meet the qualification and skill requirements in Box 2? | Appendix E |
| 3) Does the lead author of the SIA component of the EIS meet the qualification and skill requirements in Box 4? | Appendix E |
| 4) Has the lead author of the SIA component of the EIS provided a signed declaration certifying that the assessment does not contain false or misleading information? | Appendix E |
| ***Community engagement for social impact assessment (Section 2)*** | |
| 5) Does the SIA include adequate explanations of how the engagement objectives have been applied? How? | Chapter 3 |
| 6) Does the SIA demonstrate that there has been a genuine attempt to identify and engage with a wide range of people, to inform them about the Project, its implications and to invite their input? How? | Chapter 3 |

| Review Question (Appendix D of Guideline) | Location in this report |
|---|---|
| 7) Does the SIA demonstrate that an appropriate range of engagement techniques have been used to ensure inclusivity and to ensure the participation of vulnerable or marginalised groups? How? | Chapter 3 |
| ***Scoping – area of social influence (Section 3.1)*** | |
| 8) Does the Scoping Report identify and describe all the different social groups that may be affected by the Project? | Chapter 4 |
| 9) Does the Scoping Report identify and describe all the built or natural features located on or near the Project site or in the surrounding region that have been identified as having social value or importance? | Section 6.2<br>Section 6.3 |
| 10) Does the Scoping Report identify and describe current and expected social trends or social change processes being experienced by communities near the Project site and within the surrounding region? | Chapter 4 |
| 11) Does the Scoping Report impartially describe the history of the proposed Project, and how communities near the Project site and within the surrounding region have experienced the Project to date and others like it? | Chapter 4<br>Chapter 7 |
| ***Scoping – identifying social impacts (Section 3.2, Appendix A and Appendix B)*** | |
| 12) Does the Scoping Report adequately describe and categorise the social impacts (negative and positive), and explain the supporting rationale, assumptions and evidence for those categories? | Chapter 4<br>Chapter 7 |
| 13) How has feedback from potentially affected people and other interested parties been considered in determining those categories? Does the Scoping Report outline how they will be engaged to inform the preparation of the SIA component of the EIS? | Chapter 4<br>Chapter 5 |
| 14) Does the Scoping Report identify potential cumulative social impacts? | Chapter 4 |
| ***Social baseline study (Appendix C – Section C1)*** | |
| 15) Does the SIA component of the EIS discuss the local and regional context in sufficient detail to demonstrate a reasonable understanding of current social trends, concerns and aspirations? | Chapter 6 |
| 16) Does the SIA component of the EIS include appropriate justification for each element in the social baseline study, and provide evidence that the elements reflect the full diversity of views and potential experiences in the affected community? | Section 9.2 |
| 17) Does the social baseline study include an appropriate mix of quantitative and qualitative analysis, and explain data gaps and limitations? | Section 3.2 and Section 3.2.5 |
| ***Prediction and analysis of impacts (Appendix C – Section C2)*** | |
| 18) Does the SIA component of the EIS include an appropriate description of the potential impacts in terms of the nature and severity of the change and the location, number, sensitivity and vulnerability of the affected stakeholders? | Chapter 7 |
| 19) Does the SIA component of the EIS identify potential impacts at all stages of the Project life cycle? | Chapter 7 |
| 20) Does the SIA component of the EIS appropriately identify and justify any assumptions that have been made in relation to its predictions? | Chapter 7 |
| 21) Does the SIA component of the EIS include appropriate sensitivity analysis and multiple scenarios to allow for uncertainty and unforeseen consequences? If relevant, does it include comparisons with studies of similar Projects elsewhere? | Chapter 7 |

| Review Question (Appendix D of Guideline) | Location in this report |
|---|---|
| ***Evaluation of significance (Appendix C – Section C3)*** | |
| 22) Does the SIA component of the EIS explain how impacts were evaluated and prioritised in terms of significance? | Chapter 7 |
| 23) Does the evaluation of significance consider cumulative aspects where relevant? | Chapter 7 |
| 24) Does the evaluation of significance consider the potentially uneven experience of impacts by different people and groups, especially vulnerable groups? | Chapter 7 |
| ***Responses and monitoring and management framework (Appendix C – Sections C4 and C5)*** | |
| 25) Does the SIA identify appropriate measures to avoid, reduce, or otherwise mitigate any significant negative impacts of the Project, and justify these measures? | Chapter 8 |
| 26) Does the SIA explain and justify measures to secure and/or enhance positive social impacts? | Chapter 8 |
| 27) Does the SIA component of the EIS impartially assess the acceptability, likelihood and significance of residual social impacts? | Chapter 8 |
| 28) Does the SIA component of the EIS propose an effective monitoring and management framework? | Chapter 8 |
| ***Modifications (Introduction – application)*** | |
| 29) Are the social impacts associated with the modification expected to be new or different (in terms of scale and/or intensity) to those that were approved under the original consent? If yes, apply the review questions above to the SIA component of the environmental assessment. | Not applicable |

# 2 LEGISLATIVE AND SOCIAL POLICY CONTEXT

## 2.1 Legislation

The EP&A Act sets the legislative context for this study. The objects of the EP&A Act are to:

- promote the social and economic welfare of the community and a better environment by the proper management, development and conservation of the state's natural and other resources;
- facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment;
- promote the orderly and economic use and development of land;
- promote the delivery and maintenance of affordable housing;
- protect the environment, including the conservation of threatened and other species of native animals and plants, ecological communities and their habitats;
- promote the sustainable management of built and cultural heritage (including Aboriginal cultural heritage);
- promote good design and amenity of the built environment;
- promote the proper construction and maintenance of buildings, including the protection of the health and safety of their occupants;
- promote the sharing of the responsibility for environmental planning and assessment between the different levels of government in the state; and
- provide increased opportunity for community participation in environmental planning and assessment.

The SEARs (and therefore the Guideline) are issued under the provisions of the EP&A Act, and therefore set legislative requirements that this study must accommodate.

## 2.2 Community Plans and Strategies

Regional plans which reflect the aspirations of the community have been developed by the state Government and local authorities associated with the Project. These plans and a plan developed at the broader state level are outlined below.

### Regional Community Strategic Plan (CSP)

The GMC, Upper Lachlan Shire Council and Yass Valley Council prepared the joint Regional Community Strategic Plan (CSP) for the Tablelands region in July 2016 (Tablelands Councils, 2016). This plan determined the community's aspirations, helped develop plans to achieve these goals and provides a cooperative platform for engaging with state and federal Governments. The CSP is based on social justice principles of access, equity, participation, rights and focuses on the councils five strategic pillars:

1. community;
2. environment;
3. economy;
4. infrastructure; and
5. civic leadership.

### Goulburn Mulwaree Strategy 2020

The Goulburn Mulwaree Strategy 2020 (Parsons Brinckerhoff Australia, 2006) was developed to create a basis for a comprehensive new Local Environmental Plan (LEP) for the Goulburn

Mulwaree local government area. The new LEP replaced two local environmental plans that existed at the time.

Specific objectives of the 2020 Strategy are to:

- integrate the results of community engagement activities;
- provide an understanding of the existing social, economic and physical characteristics of Goulburn Mulwaree;
- analyse trends and patterns, and identify the ‘drivers of change’ across Goulburn Mulwaree;
- identify challenges facing the Goulburn Mulwaree community, including social, economic, environmental and infrastructure issues; and
- document agricultural activities and production to understand how this sector contributes to economic outcomes.

## 2018-2022 Southern Tablelands Regional Economic Development Strategy

The Southern Tablelands Regional Economic Development Strategy 2018–2022 sets out a long-term economic vision and associated strategy for the three local government areas (LGAs) of Goulburn Mulwaree, Upper Lachlan Shire and Yass Valley (AgEcon Plus, 2018).

The strategy aims to leverage the region’s endowments: its topography, water, climate and soils, natural resources, proximity to Sydney and Canberra (including the road and rail access), extractive and mineral resources, lifestyle advantages, historic heritage and villages, public order, and safety institutions, hospitals, local institutions and strong leadership, labour supply and specialist labour skills.

The specific objectives of the strategy are to:

1. sustain the region’s agriculture and agricultural processing advantage, especially in livestock;
2. build on the region’s core strength in energy generation and natural resource extraction;
3. realise the economic opportunity presented by public order, safety and aged care;
4. drive growth in the transport, access and logistics sector; and
5. enhance the liveability of the region and grow its visitor economy.

## South East and Southern Tablelands Regional Plan

The South East and Southern Tablelands Regional Plan (NSW Department of Planning and Environment, 2017) prepared by the NSW Government sets a 20-year blueprint for the future of the region, containing goals and actions that aim to build a strong, diverse economy and resilient, sustainable communities.

The vision for the South East and Tablelands is to be a “borderless region in Australia’s most geographically diverse natural environment with the nation’s capital at its heart” (NSW Department of Planning and Environment, 2017, p.8). The Southern Tablelands region is recognised through the plan alongside the Southern Highlands as an area of natural beauty and heritage, containing high value vegetation, grasslands, riparian systems, rainforests and woodlands, and cleared grazing lands. The plan also recognises the regions suitability for wind turbines.

The plan identifies opportunities to focus development in and around existing regional centres and towns to create vibrant and attractive places for residents to live and work, and to develop new communities in release areas, supported by infrastructure and services.

The proximity of the region to Canberra has played a major role in the formation of this plan. Canberra is recognised as a significant driver of growth and economic opportunity across the region, as well as the location of many of the region’s tertiary health and educational services. As such, the plan proposes closer collaboration with the ACT on infrastructure planning and delivery for new housing, jobs, services and public transport links to jobs and services.

The plan sets four primary goals:

1. a connected and prosperous economy;
2. a diverse environment interconnected by biodiversity corridors;
3. healthy and connected communities; and
4. environmentally sustainable housing choices.

A number of directions have been developed to achieve these goals. Overall, the plan aims to grow the economy and jobs throughout the South East and Tablelands by maximising the potential of tourism, agriculture and renewable energy opportunities, and by improving cross-border transport connection to make it easier to access opportunities in public administration, education and training. The ongoing use of mineral resources extracted from the region is emphasised in the plan. It recognises that the "location of many of these resources, near rail lines and freeways, and their proximity to Australia's biggest construction materials market in Sydney, makes them particularly important to NSW" (NSW Department of Planning and Environment, 2017, p.31).

## NSW Premier's Priorities in Action

The NSW State Premier has committed to 12 Key Priorities – Premier's Priorities (NSW Government, 2018) that aim to make NSW a better place to live and work. The following Key Priorities will be achieved through a series of initiatives:

1. creating jobs;
2. building infrastructure;
3. reducing domestic violence;
4. improving service levels in hospitals;
5. tackling childhood obesity;
6. improving education results;
7. protecting our kids;
8. reducing youth homelessness;
9. driving public sector diversity;
10. keeping our environment clean;
11. making housing more affordable; and
12. improving government services.

# 3 METHODOLOGY

The methods described below enabled the collection of data to address the social impact categories defined in the Guideline (refer Appendix A). Whilst this chapter describes the SIA methodology, it does not identify which social impact category each method is designed to address. This link is made clear in the assessment chapter (and summarised in **Table 13**). As stated earlier in this report, the results of the SIA are presented and discussed according to the social impact categories, to ensure compliance with the Guideline.

## 3.1 Methodology for scoping the SIA

### 3.1.1 Adopting the scoping tool contained in the Guideline

As a subset of the Guideline, DPE released a scoping tool to guide proponents in conducting their SIA scoping exercise. The scoping tool is designed to ensure a consistent approach to identifying which of the social impacts associated with a project need to be investigated in the SIA component of the EIS. While providing a methodological guide and ready-made SIA template for this purpose, at the time of this study the scoping tool is in draft form and will remain as such until the parent DPE EIS Improvement Project is complete.

The transitional arrangement (outlined in the Guideline) that applies to the Project had a bearing on how the scoping tool was adopted for the SIA. Despite the fact that Boral had obtained SEARs and conducted a comprehensive stakeholder engagement program for the Project prior to the publication of the Guideline, the transitional arrangement mandates that the Guideline must be adopted for its SIA. Therefore, the results of the early stakeholder engagement program are being used as retrospective inputs to the scoping tool with the intent of accommodating as much of the Guideline as possible. In other words, to strengthen the scoping of the SIA, the scoping tool has been ‘retrofit’ using some of the outputs of the early stakeholder engagement program.

Due to the draft status of the scoping tool and the transitional arrangement applicable to the Project, the scoping tool itself was not adopted in its entirety for the SIA scoping exercise. Instead, the overall process inherent in the scoping tool and its major elements were adopted by the Project team. The process involved:

1. considering each ‘matter’ (i.e. amenity, access, built environment, heritage, community and economic) and its subcategories, and determining how likely it is that Project activities will cause an impact to it;
2. for each matter, considering and assessing the material characteristics of any likely impact;
3. for each matter, considering stakeholder/community opinions and sentiment towards the Project activities;
4. for each matter, determining whether or not a social impact will arise from the Project activities, and then developing a rationale for the decision; and
5. for each matter, determining the level of assessment (and engagement) which is required in the EIS preparation phase, and selecting from the following list the most appropriate SIA type:

- Desktop - another specialist study or section of the EIS will provide all the information and analysis needed to predict, evaluate and develop a response to the social impact, including relevant primary and secondary research, qualitative and quantitative data, and appropriate engagement with potentially affected people, to establish a baseline and support predictions. If this is the case, the SIA component of the EIS only needs to review the data and findings from the other sources through a SIA lens and cross-reference and integrate them into the overall social baseline and assessment.

- Standard - Most information and analysis needed to predict, evaluate and develop a response to the social impact will be provided by another specialist study or section of the EIS, but it will need to be supplemented with further evidence gathering and analysis to fill any gaps and obtain a complete picture from a SIA perspective.
- Comprehensive - Only limited or no information and analysis will be provided by another specialist study or section of the EIS. If so, the author/s of the SIA component of the EIS will need to undertake the evidence gathering and analysis needed to predict, evaluate and develop a response to the social impact.

6. Each matter and its associated level of assessment (determined by the scoping tool) was considered in the context of the social impact categories specified in section 1.1 of the Guideline. See Appendix A for a list of these categories.

### 3.1.2 Stakeholder identification and analysis

A stakeholder is a group, individual or organisation that is interested in, affected by, or has the capacity to influence a project (Brereton, 2005). **Figure 3** contains a general list of people and organisations that are likely to be stakeholders in most projects. This list was valuable for providing a starting point for the stakeholder analysis conducted in the SIA scoping exercise. There will however, always be locally-specific groups and locally specific circumstances that influence the local cultural context (Vanclay, 2015).

The locally-specific stakeholders are known to Boral courtesy of their long-term presence in the Marulan South area. As part of the scoping exercise, a high-level stakeholder analysis was undertaken first by leveraging the knowledge held by Boral staff. Two senior staff members were interviewed to determine the most prominent stakeholders associated with the Project. The interviews were held during March 2018 and each had a one-hour duration (approximately). Following the interviews, a further desktop analysis (of files held by the Project team related to the 2015-16 Marulan South Limestone SSD engagement program, and online sources) was completed to identify other stakeholders potentially interested in the Project. The stakeholder list and analysis is provided in section 4.2.

**Figure 3: Stakeholders likely to be involved with a project (Vanclay, 2015)**

| | |
|---|---|
| Residents | - Within the affected area<br>- Immediate neighbours |
| People in host communities | - Those that relocate as a result of a planned resettlement or through their own migration<br>- People in communities near where construction workers or other in-migrants will be located |
| Other communities | - More distant residents whose livelihoods may be affected as a result of the project<br>- Communities near associated works such as irrigation channels, quarries, roads, railways, and transmission line corridors |
| Project employees | - Construction workers and their families |
| Indigenous people | - Non-resident Indigenous or other land-connected peoples who may have spiritual attachment to the land/river |
| Non-government organisations (NGOs) | - Local, national and international NGOs (for example, conservationists) interested in ecological or heritage values that may be influenced by a project |
| Other stakeholders | - Developer and associated contractors, regulatory agencies, local regional and national governments, funding or development agencies |

### 3.1.3 Scoping engagement methods

A comprehensive community engagement program was undertaken during 2015-16 for the SSD. A range of methods were utilised during the program to engage stakeholders and provide an opportunity to interface with Boral about their operations in Marulan South. The engagement activities delivered by Boral during the program constitute early community engagement referenced in the Guideline. A description of each method used is provided in **Table 2**. Note the intent of **Table 2** is not to identify the stakeholders targeted by each method. These are identified in section 4.2 (refer **Figure 6**).

**Table 2: Early community engagement methods**

| Method | Description |
|---|---|
| ***Basic methods*** | |
| Letter (formal) | Individual letters addressed to stakeholders. The majority of the letters were distributed during January 2016. The letters reminded recipients about the Project planning process, summarised the community workshop held during 2015, provided a link to the workshop summary report, invited feedback on the report, and welcomed ongoing correspondence about the Project. The direct contact details of Boral's Stakeholder Relations Manager were provided.<br>In 2015, letters were also sent to the relevant state and federal authorities advising them of the initial SSD application submission. |
| Email (formal/informal) | Emails sent from Boral's Stakeholder Relations Manager to individuals who attended the Project SSD workshop held during 2015. The emails were |

| Method | Description |
|---|---|
| | distributed during January 2016 and contained the same details included in the letter (above). |
| Phone briefing (informal) | Phone briefings were offered to stakeholders via contact made by Boral's Stakeholder Relations Manager. The intent of the briefings was to provide the information outlined in the letter and emails (above) but additionally, to answer any questions raised by the stakeholders. A return phone number was provided when contact was not made, and a voice mail service was available. |
| ***In-Person Interactive methods*** | |
| One-on-one meeting (formal) / Informal briefing / 'door knock' | Proactive attempts to hold one-on-one conversations regarding the Project were made by Boral staff. These took the form of meetings, informal briefings, or door knock conversations at residential properties surrounding the site. |
| Site visit/inspection (individual/small group) | GMC representatives visited the mine to visually inspect the operational areas of the Project. Boral staff escorted representatives around the site to describe its features. Each site visit lasted around one hour. |
| Formal presentation (key stakeholder/s) | Presentations were delivered by Boral staff to key stakeholders during March 2015. A power point presentation was delivered, and it contained annual limestone product sales data, an overview of the continued operations development application, an aerial map of the Project and mine layout details, and an overview of the next steps in the development application process. The presentations typically lasted 30 minutes and questions were invited from the audience afterwards. |
| Community workshop | A community workshop was held at the administration offices of the mine on 22 July 2015 at 6pm. The purpose of the community workshop was to provide local stakeholders with an introduction to the SSD being prepared by Boral to allow for the continuation of mining operations during the next 30 years.<br>Prior to the workshop, members of the local community were invited to participate via:<br>▪ a letter left in the letterboxes of immediate boundary neighbours, as well as residents living along Marulan South Road, Glynmar Road and Long Point Road;<br>▪ an item in the Focus on Marulan newsletter;<br>▪ an advertisement placed in the Goulburn Post;<br>▪ a website update, and<br>▪ letters sent directly to key stakeholders such as Council and local Members of Parliament. |
| Marulan Chamber of Commerce meeting | On 18 June 2015, members of the Project team attended the Marulan Chamber of Commerce meeting and provided an overview of the SSD. The meetings are attended by representatives of a number of key community associations from Marulan, Tallong and Bungonia. |
| Tallong Apple Day Festival | On 3 May 2015, the Project team attended the Tallong Apple Day Festival and hosted a community event display. The event was attended by approximately 4000 people. The Project was discussed with those who attended amongst other Boral projects. Boral contributes to the festival on an annual basis. |
| GMC meeting | In late January 2015, members of the Project team attended a meeting with the General Manager and Mayor of GMC, and provided an overview of the SSD. |
| ***Written methods*** | |
| Information/fact sheet | A fact sheet titled "Boral in Marulan South - carrying on a century-old tradition" was created and distributed in June 2015. It was distributed via email to the stakeholder database. The fact sheet provided a brief history of the Project and highlighted its importance to the NSW building industry. It provided an overview of the SSD application to continue operating, and invited recipients to obtain more information via Boral's website, email or telephone correspondence, and via the community workshop (refer above). |
| Questions and answers (Q&A) | A Q&A document was created and distributed in June 2015. It was distributed via email to the stakeholder database. The document provided responses to questions predicted to be raised by stakeholders associated |

| Method | Description |
|---|---|
| | with the Project. Such questions included the reason for the SSD application to continue operating, new emplacements, re-vegetation, Marulan South Road modifications, noise and dust levels, and support of community initiatives. Recipients were invited to obtain more information via Boral's website, email or telephone correspondence, and via the community workshop (refer above). |
| Column in the *Focus on Marulan* e-news publication | The e-news publication was distributed by the Marulan Region Chamber of Commerce in May 2015 to approximately 2000 subscribers. It provided a brief history of the Project and highlighted its importance to the NSW building industry. It provided an overview of the SSD application to continue operating, including details about the overburden/emplacement and Marulan South Road modifications. It invited recipients to obtain more information via Boral's website, email, and telephone correspondence. |
| ***Media methods*** | |
| Editorial (media release / statement) | Boral issued a media release on 20 May 2015 (see Appendix B) regarding the Project. The media release outlined the role the mine plays in the growth and development of NSW and ACT. It also outlined the features of the Project (e.g. overburden emplacements, Marulan South Road realignment and improvements), Council involvement, the interface with the Peppertree Quarry Modification 4 application, and a reference to additional information on the Boral website. |
| Editorial (media opportunity / photo) | The *Goulburn Post* published an article titled "The Lime is Right" (see Appendix B) 25 May 2015 which promoted the Project. A series of statements attributed to Boral's Mine Manager were published in the article which outlined the features of the Project and elaborated on details provided in the media release (refer above). |
| Advertorial / advertising | Four advertorials were published in the *Goulburn Post,* in a series titled "Boral in Marulan South - continuing a century-old tradition", on the following dates:<br>▪ 18 May 2015;<br>▪ 25 May 2015;<br>▪ 1 June 2015; and<br>▪ 8 June 2015.<br>The series provided a brief history of the mine, emphasised its contribution to nationally significant developments, described the Project including changes to overburden emplacements and Marulan South Road, road conditions and driver behaviour, the interface with Peppertree Quarry, and an invitation and instructions on how to provide feedback about the Project. |
| ***Social media methods*** | |
| Website | Information about the Project and updates about the early engagement activities was hosted on the Marulan South Operations shared website (available at www.boral.com.au/marulan). The website was referenced in all material developed for the Project and provided a central repository of information associated with the Project. |

### 3.1.4 Area of social influence development and determination

The Area of Social Influence (ASI) for the Project was developed in accordance with the considerations outlined in the Guideline. The Guideline explains that the term 'locality' does not have a prescribed meaning or refer to a fixed, pre-defined geographic boundary. In the context of the Project, care was taken to determine the ASI comprising the area within the actual Project boundary, but also the geographies external to the site where social impacts may arise.

The ASI was developed on the premise that relationships within and between scales will affect what people understand as impacts (Vanclay and Esteves 2011). This means that people may not perceive social impacts created by a project to be those felt exclusively within or immediately adjacent to the project boundary, or at a time when operations are conducted on site. Instead, it is possible for impacts to be felt at locations outside the project boundary and at any time of day (particularly in the event of long-distance haulage routes or complex supply chains). These time and space relationships between the Project site and communities, economies, infrastructure, and resources (both human and natural), were explored using a mixed-methods approach. The specific methods adopted were:

1. semi-structured interviews with key Boral Project personnel familiar with the existing operations on site and the local communities near the Project;
2. feedback from residents obtained during the early community engagement methods, in particular the in-person interactive methods (refer **Table 2**); and
3. analysis of historical correspondence records.

The development of the ASI considered factors including but not limited to:

- supply chains;
- haulage of resources;
- transport of goods;
- materials and equipment;
- movement of workers (drive-in-drive-out/fly-in-fly-out working arrangements);
- natural features and recreational values (e.g. Bungonia National Park, gorges and caves)
- ancillary infrastructure; and
- reputation of other extractive industries in the area.

## 3.2 Methodology for preparing the SIA

### 3.2.1 Existing social baseline

An analysis of the existing population was undertaken to establish the social baseline. Secondary data was obtained from the most reliable sources available, primarily being the 2016 Australian Census of Population and Housing (Australian Bureau of Statistics, 2018). In the context of Marulan, data was available at the Urban Centres and Localities (UCL) and State Suburbs (SSC) geographies. The latter was selected for the baseline as it provided more adequate coverage of the ASI (i.e. the UCL scale was too fine). Where available and relevant, comparative data at the NSW state level was obtained and formed part of the baseline.

A wide range of social indicators were considered prior to conducting the statistical analysis and developing the baseline. The selection of social indicators was made at the completion of the scoping exercise, when preliminary community feedback about the Project was known. More importantly, the Tablelands Regional Community Strategic Plan 2016-2036 (Tablelands Councils, 2016) was used as a guide when selecting the specific social indicators. The strategic plan is Councils leading corporate document which sets a vision and strategic priorities (termed the “strategic pillars”) for the local authority. It was developed with input from the community, obtained via face to face conversations, community workshops, and a community survey. Using the strategic plan as a guide to select the social indicators provided confidence that they represented the health and wellbeing values, and interests of the communities (Vanclay, 2015) surrounding the Project. Each social indicator and its relevance to four[1] strategic pillars listed in Councils strategic plan is outlined in **Table 3**.

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[1] The ‘Our environment’ pillar is not addressed in the SIA baseline, as a baseline containing environmental indicators is contained in the EIS.

**Table 3: Relationship between social indicators and Tablelands Councils strategic plan**

| Strategic pillar listed in the Tablelands Regional Community Strategic Plan 2016-2036 (Tablelands Councils, 2017) | Relevant social indicator contained in the baseline |
|---|---|
| 1) Our economy: we have a strong regional economy experiencing sustainable growth, which provides for a diverse range of employment opportunities. | Education, employment and training<br>Educational status<br>Weekly income individual and household |
| 2) Our community: we are a network of vibrant, inclusive and diverse communities that value our cooperative spirit, self-sufficiency, and rural lifestyle. | Community profile<br>Population projections<br>Family composition<br>Indigenous population |
| 3) Our infrastructure: our community is well serviced and connected to built, social and communications infrastructure. | Mobility<br>Housing and accommodation<br>Housing opportunity |
| 4) Our civic leadership: our leaders operate ethically and implement good governance. We empower our residents with the tools to participate actively in the development of our communities. | Social disadvantage |

### 3.2.2 Existing social infrastructure

An online desktop search was the method used to determine the existing social infrastructure associated with the Project. Data was sourced from a range of websites including:

- GMC website (Goulburn Mulwaree Council, 2018);
- Goulburn Mulwaree Community Directory (Goulburn Mulwaree Council, 2018);
- NSW Department of Education (NSW Department of Education, 2018);
- Discover Marulan (Marulan Region Chamber of Commerce Inc, 2018);
- NSW Health (NSW Health, 2018); and
- NSW National Parks and Wildlife Service (NSW National Parks and Wildlife Service, 2018).

### 3.2.3 Further engagement methods

As described above, scoping engagement for the Project comprised a comprehensive community engagement program undertaken during 2015-16. Further engagement activities were essential during 2018, given the time that had passed since the early conversations with stakeholders. Accordingly, a range of further engagement methods were implemented to emphasise and seek feedback about the revised mine plan and the Project in general. The 'in-person interactive' methods and phone briefings/emails described in **Table 2** served a dual-purpose, both as a community engagement tool and a tool to identify social impacts. Each of the methods implemented for further engagement are described in **Table 4**.

**Table 4: Further engagement methods**

| Method | Description |
|---|---|
| ***Basic methods*** | |
| Doorknock notification letter (formal) | In June 2018 a letter was sent to residences surrounding the Project (i.e. fenceline neighbours as well as residents along Marulan South Road, Long Point Road, and Glynmar Road) advising of the SSD and providing advanced notice of a doorknock to be conducted by the Project team, to share further details. It also encouraged feedback or concerns about the current operations to be sent to Boral's Stakeholder Relations Manager. |

| Method | Description |
|---|---|
| Staff briefing (toolbox talk) | During June 2018 employees at the mine were briefed on the SSD. Questions from staff were addressed by Boral's management team involved with the SSD. |
| Email (formal/informal) | Emails sent from Boral's Stakeholder Relations Manager to Project stakeholders in July 2018. The emails contained the same details included in the letter (above). |
| Phone briefing (informal) | Phone briefings were offered to stakeholders via by Boral's Stakeholder Relations Manager. The intent of the briefings was to provide the information outlined in the letter and emails (above) but additionally, to answer any questions raised by the stakeholders. A return phone number was provided when contact was not made, and a voice mail service was available. |
| ***In-Person Interactive methods*** | |
| 'Door knock' (briefing) | During June 2018, one week after distribution of the doorknock notification letter (refer above) to residences surrounding the Project, attempts to hold one-on-one conversations regarding the Project were made by Boral staff. These took the form of an informal briefing, or door knock conversations, at residential properties surrounding the Project. The doorknocks reached some individuals who attended the community workshop held as part of scoping engagement. |
| Peppertree Community Consultative Committee meeting | On 15 August 2018, members of the Project team attended the Peppertree Quarry Community Consultative Committee regular meeting and provided an overview of the SSD. |
| Marulan Chamber of Commerce meeting | On 15 August 2018, members of the Project team attended the Marulan Chamber of Commerce meeting and provided an overview of the SSD. The meetings are attended by representatives of a number of key community associations from Marulan, Tallong and Bungonia. |
| Meeting with GMC | On 11 September 2018 the Project team met with planning and operations staff from GMC. The Project team delivered a presentation to Council. A range of operational aspects of the SSD were discussed following the presentation. |
| Interviews | During July 2018 interviews were held with two members of Boral's senior management team. The interviews were conducted under a semi-structured format and designed to obtain information to assist the ASI development. The interviews lasted for approximately 1 hour and were recorded. |
| Site visit | On 3 October 2018 members of GMC planning team visited the mine and were provide with an escorted tour of operational areas. The visit was intended to be an information gathering session ahead of the SSD submission, for Council staff who were not familiar with the site. |
| Briefing for GMC Councillors | On 20 November 2018 a briefing was provided to the elected representatives of GMC. On this occasion a briefing only was provided due to time constraints. Operational aspects of the SSD were discussed and feedback from Councillors was invited. |
| Community drop-in sessions | Community drop-in sessions were held from 2:30pm-5.30pm on 8 August 2018, and 9:30am-1pm on 9 August 2018. Both sessions were held at Marulan Community Hall. A community newsletter (see below) about the SSD was compiled and made available to attendees. It explained that the SIA and consultation with stakeholders forms a key component of the process. All attendees were invited to participate in the SIA and asked to indicate on arrival whether or not they would be interested to share their feedback in a one-on-one interview. Senior members of the Project team attended the sessions and invited questions and feedback from attendees. |
| Consultation with fenceline neighbours | During September and October 2018, fenceline residents and businesses were consulted about the SSD. Members of the Project team separately met property and business owners who had previously provided feedback about the SSD. The consultation occurred at the properties of the business owners and residents. |
| ***Written methods*** | |

| Method | Description |
|---|---|
| Letter (formal) | Individual letters addressed to stakeholders. The majority of the letters were distributed during July 2018 to residences surrounding the Project (i.e. fenceline neighbours as well as residents along Marulan South Road, Long Point Road, and Glynmar Road). The letters advertised the upcoming community drop-in session (see above) and extended an invite to recipients. It explained the Project and SIA, and contained the direct contact details of Boral's Stakeholder Relations Manager as a feedback channel.<br>On 18 September 2018, letters were also sent to the NSW MP for Goulburn, the Federal MP for Hume, and Pejar Local Area Land Council (LALC). The letter informed each party about the ongoing SSD assessment process and the final steps towards lodging an EIS with DPE. |
| Column in the *Discover Marulan* e-news publication | The Marulan Region Chamber of Commerce publishes the *Discover Marulan* monthly e-newsletter, which is distributed to approximately 2000 subscribers. The August 2018 issue featured an article on the SSD. It provided a short history of the mine and its importance to the building industry and the region, an overview of the SSD, and an invitation to the community drop-in sessions (refer above). A follow-up article was published during September 2018 which provided a reminder about the SSD and a further feedback invitation. |
| ***Media methods*** | |
| News editorial | On 20 August 2018 an article about the SSD was published in the *Goulburn Post*. It provided an explanation of the need for and purpose of the SSD. It contained statements made by some of Boral's management staff. Refer to the article extract in Appendix B. |
| News advertisement | Advertisements for the community drop-in sessions were published in the *Goulburn Post* on 6 and 8 August 2018. It contained an open invitation to all readers. Refer to the advertisement in Appendix B. |
| ***Social media methods*** | |
| Website | Information about the SSD and updates about the further engagement activities was hosted on the Marulan South Operations shared website (available at www.boral.com.au/marulan). The website was referenced in all material developed for the Project and provided a central repository of information associated with the SSD. A major update of the Project information on the website (including details of the community drop-in sessions) was undertaken on 6 July 2018. |
| Facebook campaign | During August 2018, Boral conducted a 2-week advertising campaign on Facebook. It involved a single post which highlighted the SSD and encouraged visits to the Marulan South Operations shared website for more detail. The campaign targeted users in the geographic region surrounding the Project. Refer to the post in Appendix B.<br>The *Goulburn Post* editorials (refer above) were also reproduced in a post on the Facebook page of the news publication. |

### 3.2.4 Social impact assessment methods

A range of methods were selected for the SIA. Each method was adopted to address one or more of the matters determined by the DPE scoping tool, to require further social impact investigations. The selection process involved:

1. Populating the DPE scoping tool with the relevant information
2. Determining the level of assessment prescribed by the scoping tool
3. Selecting a method or a combination of methods to satisfy the level of assessment, bearing in mind:
    a. the specific social matter to which the assessment related;
    b. the availability of existing data held by the Project team (if any); and
    c. feasibility of the methods (e.g. time, cost, reliability).

The methods adopted for the study are outlined below. The social matters to which each method relates are identified in Chapter 7.

## Consultation with residents and business owners

The strategic approach developed by the Centre for Social Responsibility in Mining (Developing a Community Impacts Monitoring and Management Strategy: A Guidance Document for Australian Coal Mining Operations, 2005) was adopted for consultation with residents and business owners. It involved four stages:

1. deciding who will be consulted and by what means;
2. undertaking consultations;
3. summarising the outcomes; and
4. providing follow up to stakeholders.

Consultation took the form of one-on-one meetings with a duration of less than one hour, which enabled an in-depth exploration of individual issues (Social Responsibility in Mining, 2005). The meetings took place at the properties owned by the resident or business owner. The dialogue in each case commenced prior to or during the scoping phase of the SIA. The majority of residents/business owners consulted also attended the community workshop, held during August 2018. This method was therefore designed to be supplementary in nature.

## Visual impact assessment

A visual impact assessment (VIA) should describe the likely nature and scale of changes in views resulting from a development, and changes to visual amenity experienced by the receptors (Knight & Therivel, 2018). For the EIS a specialist VIA was conducted and involved an analysis of a photo montage archive. For the purposes of the SIA, a VIA was also conducted and intended to be supplementary, alongside further engagement with impacted residents. In particular, the assessment was adopted in response to visual impact concerns reported by a resident near the mine. The photo montages contained in the standalone VIA were again used as the basis of the VIA in this SIA.

The VIA applied by Andrews et. al. (2012) was adopted for this study. It enables the potential visual impact of the Project to be assessed in relation to viewpoints of the residents. The significance of potential visual impacts was assessed by considering:

1. Magnitude

   This relates to the magnitude of visual change in the landscape, and its proximity to the viewer. The magnitude of visual change is strongly influenced by the level of visibility of the proposed new work. This results from the combination of scale, extent, distance and duration of the views.

2. Sensitivity

   Sensitivity in relation to the quality of the view and how sensitive it is to the proposed change. Visual sensitivity depends on the nature of the existing environment and on the likely response from people viewing the scene. People driving on a busy road and/or at high speeds are likely to be less sensitive to a change in the environment since they are focused on changes in traffic conditions and driving, compared to someone who is enjoying a recreational experience or someone who is viewing the scene from their living room.

The categories of magnitude and sensitivity of visibility are defined in **Table 5**.

**Table 5: Categories of magnitude and sensitivity (Andrews et. al., 2012)**

| Rank | Description |
|---|---|
| Negligible | Very minor loss or alteration to one or more key elements/features/characteristics of the baseline visual character (i.e. pre-SSD approval view) and/or introduction of elements that are consistent with the visual character to the existing landscape character (i.e. approximating the 'no change' situation). |
| Low | Minor loss of/or alteration to one or more key elements/features/characteristics of the baseline visual character (i.e. view pre-SSD approval) and/or introduction of elements that are consistent with the existing landscape character. |
| Moderate | Partial loss of/or alteration to one or more key elements/features/characteristics of the baseline visual character (i.e. view pre-SSD approval) and/or introduction of elements that may be prominent but not considered to be substantially uncharacteristic of the existing landscape character. |
| High | Substantial to total loss of key elements/features/characteristics of the baseline visual character (i.e. view pre-SSD approval) and/or introduction of elements considered to be totally uncharacteristic of the existing landscape character. |

As described above, the magnitude and sensitivity of potential visual impacts to existing views would depend on a combination of scale, extent, distance and duration of the views. Impacts were assessed by applying a consistent set of criteria to each of the resident viewpoints addressed by the visual impact assessment. The criteria are outlined in **Table 6**.

**Table 6: Visual impact criteria (Andrews et. al., 2012)**

| Criteria | Definition | Rating |
|---|---|---|
| **Duration of view** | | |
| Long term | >1 hour | High |
| Moderate term | 30 minute to 1 hour | Moderate |
| Short term | <30 minute | Low |
| **Number of viewers** | | |
| High | >1,000 | High |
| Moderate | 100-999 | Moderate |
| Low | <100 | Low |
| **Viewer sensitivity (type)** | | |
| Resident | N/A | High |
| Pedestrian/cyclist | | Moderate |
| Motorist | | Low |
| **View sensitivity** | | |
| Pristine landscape | N/A | High |
| Moderately modified landscape | | Moderate |
| Significantly modified landscape | | Low |
| **View distance/proximity** | | |
| Short | < 100m | High |
| Medium | 100m-500m | Moderate |
| Long | >500m | Low |

## Semi-structured interview

Interviewing was selected as a SIA method to explore and assess a number of matters identified in the scoping tool. An interview was conducted under a semi-structured format using a list of predetermined questions. This format provided a flexible structure which allowed the interviewer to create and ask questions about situations as they emerged, and the interviewee to digress and express views freely (Vilela, 2018).

The work of Bradshaw and Stratford (Qualitative research design and rigour, 2010) with regard to qualitative research design and rigour, was helpful in designing the semi-structured interview methodology. The authors provide guidance in relation to participant selection and sampling. Their work explains that in qualitative research, the number of people we interview, communities we observe, or texts we read, is less important than the quality of who or what we involve in our research, and how we conduct that research. Their work emphasises that 'purposive' sampling is typical in this type of research, and that the sample is not intended to be representative given the emphasis is usually on the analysis of meanings. These principles were applied to the SIA interview, and the Director of Operations at GMC was invited to participate.

The implementation of the method involved:

1. developing the pre-determined interview questions, designed to explore the social matters identified in the scoping tool;
2. sending an interview invitation letter to the participant. The letter explained the purpose of the interview, the intention to record it, and provided some frequently asked questions. It explained that consent was required, and sought to obtain it in a "free, prior and informed" (Vanclay, 2015, p. 6) fashion;
3. obtaining participant consent;
4. arranging a date and forwarding the participant an advanced copy of the predetermined questions;
5. conducting and recording the interview;
6. drafting and conducting a qualitative analysis of the interview transcript; and
7. extracting transcript content for use in the SIA assessment.

## Health Impact Assessment

The scoping tool outcomes revealed a need to conduct a Health Impact Assessment (HIA) as part of the SIA. "Most contemporary definitions of health acknowledge that good health comprises more than just the absence of disease; it includes physical, mental, and social well-being" (Orenstein, 2018, p. 578). In its broad definition, health can therefore be influenced by living and working conditions, housing, or changes to physical environments. The assessment of "most health impacts is approached in a qualitative manner" (Orenstein, 2018, p. 594) and the approach for this SIA is no different. In a HIA, information from a variety of sources is used to help predict the potential effects of a project on the selected health issues. Orenstein (2018) states that sources of information typically used in a HIA include published literature, discussions with key informed sources, information gleaned from engagement with various stakeholder groups, and evidence gathered from the effects of past projects in the area.

For the SIA, the HIA was selected to address the 'Way of Life' social impact category which is identified in Chapter 7 of this report. In this case, a number of data sources were used including an interview transcript, complaints records associated with the existing operations at the mine, media articles collected for the Ethnographic Content Analysis method (see below), and doorknock records. Using a wide range of data sources increased the likelihood that feedback from marginalised groups was considered as part of the study. The HIA methodology involved:

1. referring to the scoping tool results and identifying the social matters to be assessed using the HIA;
2. for each matter, undertaking a qualitative analysis of the interview transcript, complaints records, media articles and doorknock records. The analysis aimed to identify statements regarding health impacts of the SSD, or other similar operations which may cause cumulative impacts;
3. for each matter, considering the statements against the health impact rating descriptions in **Table 7**, adapted from Orenstein (2018); and
4. Applying a health impact rating.

**Table 7: Health impact ratings (adapted from Orenstein, 2018)**

| Health impact rating | Description |
|---|---|
| Positive | Effect results in improvements to well-being or the likelihood of injuries/illness, or preserves livelihood status quo |
| High positive | Effect results in moderate improvements to well-being, the likelihood of injuries/illness, or livelihood |
| Very High positive | Effect results in a well-being revolution, a significant reduction in the likelihood of injuries/illness, or dramatic livelihood improvement |
| Neutral | Effect is not perceptible/influential on livelihood |
| Negative | Effect results in annoyance, minor injuries, illnesses, or livelihood impacts that do not require intervention |
| High negative | Effect results in moderate injury, illness, or livelihood impact that may require some intervention |
| Very High negative | Effect results in loss of life, sever injuries, chronic illness, or livelihood impact that requires intervention |

## Ethnographic Content Analysis (media analysis)

Altheide's (1996) Ethnographic Content Analysis (ECA) was selected and adapted as the method to assess impacted social matters identified during the scoping exercise. ECA is a qualitative media analysis methodology used to obtain, categorise and analyse different media documents (such as newspapers and magazines) in addition to other forms of media delivered online and via television. ECA is an approach which blends the "traditional notion of objective content analysis with participant observation to form ethnographic content analysis" (Altheide, 1996, p. 2). It is therefore unlike the traditional positivist and quantitative approach to media analysis which engages in a rigorous quantitative testing of phenomena against a template devoid of human interface (Guba & Lincoln, Y., 2005). Instead ECA encourages the investigator to be reflexive and interactive, and it enables an element of ongoing discovery as progress is made towards the SIA research goal. It is in this vein that ECA enables documents to be "studied to understand culture – or the process and the array of objects, symbols, and meanings that make up social reality shared by members of a society" (Altheide 1996, p.2).

The characteristics of ECA are clearly distinguished from those associated with quantitative approaches (QA) to media analysis (see **Table 8** for a comparison). Unlike QA which is concerned with statistical reliability, Altheide (1996) suggests that the emphasis of ECA is fixed more so on research 'validity'. Although itself a term commonly associated with statistical tests, validity in this sense refers instead to the degree of rigour in a research project, as determined by the interpretive community who check the research for credibility and good practice (Bradshaw & Stratford, 2005). ECA is also dissimilar to QA in terms of researcher involvement. Each of the research phases in an ECA approach is very individualistic in the sense that the main investigator is 'involved' with the concepts, relevance and development of the protocol and the way in which items are collected for purposes of later analysis (Altheide, 1996). Furthermore, in contrast to QA, data collection for ECA is predominantly undertaken using a purposive or theoretical sampling technique and is not intended to provide a representative sample (refer Bradshaw and Stratford, 2005).

As shown in **Table 8**, ECA focuses on narrative data (in addition to numerical data that is more commonly associated with QA) and always allows the researcher to make analytical commentary on this data. This approach not only involves the measurement of the frequency and extent of terms consistent with QA approaches, but it also enables the investigation of text meaning, and encourages the provision of descriptive information (Altheide, 1996). The qualitative text analyst produces this descriptive information by repeatedly exploring the sampled texts, and by noting the peculiarities contained in the sample (Roberts, 1997). It is through this process that the analytical concepts emerge and are applied to the text in ECA research. Roberts (1997) describes this as a key difference between QA and ECA; on the one hand "quantitative researchers specify their measures and their tests in advance…on the other hand, qualitative [ECA] researchers typically explore their data, applying one classification scheme after another, before settling on that scheme (or schemes) that in their view resonates best with their data" (Roberts 1997, p.2). Analysis therefore "takes place throughout the entire research process, a study is shaped and reshaped as a study proceeds, and data is gradually transformed into findings" (Watt, 2007, p. 95).

**Table 8: A comparison of quantitative media analysis and ECA (source: Altheide 1996)**

| Characteristic | Quantitative approach to media analysis (QA) | Ethnographic approach to media analysis (ECA) |
|---|---|---|
| **Emphasis** | Reliability | Validity |
| **Primary Researcher involvement** | Data analysis and interpretation | All phases |
| **Sample** | Random or stratified | Purposive or theoretical |
| **Type of data** | Numbers | Numbers; narrative |
| **Narrative description and comments** | Seldom | Always |
| **Concepts emerge during research** | Seldom | Always |
| **Data analysis** | Statistical | Textual; statistical |
| **Data presentation** | Tables | Tables and text |

## Applying ECA to the SIA using online news articles

The most important element of the entire ECA exercise is the protocol (or a data collection sheet). It is "a way to ask questions of a document; a protocol is a list of questions, items, categories or variables that guide data collection from documents" (Altheide 1996, p.26). It is therefore an essential utility of ECA. The protocol itself consists of two tables – Table A and Table B - as shown in the example in **Figure 4**. Table A, the first of the two tables, has 9 columns with the following headers and definitions:

1. Case Number – a number sequentially allocated to each article analysed (i.e. number '1' was allocated to the first article analysed, number '2' to the second and so on).
2. Source Publication – the title of the newspaper which contained the article. Each article analysed in this ECA exercise was sourced from the Goulburn Post website.
3. Date of Article – the production date of the newspaper article (found on the web page). Note only articles collected from 2012 to September 2018 were collected.
4. Page Location – the hard copy page of the newspaper where the article appeared (if available).
5. Title – the title of the newspaper article.
6. Frame – A numeral, corresponding to a particular Frame in Table B which is allocated during the analysis of a Goulburn Post article.
7. Theme - A numeral, corresponding to a particular Theme in Table B which is allocated during the analysis of a Goulburn Post article.

8. Discourse - A numeral, corresponding to a particular Discourse in Table B which is allocated during the analysis of a Goulburn Post article.
9. Notes – miscellaneous information specific to an article can be included in the notes column.

A new record containing the above information was added to Table A each time an article containing a narrative about dust or safety (being two social matters identified during the scoping exercise) was read.

The second table (Table B) contained in the protocol lists all the categories (Frames, Themes and Discourses) that emerged from the Goulburn Post. Table B is best understood as a 'lookup table' or a 'storage table' which holds the categories that are individually applied to Goulburn Post articles during analysis. The 3 columns in Table B (refer **Figure 4**) have the following headers and definitions:

1. Frames - "very broad thematic emphases or definitions of a report" or "a way of discussing the problem or the kind of discourse that will follow" (Altheide 1996, p.30).
2. Themes - "general meanings or even 'miniframes for a report'" or "the recurring typical theses that run through a lot of reports" (Altheide 1996, p.30).
3. Discourses - "a series of representations, practices and performances through which meanings are produced" (Johnston & Gregory, 2000, p. 178).

Each *Goulburn Post* article that mentioned or suggested an association to the target social impact matters was analysed for its relevance to the Project. Using Table B, this objective was achieved by developing a Frame, Theme and Discourse for each article. As each article was read, the message it conveyed about the Project was considered, and the most appropriate Frame, Theme and Discourse was allocated to it. Articles that did not contain content meeting the definitions of a Frame, Theme and Discourse were disqualified from the ECA. It is important to note that the Frames, Themes and Discourses developed and entered into Table B reflected only the manifest content of the news articles. Manifest content is the descriptive information contained in a media message that is easily recognised and immediately digested by the reader. Manifest content has been described as the information existing 'on the surface' of a text document, and it contrasts with latent content which is characterised by information 'hidden beneath the surface' of a text document which is obtained through deeper analysis (Lombard, M. & Snyder-Duch, 2002). The Frames, Themes and Discourses were developed, defined in one or two sentences, and added to Table B as they emerged from reading each article. The categories were therefore 'stored' in Table B, and they were assigned a numerical code which was eventually copied into the corresponding cell in Table A.

Rather than being produced at the end of the collection and analysis of newspaper articles, both tables which comprise the protocol are drawn up prior to commencement and entries are gradually and progressively added to it during the execution of ECA. Each time a pertinent article containing a discourse relevant to the target social impact matter was read, a new record was added to Table A. In addition, if no suitable categories (i.e. Frames, Themes or Discourses) existed in Table B, then new categories were developed and added to that table. The information added to each new record in the protocol corresponds with details sourced from each individual *Goulburn Post* article. The protocol was therefore expanded as the newspaper sample was read.

There were 10 key steps involved in carrying out the ECA method, and whilst being fundamental to the practice of ECA, the Protocol is not utilised until Step four. The following section will outline all 10 steps and further illustrate the utility of the Protocol described above.

Figure 4: Example of a draft ECA Protocol used in the analysis of the narratives

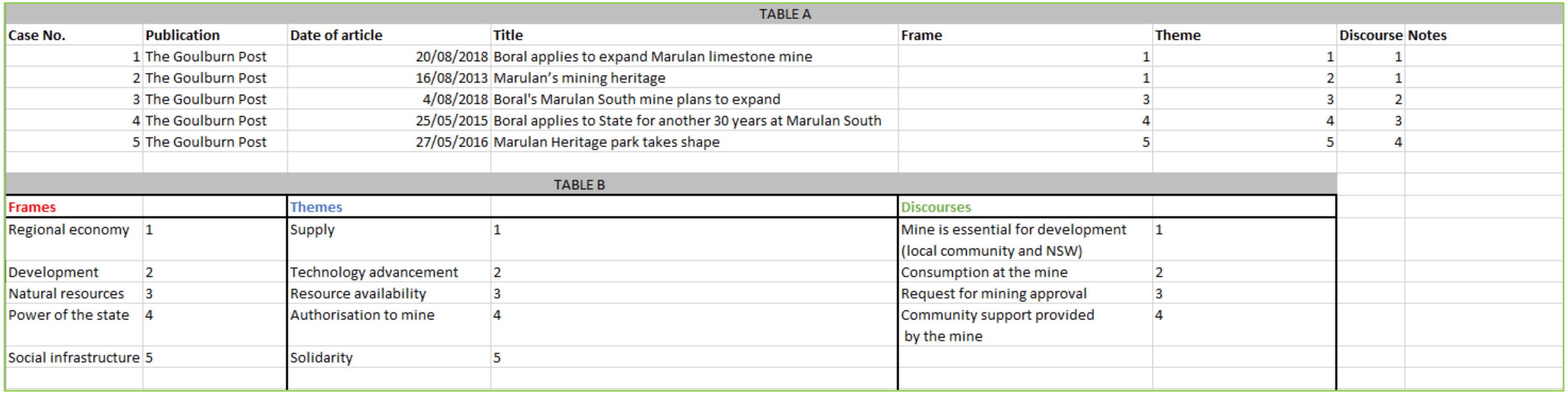


TABLE A

| Case No. | Publication | Date of article | Title | Frame | Theme | Discourse | Notes |
|---|---|---|---|---|---|---|---|
| 1 | The Goulburn Post | 20/08/2018 | Boral applies to expand Marulan limestone mine | 1 | 1 | 1 | |
| 2 | The Goulburn Post | 16/08/2013 | Marulan's mining heritage | 1 | 2 | 1 | |
| 3 | The Goulburn Post | 4/08/2018 | Boral's Marulan South mine plans to expand | 3 | 3 | 2 | |
| 4 | The Goulburn Post | 25/05/2015 | Boral applies to State for another 30 years at Marulan South | 4 | 4 | 3 | |
| 5 | The Goulburn Post | 27/05/2016 | Marulan Heritage park takes shape | 5 | 5 | 4 | |

TABLE B

| Frames | | Themes | | Discourses | |
|---|---|---|---|---|---|
| Regional economy | 1 | Supply | 1 | Mine is essential for development (local community and NSW) | 1 |
| Development | 2 | Technology advancement | 2 | Consumption at the mine | 2 |
| Natural resources | 3 | Resource availability | 3 | Request for mining approval | 3 |
| Power of the state | 4 | Authorisation to mine | 4 | Community support provided by the mine | 4 |
| Social infrastructure | 5 | Solidarity | 5 | | |

## The ten steps of ECA

The implementation of ECA to *Goulburn Post* articles involved carrying out 10 of the key steps defined by Altheide (1996). Each of these 10 steps is listed below, along with a description of how it was applied in the context of the *Goulburn Post* analysis.

- Step 1: Pursue a specific problem to be investigated.

The SIA scoping tool identified social matters that required assessment as part of the SIA. These assessments resemble the problems to be investigated.

- Step 2: Become familiar with the process and context of the information source. Explore possible sources of information.

Given its position as the most dominant and popular text media publication in the Goulburn Mulwaree district, the *Goulburn Post* is a unique source of social narratives. The publication broadcasts the views held by society in respect to topical issues and it does so in a standardised process. This process involves the regular and frequent publication of news topics in a uniform format. Articles from the publication are made available online and free of charge. For these reasons it was adopted for the ECA exercise.

- Step 3: Become familiar with several examples of relevant documents and select a unit of analysis.

Familiarity with individual *Goulburn Post* articles was gained by completing a scoping activity. This activity involved conducting an online search for a *Goulburn Post* article, using the search strings “Marulan + mine”. The search was conducted using a Google chrome ‘news’ search and the Isentia Media Portal search engine. The search string returned a page of search results, and the five highest ranked articles with Marulan mentioned in the title were read. The process enabled recognition of the layout of the articles and other sections of the page (e.g. comments section and advertisements which were not analysed).

During the initial scoping activity, a decision was made concerning the unit of analysis to be incorporated into the ECA exercise. A ‘unit of analysis’ refers to the portion or segment (e.g. a particular page, an individual article, a certain paragraph) of relevant articles that will actually be subject to ECA. It was decided that the entire individual articles (including any heading, body text, caption text and/or images) that mentioned or suggested an association to the target social impact matters would be the unit of analysis. This decision was made “because it was clear from the content of the messages [contained in the *Goulburn Post* articles] that they could not be further reduced before analysis without losing valuable contextual information” (Markman & Simons, 2003, p. 16).

- Step 4: List several categories (variables) to guide data collection and draft a protocol (data collection sheet).

Step 4 marked the phase where a protocol (or data collection sheet) was first introduced to the ECA exercise. Categories (i.e. Frames, Themes and Discourses) that emerged from the articles read during Step 3 were entered into a draft Protocol (refer **Figure 4**). In terms of discourses, there were initially four observed in the *Goulburn Post* that conveyed specific information regarding the target social impact matters. They included (1) Mine is essential for development (local community and NSW), (2) Consumption at the mine, (3) Request for mining approval (4) Community support provided by the mine. At this step of the ECA, these understandings of the Project were derived only from the description immediately recognised within each article. Subsequently, the above four categories only reflected the manifest content of the news articles. These categories were entered into the protocol as they emerged.

- Step 5: Test the protocol by collecting data from several documents.

At Step 5 the additional articles were collected to test the protocol. An additional search was made at this time using the search string “Marulan + mine news”. During the collection and analysis activities there were additional Frames, Themes and Discourses that emerged from the manifest content of the news articles. An entry was created in the protocol for each article, and the protocol expanded progressively as a consequence.

- Step 6: Revise the protocol and select several additional cases to further refine the protocol.

A revision of the protocol was undertaken when all articles (obtained at the time) that mentioned or suggested an association to the target social impact matters had been tentatively analysed. The revision involved checking the definitions of all categories to ensure that they were succinct and appropriate for the articles that they represented. Modifications to inadequate categories listed in Table B of the protocol were made as needed. The modifications were made in one of four ways; categories were renamed, re-defined, split into two or merged into one.

- Step 7: Arrive at a sampling rationale and strategy (e.g. theoretical, purposive, opportunistic, cluster or stratified).

Following the consideration of a range of sampling techniques, theoretical sampling was the technique adopted. Theoretical sampling involves “the selection of material based on emerging understanding of the topic under investigation” (Markman and Simons 2003, p.17). The theoretical sampling technique was adopted in order to identify and refine knowledge of narratives about the mine, over time. At Step 7, other sampling parameters were confirmed such as:

- The publication date range: articles published between September 2012 and September 2018 were considered for the ECA method. Any articles published outside this date range were excluded from the study. There were two reasons this date range was selected. The first is that during 2013-14, Boral funded road improvement work along a number of sections of Marulan South Road. Traffic and the condition of local roads attracted significant attention in the *Goulburn Post* articles. It was decided that starting the date range prior to the roadwork (i.e. from September 2012) would yield important data pertaining to the prominent social issue. The second is that a 5-year range was sufficient to identify any cumulative social impacts emerging in the media narratives. It was decided that a shorter range may not yield the same.
- Additional search strings: the terms used to search for online articles via a Google chrome ‘news’ search, and the Isentia Media Portal search engine, were expanded. The exact search strings are identified below in the Impact Assessment section of this report.
- Step 8: Complete data collection for the target social matters.

The relevant search strings were applied and the collection of relevant *Goulburn Post* articles continued in a sustained and rigorous fashion until all articles returned via the online searches had been covered. As articles were collected, they were added to the protocol following the procedure outlined earlier (i.e. a record of each article was created in Table A of the protocol using its attribute details, and each article was categorised with a Frame, Theme, and Discourse in Table B).

At the completion of Step 8 the sample had been obtained, each article in the sample had been subject to a manifest content analysis, and the results from these analyses had been recorded in the protocol. The results provided a means to understand the implications of the SSD for the target social impact matters, via the discourses being circulated amongst the population.

- Step 9: Consider the content analysis results shown in the ‘discourse’ column. Write summaries or overviews of the key findings

Once every *Goulburn Post* article listed in Table A of the protocol had been analysed and the results had been entered into the ‘discourse’ column, then the individual results were considered. Summaries were produced of each discourse, and they were the key findings of the ECA exercise.

- Step 10: Integrate the findings including the discourse interpretations and key concepts into the SIA report.

The final step of the ECA involved collating the results contained in the protocol and the discourse summaries into the SIA report. Chapter 7 contains the results.

### 3.2.5 Data limitations

Despite the amount and quality of community engagement and SIA data being adequate for the SIA, some data limitations have been identified. Changes to the mine plan due to new geological information resulted in a protracted SSD process. Consequently, correspondence and consultation with the community has been undertaken over a long period of time. Work toward gaining a new SSD approval for the mine originally began during 2015.

Not long into 2016, the environmental impact assessment process was put on hold while further geological drilling took place and the earlier mine plan was revised based on new knowledge on the extent and configuration of the limestone resource. During this time the community was advised, and the community program was appropriately wound down. The cessation of the SSD application process potentially reduced the volume of correspondence that may have been offered by the community during this time, should the program have continued to its then, logical end point. This scenario presents a data limitation.

The timing of the application for SSD approval alongside the release of the Guideline may have also influenced the data used for the SIA. As described earlier in this report, to strengthen the scoping of the SIA, the scoping tool (contained in the Guideline) was 'retrofit' using some of the outputs of the initial stakeholder engagement program. A small number of outputs from the initial program were not able to be carried through this process effectively, due to records being incomplete. In addition, the author of this report was not involved in the initial program and can rely only on the secondary data available, not on first-person experience and records which would potentially improve the data analysis.

To ensure an equitable community engagement program, after the further drilling program and revised mine plan development, the Project team was diligent in re-establishing contact with any stakeholders that provided feedback about the initial mine plan. Subsequently, contacts were re-established with all stakeholders. The Project team sought to 'close the loop' on any outstanding questions about the Project, and individual consultation sessions with fenceline and other neighbours were conducted for this reason. At the time of writing however, consultation in this fashion was yet to be completed with one fenceline neighbour as an appointment had not been possible. This presents a minor data limitation. The Project team will continue to pursue a time to consult with the resident.

Finally, the revised mine planning process and the 're-start' of the community engagement program may be responsible for a reduced level of interest in the further engagement program. For example, stakeholder groups including the Pejar LALC, did not respond to Boral's proactive attempts to obtain their input into the SSD. This is despite the repeated attempts to seek stakeholder opinions and the well-publicised nature of the SSD. Data used in the SIA would have been stronger if these scenarios did not eventuate.

# 4 SCOPING EXERCISE OUTCOMES

## 4.1 Area of Social Influence

The ASI proposed for the Project is illustrated in **Figure 5**. The area is comprised of a polygon containing the Project site, the nearest communities including Goulburn, residential and business properties along Glymar Road, Tangryang Road, and Long Point Road in the cleared area across the Gorge, and Bungonia Lookdown from where a large extent of the Project is visible. Being transport corridors with obvious links to social issues, haulage routes are also included in the ASI as linear areas. The haulage routes are via road (i.e. from site to Hume Highway along Marulan South Road), and rail (from site to interchange at Medway Junction where spur line meets main railway). There are no remote locations considered to be indirectly impacted.

### 4.1.1 Rationale for selecting the ASI

The beginnings of the mine date back as far as 1869 when the first mining activities took place in the location. Boral purchased the mine in 1987 and has developed strong connections with communities across the region and their employees. Their long-term employees are familiar with the extent and influence of the Projects operations. Boral management staff were therefore the logical source of information to be used for the ASI development. Semi-structured interviews were conducted with two management staff to obtain this information. A summary of the interviews is contained in **Table 9**.

Historical correspondence records maintained by Boral provide evidence of complaints or issues raised by nearby residents and/or business owners. The Environmental Complaints Register maintained by Boral is one such source. The locations of the incidents (or incidents that led to complaints) were recorded in this document and provide a cue to the ASI associated with the current Project operations. The Project would likely maintain and potentially expand the ASI. Accordingly, the addresses that emerged from the records were included in the ASI. These were Marulan South Road and Glynmar Road.

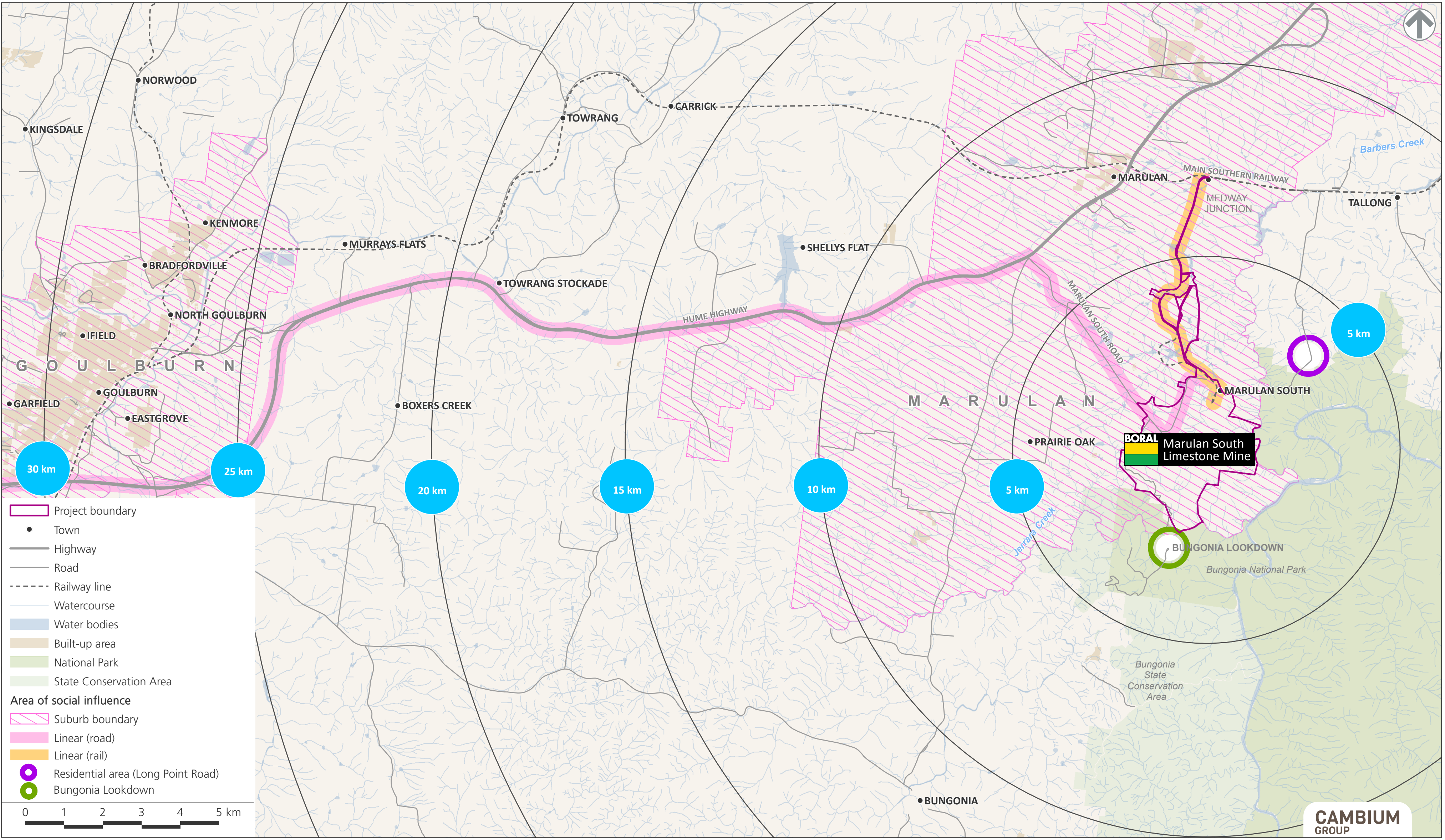
Traffic and haulage routes (road and rail) to be used by the Project were considered during the ASI development. It is anticipated that most social impacts related to traffic will be experienced along the primary road haulage route, the Marulan South Road from its connection to the Hume Highway. So this route was an obvious inclusion in the ASI. The rail network is less relevant to the ASI. Boral staff advised that the Project will create only one extra train per day. If at all present, rail haulage impacts would be most prominent along the rail line from the Project to interchange at Medway Junction where the spur line meets Main Southern Railway. This part of the network was included in the ASI.

Aside from the Project history and traffic routes, Boral staff were prompted to comment on the physical features of the Project site and its surrounds as part of the ASI development. Due to the natural undulating topography with elevated areas surrounding the site, the Project is accessible from a visual perspective. Staff highlighted the Bungonia Lookdown as a good example of a location where the Project is visible. Visitors are attracted to the nearby Bungonia National Park and gorges, and occasionally a link is drawn between the mine operations and influence on these natural areas. These observations influenced the broad nature of the ASI.

Figure 5

## Area of social influence

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
SOCIAL IMPACT ASSESSMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Element Environment (2019), Cambium Group (2019).

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**Table 9: Summary of interviews with Boral staff**

| ASI Factor discussed during interview | Feedback obtained |
|---|---|
| Supply chains | Continued operations at the site would require the procurement of supplies at local and regional scales. Minor increases in fuel and other supplies (e.g. maintenance supplies) would be most common. Boral's considerable expenditure with existing local businesses would continue. |
| Haulage of Limestone and transport of other goods | Marulan South Road from its connection to the Hume Highway to the Project, would continue to be the road transportation route for the Project. One extra train may be used per day during the Project. |
| Materials and equipment | No new equipment would be required for continued mining operations, however some new machinery would be required for construction. These items should have a minor influence on the extent of the ASI.<br>Where contractors are used at the mine, they use their own machinery which results in a positive commercial benefit to the contractors. |
| The movement of workers (drive-in-drive-out [DIDO] and fly-in-fly-out [FIFO] working arrangements | Staff are predominantly based in the local area, between 30-40 mins drive from site. Not many choose to live in Marulan. Most live in Goulburn (approximately 20 mins away). Some senior management live in the highlands. The Project does not employ long range DIDO and FIFO workers at present and there would be no requirement to do so in the foreseeable future. |
| Natural features and recreational values (e.g. Bungonia Lookdown) | Limestone belt caves are common in the area surrounding the mine. Heads of Shoalhaven river run into the Sydney Basin. Other natural features in the area include Morton National Park, Bungonia National Park, and water resources at the bottom of the gorge. Camping is popular in the area courtesy of the National Parks, as are outdoor recreation options, and lookouts (note: Bungonia Lookdown provides as visual perspective of the mine). |
| Ancillary infrastructure | The rail spur line is ancillary infrastructure associated with the Project. It should be included in the ASI from site up to the interchange at Medway Junction, where the spur line meets the main railway. |
| Reputation of other operations in area | Other prominent operations in the area are Bungonia quarry (Ardmore Park Quarry), Lynwood Quarry and Peppertree Quarry. Like other operations in the region, they receive both positive and negative feedback which affects their reputation. The region is renowned for extractive industries and the community is generally supportive. |

## 4.2 Key Stakeholders

Key stakeholders associated with the Project were identified by Boral at the start of the SSD process, during development of the stakeholder engagement program and scoping exercise analysis. **Figure 6** contains a matrix with the key Project stakeholders, and the engagement techniques applied to establish and foster a dialogue about the Project.

**Figure 6: Stakeholder engagement matrix (early engagement 2015-16)**

| | Basic | Letter (formal) | Email (formal/informal) | Phone briefing (informal) | In-Person Interactive | One-on-one meeting (formal) / Informal briefing / 'Door knock' | Site visit/inspection (individual/small group) | Formal presentation (key stakeholder/s) | Community meeting (general) | Community Liaison / Reference Group meeting | Panel discussion / workshop | Site Open Day / experience | Community drop-in sessions | Written | Information/fact sheet | Q&A | Community newsletter | Media | Editorial (media release / statement) | Editorial (media opportunity / photo) | Advertorial / advertising | Social media / online | Website / microsite |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fenceline Neighbours / Host Communities / Supported Community Organisations** | | | | | | | | | | | | | | | | | | | | | | | |
| Immediate boundary neighbours | | X | X | X | | X | | | | | | | X | | X | X | X | | X | | X | | X |
| Non-boundary Marulan Sth Road residents | | X | X | X | | X | | | | | | | X | | X | X | X | | X | | X | | X |
| Peppertree Quarry Community Consultative Committee | | X | X | X | | | | | | X | | | X | | X | X | X | | X | | X | | X |
| Marulan township and area residents / Tallong township and area residents | | | | | | | | | | | | | X | | X | X | X | | X | | X | | X |
| Residents in wider region - Goulburn / Mulwaree villages | | | | | | | | | | | | | X | | X | X | X | | X | | X | | X |
| HASP Project participants / individual community group members | | X | X | X | | | | X | | | | | X | | X | X | X | | X | | X | | X |
| Tallong Community Focus Group | | X | X | X | | | | X | | X | | | X | | X | X | X | | X | | X | | X |
| **Local Government** | | | | | | | | | | | | | | | | | | | | | | | |
| Goulburn Mulwaree Council - Mayor | | X | X | X | | X | X | X | | X | | | X | | X | X | X | | X | | X | | X |
| Goulburn Mulwaree Council - GM | | X | X | X | | X | X | X | | | | | X | | X | X | X | | X | | X | | X |
| Goulburn Mulwaree Council - Elected Councillors | | | | | | | X | X | | | | | X | | X | X | X | | X | | X | | X |

|  | Basic | Letter (formal) | Email (formal/informal) | Phone briefing (informal) | In-Person Interactive | One-on-one meeting (formal) / Informal briefing / 'Door knock' | Site visit/inspection (individual/small group) | Formal presentation (key stakeholder/s) | Community meeting (general) | Community Liaison / Reference Group meeting | Panel discussion / workshop | Site Open Day / experience | Community drop-in sessions | Written | Information/fact sheet | Q&A | Community newsletter | Media | Editorial (media release / statement) | Editorial (media opportunity / photo) | Advertorial / advertising | Social media / online | Website / microsite |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Goulburn Mulwaree Council - Dir Planning / Planning & Environment teams |  |  | X | X |  | X | X | X |  |  |  |  | X |  | X | X | X |  | X |  | X |  | X |
| Goulburn Mulwaree Council - Economic Development |  |  | X | X |  |  | X | X |  |  |  |  | X |  | X | X | X |  | X |  | X |  | X |
| **State and Federal Government** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NSW Member for Goulburn |  | X | X | X |  | X |  |  |  |  |  |  | X |  | X | X | X |  | X |  | X |  | X |
| Fed Member for Hume |  | X | X | X |  | X |  |  |  |  |  |  | X |  | X | X | X |  | X |  | X |  | X |
| **Govt Authorities** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NSW Dept of Planning & Environment |  | X | X | X |  | X | X | X |  |  |  |  |  |  | X | X | X |  | X |  | X |  | X |
| Environment Protection Authority (NSW) |  | X | X | X |  | X | X | X |  |  |  |  |  |  | X | X | X |  | X |  | X |  | X |
| National Parks & Wildlife Service (NSW) |  | X | X | X |  | X |  |  |  |  |  |  | X |  | X | X | X |  | X |  | X |  | X |
| Transport for NSW (RMS / Centre for Transport Planning) |  | X | X | X |  | X |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  | X |
| NSW Dept of Primary Industries |  | X | X | X |  | X |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  | X |
| Local Land Services NSW |  | X | X | X |  | X |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  | X |
| NSW Resources & Energy |  | X | X | X |  | X |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  | X |
| WaterNSW |  | X | X | X |  | X |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  | X |
| ARTC |  | X | X | X |  | X |  |  |  |  |  |  |  |  |  |  |  |  | X |  |  |  | X |

| | Basic | Letter (formal) | Email (formal/informal) | Phone briefing (informal) | In-Person Interactive | One-on-one meeting (formal) / Informal briefing / 'Door knock' | Site visit/inspection (individual/small group) | Formal presentation (key stakeholder/s) | Community meeting (general) | Community Liaison / Reference Group meeting | Panel discussion / workshop | Site Open Day / experience | Community drop-in sessions | Written | Information/fact sheet | Q&A | Community newsletter | Media | Editorial (media release / statement) | Editorial (media opportunity / photo) | Advertorial / advertising | Social media / online | Website / microsite |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NSW Dept of Industry | | X | X | X | | X | | | | | | | | | | | | | X | | | | X |
| **Media** | | | | | | | | | | | | | | | | | | | | | | | |
| Goulburn Post | | | X | X | | | | | | | | | | | X | X | | | X | X | X | | X |
| Discover Marulan e-newsletter | | | X | X | | | | | | | | | | | X | X | X | | X | X | | | X |
| 2GN/Eagle FM | | | X | X | | | | | | | | | | | X | X | | | X | | | | X |
| **Interest / Activist Groups** | | | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | | | |
| **Environment / Heritage Groups** | | | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | | | |
| **Business Groups** | | | | | | | | | | | | | | | | | | | | | | | |
| Marulan Chamber of Commerce | | X | X | X | | | | X | | | | | X | | X | X | X | | X | | X | | X |
| Cement Industry Federation | | X | | | | | | | | | | | | | X | X | | | X | | | | X |
| Concrete Cement Aggregates Australia (NSW) | | X | | | | | | | | | | | | | X | X | | | X | | | | X |
| **Indigenous Groups** | | | | | | | | | | | | | | | | | | | | | | | |
| Pejar Local Aboriginal Land Council | | X | | | | | | | | | | | | | | | | | X | X | X | | X |
| **Customers/Contractors/Lessees** | | | | | | | | | | | | | | | | | | | | | | | |
| Aglime | | X | X | X | | X | | | | | | | X | | X | X | X | | X | | X | | X |
| Omya | | | X | X | | | | | | | | | | | X | X | | | X | | | | X |
| BlueScope Steel | | | X | X | | | | | | | | | | | X | X | | | X | | | | X |

|  | Basic | Letter (formal) | Email (formal/informal) | Phone briefing (informal) | In-Person Interactive | One-on-one meeting (formal) / Informal briefing / 'Door knock' | Site visit/inspection (individual/small group) | Formal presentation (key stakeholder/s) | Community meeting (general) | Community Liaison / Reference Group meeting | Panel discussion / workshop | Site Open Day / experience | Community drop-in sessions | Written | Information/fact sheet | Q&A | Community newsletter | Media | Editorial (media release / statement) | Editorial (media opportunity / photo) | Advertorial / advertising | Social media / online | Website / microsite |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boral Berrima Cement |  |  | X | X |  |  |  |  |  |  |  |  |  |  | X | X |  |  | X |  |  |  | X |
| Key non-competitor customers (via Sales/Marketing) |  |  | X | X |  |  |  |  |  |  |  |  |  |  | X | X |  |  | X |  |  |  | X |
| **Essential Community Services** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| School bus service accessing Marulan Sth Road |  | X | X | X |  | X |  |  |  |  |  |  | X |  | X | X | X |  | X |  | X |  | X |

## 4.3 Early engagement results

The early engagement activities conducted by the Project team enabled stakeholders to provide feedback about the Project. The feedback was relevant to the SIA scoping phase and was used to consider what social impacts might warrant investigation. The results of the early engagement activities are outlined below, listed by the type of activity. Only the activities which generated stakeholder feedback are discussed.

### Community workshop

As described in the methods chapter, a community workshop was held at the mine administration offices on 22 July 2015 to present the original mine plan. A total of 11 people (other than the Project team members) attended the community workshop. Nine issues were verbally raised by attendees at the workshop, and a further one issue was raised in writing via a feedback form at the conclusion of the workshop. These issues are outlined in **Table 10**, Following the session, the Project team provided responses to issues raised by attendees based on the knowledge of the Project, and accompanying specialist studies, that were available at the time.

**Table 10: Issues verbally raised by community workshop attendees**

| Issue number | Feedback/question raised in the first community workshop |
|---|---|
| ***Verbal feedback*** | |
| 1) | Will the continued operations of the mine result in increased traffic volumes on Marulan South Road? |
| 2) | Has the Gunlake Quarry and Lynwood Quarry traffic been taken into consideration in the traffic assessment of the Marulan South Road – Hume Highway intersection? |
| 3) | Marulan South Road requires upgrading and any future upgrades should include the driveways of residents. |
| 4) | Will an increase in traffic volumes impact the safety of road users? |
| 5) | The speed limit on Marulan South Road should be reduced to 60-70 km/h. |
| 6) | What is the potential impact that continued mining operations could have on property values in the vicinity? Are there any examples from other projects on how much property values may be affected in proximity to a mine? |
| 7) | When easterly winds blow (mainly during the summer months) there are occasional dust fallouts on a neighbouring farm that affect the condition of a zinc shed on the property. |
| 8) | Resident (living on Long Point Road in a north-east direction from the Project) observed low frequency noise associated with the mine operations, also night time noise impacts, and cumulative noise impacts associated with Peppertree Quarry. |
| 9) | Peppertree Quarry is the main source of visible night light (glow). Is the limestone mine going to increase their lighting over time, making the mine more visible at night. |
| ***Written feedback*** | |
| 10) | Expression of gratitude to the Project team for conducting the workshop, and statement that excessive demands were being placed on the Project team by some workshop attendees. Resident was pleased with the plans and considerations that Boral had developed for the mine. |

### Email and phone briefings

During the early engagement program, email correspondence occurred between the Project team and stakeholders. Two conversations occurred. The first involved a relative of a family that lived nearby to the Project site. The issue raised was the effect of the Project on the value of the family property. The second was from a fenceline neighbour who voiced concern about noise impacts experienced at the residence.

### One-on-one meetings

Subsequent to the email and phone conversations outlined above, members of the Project team met separately with each resident. Regarding the property value issue, the concerns of the resident were discussed and considered in person however no action was deemed necessary or plausible. Regarding the noise issue, historic noise monitoring data was discussed with the resident. Noise monitoring was also conducted at the property.

### Marulan Region Chamber of Commerce meeting

During the 2015 meeting to present the original mine plan, the Project team delivered a presentation to the committee members in attendance. The presentation focussed on the key aspects of the Project. Following the presentation, the Project team invited questions and feedback from the members. The feedback included:

- traffic: questions raised and answered about extra traffic volumes on Marulan South Road, volume of material transported from Peppertree Quarry; and
- visual amenity: a query about the visual appearance of rehabilitation of the south pit overburden emplacements.

### GMC meeting

The meeting with Council held in January 2015 involved a presentation from the Project team to the Goulburn Mulwaree Council Mayor and General manager. The presentation focussed on the key aspects of the SSD. Council representatives indicated support and provided the following feedback in relation to the SSD:

- Council has an interest obtaining ongoing financial contributions for the maintenance of Marulan South Road, and ensuring appropriate upgrades are undertaken;
- community contributions separate of any operations-related levies would be preferred; and
- Council would support the northward extension of the western overburden emplacement across the current Marulan South Road, and the realignment of the road to the north.

### Consultation with government agencies

Various government agencies were consulted about the Project subsequent to receiving SEARs. The consultation concerned procedural matters or clarification about the SEARs. Nothing was raised in this consultation that required specific feedback relevant to the SIA.

## 4.4 Scoping tool results

As outlined in the methods chapter, the early engagement results presented above were used as scoping tool inputs (and therefore assigned a relevant ‘social matter’ for the purpose of the scoping tool). The scoping tool informed the level of assessment and engagement required in the EIS preparation phase. The early engagement topics and stakeholder feedback are presented in **Table 11** alongside their relevant social impact category per Section 1.1 of the Guideline (refer Appendix A), and detail about which social matter will be the subject of a specialist study in the EIS.

Whilst the full range of social impact categories outlined in Section 1.1 of the Guideline were considered during the scoping phase, three (i.e. Community, Culture[2], and Decision Making Systems) were not recognised in the scoping tool outputs as having potential to cause a social

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[2] A site at the mine has been the subject of an Aboriginal Cultural Assessment, conducted by a cultural heritage specialist (Waters Consultancy, 2017). The assessment has obvious relevance to the ‘Culture’ social impact category, however further assessment of the site or the prescribed management measures are beyond the scope of this SIA.

impact. In each case, there was no suggestion in the information offered by stakeholders, that any aspect of these social impact categories would be influenced by the Project. When speculating about the reasons for this, the history of mining in the Marulan South area and the local employment opportunities it has provided over many years, warrant some commentary. Dubber (Goulburn Post - Marulan's mining heritage, 2013) emphasised that for over 180 years, the area around Marulan has been home to mining companies that together employ hundreds of people. The significance of this is described in two of the regions key strategic documents being the Southern Tablelands Regional Economic Development Strategy, and the Goulburn Mulwaree Strategy 2020:

*"Relative to the rest of NSW, the Southern Tablelands has a core advantage in non-metallic Mineral Mining and Quarrying. On the ground this manifests itself as a large construction material quarrying sector based in the Goulburn LGA at Marulan. The sector creates employment and economic activity in the Region, is vital for Sydney's ongoing growth and has scope for expansion"* (AgEcon Plus, 2018, p. 12).

*"Key employment activities include several existing and proposed industrial activities, such as the Lynwood Quarry and the Marulan Waste Management Facility, and a number of industries located within the industrial zone. Marulan provides an important employment base for the local government area and will be of key importance to the future growth of Goulburn Mulwaree particularly within the mining and industry sectors"* (Parsons Brinckerhoff, 2006, p. 5).

Therefore, it may be that extractive industries are generally accepted as part of the social fabric (i.e. Community, Culture, and Decision Making Systems) in the region due to their long presence, and as industries that provide some socio-economic comfort in terms of long-term employment opportunity. Although not identified in early engagement feedback and therefore the scoping tool as social impacts requiring assessment, the positive social impacts that the SSD will provide in terms of employment and business opportunity should be given attention in the SIA, as potential 'Way of Life' improvements. They were therefore added as an outcome of the scoping exercise and will be assessed, along with access to properties (refer **Table 11**).

**Table 11: Scoping tool outcomes**

| Early engagement topic and stakeholder feedback (scoping tool input) | Social impact category (Guideline section 1.1) | Will a specialist study be conducted for the EIS? | Level of assessment for the social impact (scoping tool output) | SIA method(s) implemented for the assessment |
|---|---|---|---|---|
| **Acoustic**<br>Resident (living on Long Point Road in a north-east direction from the Project) observed low frequency noise associated with the mine operations, also night time noise impacts, and cumulative noise impacts associated with Peppertree Quarry. | Health and wellbeing | Yes | Desktop SIA | Consultation with residents |
| **Visual**<br>Resident raised question about light spill from new operations, and cumulative impacts associated with Peppertree Quarry light spill.<br>Marulan Region Chamber of Commerce query about the visual appearance of | Surroundings | Yes | Standard SIA | VIA<br>Consultation with residents |

| Early engagement topic and stakeholder feedback (scoping tool input) | Social impact category (Guideline section 1.1) | Will a specialist study be conducted for the EIS? | Level of assessment for the social impact (scoping tool output) | SIA method(s) implemented for the assessment |
|---|---|---|---|---|
| the rehabilitation of the south pit overburden emplacement from Bungonia National Park. | | | | |
| **Dust**<br>When easterlies blow (mainly during the summer months) there are occasional dust fallouts on a neighbouring farm that affected the condition of a zinc shed on the property. | Personal and property rights | Yes | Desktop SIA | ECA<br>Consultation with residents |
| **Access to property**<br>Marulan South Road requires upgrading and any future upgrades should include the driveways of residents. | Personal and property rights | No | No SIA required | Interview |
| **Road and rail network / Public Infrastructure**<br>Resident concerned about traffic impacts between the Project and Hume Highway along Marulan South Road.<br>Resident concerned the continued operations of the mine will result in increased traffic volumes on Marulan South Road.<br>Questions raised by Council and Maurlan Region Chamber of Commerce about traffic volumes on Marulan South Road. | Access to and use of infrastructure, services and facilities | Yes | Standard SIA | ECA<br>Interview |
| **Safety**<br>Will an increase in traffic volumes impact the safety of road users?<br>Request for speed limit reduction on Marulan South Road. | Fears and aspirations | Yes | Standard SIA | Interview<br>HIA |
| **Livelihood**<br>Impacts of the continued operations of the mine on nearby property values was queried.<br>The provision of employment opportunities to the regional population. | Way of life | Yes | Standard SIA | HIA |

# 5 FURTHER ENGAGEMENT OUTCOMES

During 2018, the Project team conducted further stakeholder engagement via the range of stakeholder engagement methods outlined in the methodology chapter. The engagement activities emphasised and sought feedback about the revised mine plan. During this process the Project team were conscious of the early engagement results, and ensured each stakeholder who originally provided feedback was again invited to provide feedback on the revised mine plan. **Table 12** contains the results of the further engagement program. For the benefit of the reader, only the engagement activities that enabled a two-way dialogue are listed below. Accordingly, the full collection of further engagement activities listed in the methodology chapter are not duplicated in the table.

**Table 12: results of the further engagement activities**

| Engagement activity | Feedback/question received by Project team |
|---|---|
| Door knock (briefing) – private premises within footprint of Marulan South Operations. Five interviews conducted, contact cards left at non-attended premises | 1) There is a dust fallout from the mine. It settles on vehicles and buildings, and is corrosive.<br>2) Supportive of the Project.<br>3) Proposed alignment of section of Marulan South Road will put headlights of vehicles in line with anticipated location of new dwelling (yet to be built). Requested visual bunding/barrier to address this.<br>4) Concerned about the prospect of heavy vehicles using air brakes outside of normal business hours. Indicated previous incidences of this nature appear to have involved contractor vehicles (i.e. not Boral branded).<br>5) Need to ‘level out’ road undulations on Marulan South Road and improve private accesses as part of the road upgrade. Discussed headlight spill screening options for residential property. |
| Staff briefing (toolbox talk) | Interest shown by employees about longer term future of the mine and longevity of employment. |
| Website update | Nil feedback about the mine was received via the website company email address. |
| Email (formal) to all stakeholders on the Project mailing list | Nil email responses received. |
| Community drop-in sessions | Seven people attended each of the community drop-in sessions (i.e. 14 people in total). There was genuine interest in the Project shown by all attendees. The following feedback was provided by attendees:<br>1) resident raised the potential for headlight spill from vehicles travelling on the re-aligned section of Marulan South Road to the residence;<br>2) resident request for undulations in the road to be rectified when the upgrades are carried out;<br>3) Marulan South Road business owner queried the capacity of the road to absorb the extra road volumes proposed in the SSD;<br>4) marulan south road business owner raised concern that the SSD application for additional road tonnage could threaten the revenue potential of the business;<br>5) request raised by Marulan South Road resident to reduce the truck speed limit on the road to 60 km/h; and<br>6) request for vegetation to be retained during Marulan South Road re-alignment, to act as visual screening (i.e. vehicle headlight spill mitigation). |
| Peppertree Community Consultative Committee meeting | No specific feedback provided. |
| Marulan Region Chamber of Commerce meeting | Member raised question about Marulan South Road traffic changes proposed in the SSD, and how the community drop-in sessions were received. |

| Engagement activity | Feedback/question received by Project team |
|---|---|
| Facebook campaign | At 31 October 2018, the Facebook post (refer Appendix B) had attracted 95 'likes' and one 'reaction'. It had been shared six times and attracted five comments (one positive, three neutral, and one 'tag'). Predictive post reach at 24 September 2018 was 2700 users at an engagement rate of 13 percent. |
| Meeting with GMC | 1) 11 September 2018: Council expressed interest in Boral carrying out the road upgrades, instead of Council per their initial preference. No other specific feedback provided.<br>2) 20 November 2018: Seven councillors in attendance. Councillors raised questions about design elements of the dam, and the expected timing of the start of road upgrade work on Marulan South Road. |
| Community newsletter sheet - emailed to neighbours, Project mailing list, and the Peppertree Quarry Community Consultative Committee. | Nil specific feedback received. |
| Letters (formal) – sent to NSW MP for Goulburn; Federal MP for Hume; Pejar LALC | Nil specific feedback received. |
| Site visit (GMC planning representatives) | Nil specific feedback received. |
| Consultation with fenceline and nearby neighbours | 1) Resident raised concern about the potential for future development north of Peppertree Quarry, and associated visual impacts.<br>2) Resident suggested the Project team consider using Marulan Creek Road for haulage instead of the proposed route along an upgraded Marulan South Road.<br>3) Long Point Road resident reviewed results of noise monitoring conducted at the residence. Raised questions about the methodology and efficacy of monitoring during periods of equipment inactivity on site.<br>4) Following the community drop-in session, a Marulan South Road business owner was concerned that the proposed additional road transportation volumes meant Boral was intending to cease the supply of raw materials to their business. The business is 100% reliant on the mine for that supply. Although the business owner has a commercial agreement with Boral to supply raw materials, the consultation revealed the business owner's perception that an increased road tonnage would threaten that agreement. Boral committed to meeting both Principals of the company to address that concern and dispel the perception. |

At the completion of the further engagement activities, the Project team possessed a thorough collection of feedback and questions raised by stakeholders. This collection was obtained from both the scoping engagement and further engagement activities. At this point in time the full collection of results was considered, and a decision was made about the SIA methods to be implemented for the study. It was evident that the feedback and questions raised during the early engagement activities, closely aligned with those raised in the equivalent 2018 activities. **Table 13** summarises the collection of stakeholder feedback and reflects the decisions made in regard to the SIA methods.

Table 13: The collection of stakeholder feedback and the SIA method selected for the study

| Engagement topic and stakeholder feedback | Social impact category (Guideline section 1.1) | Will a specialist study be conducted for the EIS? | Level of Assessment for the social impact (scoping tool output) | SIA method(s) to be implemented for the assessment |
|---|---|---|---|---|
| **Acoustic**<br>Low frequency, night time, and cumulative noise impacts<br>Methodology and efficacy of monitoring<br>Use of truck air brakes outside of normal business hours | Health and wellbeing | Yes | Desktop SIA | Consultation with residents |
| **Visual**<br>Bungonia Lookdown provides a visual perspective of the mine<br>Lightspill from continued operations and cumulative impacts associated with Peppertree Quarry<br>Appearance of the rehabilitated south pit overburden emplacements<br>Headlight spill from vehicles using Marulan South Road<br>Retention of vegetation for screening on Marulan South Road during re-alignment and upgrade | Surroundings | Yes | Standard SIA | VIA<br>Consultation with residents |
| **Dust**<br>Dust fallout and impacts to private assets | Personal and property rights | Yes | Desktop SIA | ECA<br>Consultation with residents |
| **Access to property**<br>Improve private driveway accesses as part of the Marulan South Road upgrade | Personal and property rights | No | No SIA required | Interview |
| **Road and rail network / Public Infrastructure**<br>Traffic impacts between the Project and Hume Highway along Marulan South Road<br>Traffic changes and increased traffic volumes on Marulan South Road<br>Need to 'level out' road undulations on Marulan South Road during road upgrade<br>Use Marulan Creek Road for haulage instead of the proposed route along an upgraded Marulan South Road | Access to and use of infrastructure, services and facilities | Yes | Standard SIA | ECA<br>Interview |

| Engagement topic and stakeholder feedback | Social impact category (Guideline section 1.1) | Will a specialist study be conducted for the EIS? | Level of Assessment for the social impact (scoping tool output) | SIA method(s) to be implemented for the assessment |
|---|---|---|---|---|
| **Safety**<br>Will an increase in traffic volumes impact the safety of road users?<br>Reduce truck speed to 60 km/h on Marulan South Road | Fears and aspirations | Yes | Standard SIA | Interview<br>HIA |
| **Livelihood**<br>Impacts of the continued operations of the mine on nearby property values was queried<br>The provision of employment opportunities to the regional population<br>The proposed additional road transportation volumes suggest that Boral intends to cease supply to one of the neighbouring businesses | Way of life | Yes | Standard SIA<br>Standard SIA<br>Comprehensive SIA | HIA |

# 6 EXISTING SOCIAL BASELINE

This chapter presents the social baseline for the Project. The baseline is the nominated set of social indicators for communities potentially affected by the Project. It provides a point of comparison – it can be used as reference data against which to measure the impacts of the project as it develops, and/or to determine the adequacy or otherwise of existing facilities (Vanclay, 2015). All data used in the baseline is derived from the 2016 Australian Census of Population and Housing (Australian Bureau of Statistics, 2018) unless an alternate source is cited.

The unit of analysis for the regional context is the Southern Tablelands region, as defined by two of the key strategic documents developed by the relevant authorities (refer Tablelands Councils, 2016, and AgEcon Plus, 2018). In these documents the region consists of the three LGAs; Goulburn Mulwaree Council, Upper Lachlan Shire Council, and Yass Valley. The equivalent for the local context is the State Suburb (SSC) geography, as defined by the census. A comparison to NSW data is provided where possible.

## 6.1 Regional context

Goulburn City exists as the strategic capital of the Southern Tablelands. It is Australia’s earliest established inland city which today offers contemporary services, modern assets, strong arts, an emerging entertainment scene, and economic opportunities. Yass Valley and Lachlan Shire LGAs are synonymous with the productive rural lands and rural residential areas in the region. As a whole, the region has strong links to Canberra and Sydney (including the road and rail access), extractive and mineral resources, lifestyle advantages, and historic heritage and villages. The region supports rural lifestyles for many seeking a lifestyle change. Crookwell for example is becoming a popular destination for retirees and people wishing to leave large cities (Tablelands Councils, 2016).

The region boasts thriving agricultural industries which contribute to employment and tourism. For example, NSW Department of Planning and Environment (2017) identify a range of diversified rural products and emerging agricultural industries in the region which include wine, alpaca studs, olives and berries in the Yass Valley LGA alone. Agricultural assets in the neighbouring Upper Lachlan Shire LGA include fine wool and potato production. Whilst the agricultural endowments in the region are substantial, extractive industries must also be emphasised. The “hard rock and limestone extraction at Marulan and the region’s only bioreactor at Tarago contribute to local and national construction markets” (NSW Department of Planning and Environment, 2017, p.61).

In 2016, the Southern Tablelands region was home to 53,446 people, with 29,609 residing in the Goulburn Mulwaree LGA, 16,142 residing in the Yass Valley LGA and 7,695 residing in the Upper Lachlan Shire LGA. People who work in the region typically live in the region as 89% of the jobs in these three LGAs are held by residents. Almost a third of the employed labour force residing in the region commutes to a work location outside it however, principally to the ACT. The region has a higher proportion of people in the younger aged groups (under 15 years) and 40-54 years cohort, and a lower proportion in the 20-34 age group and over 60 years of age. **Table 14** conveys a sex and median age breakdown of the regional population in comparison to the NSW population.

**Table 14: Sex and age data: Southern Tablelands compared to NSW**

| Council Area | Proportion of males | Proportion of females | Median age |
|---|---|---|---|
| Goulburn Mulwaree | 50.6% | 49.4% | 42 |
| Upper Lachlan Shire | 49.5% | 50.5% | 48 |
| Yass Valley | 50.2% | 49.8% | 41 |
| NSW | 49.3% | 50.7% | 38 |

*Source: Tablelands Councils, 2016)*

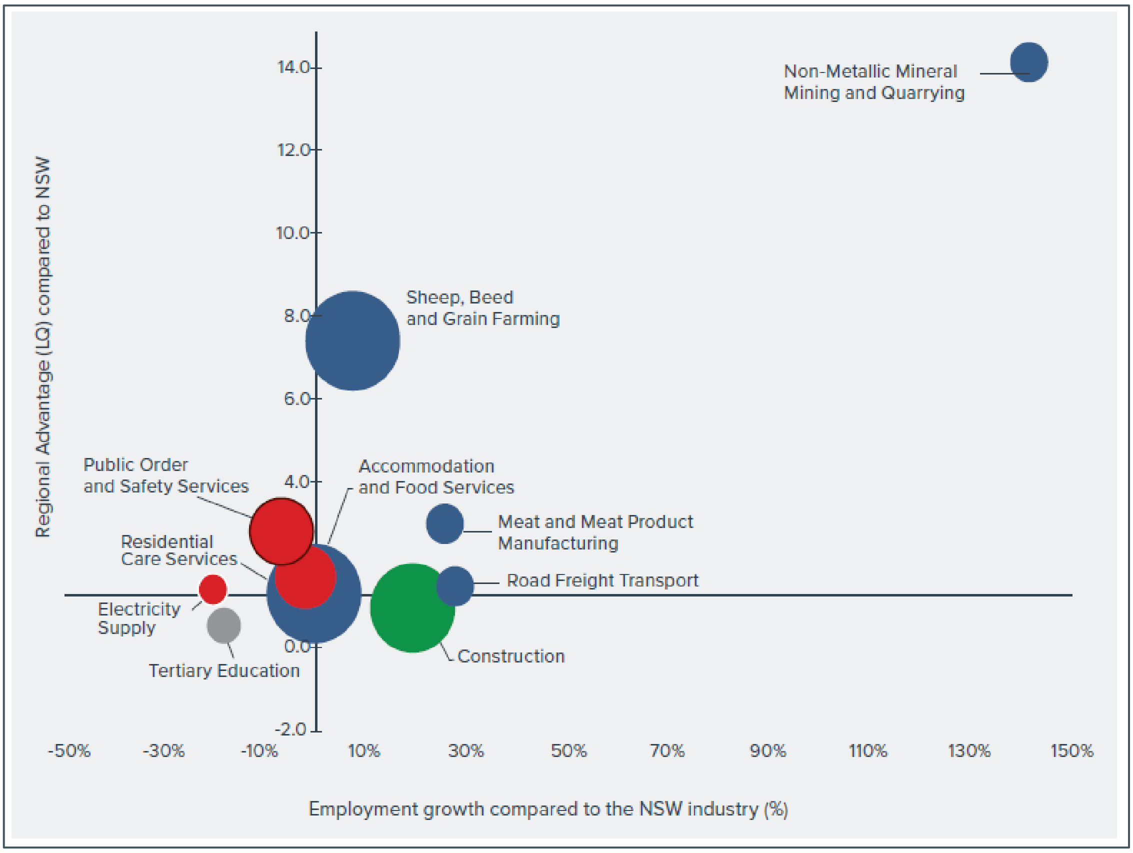
Census data illustrates diversity in the regional population. Similar to the trend across NSW, the region experienced proportional growth of Aboriginal and Torres Strait Islander populations over the 5 years from 2006-2011. Of the non-Australian born population, the most common places of birth are the United Kingdom, New Zealand, Germany and the Netherlands.

In terms of unemployment, rates in 2016 were similar to or lower than the NSW rate of 4.9% unemployment. In particular, Yass Valley's unemployment rate was measured to be 1.7%, the third lowest in the whole of NSW. The industries that support employment in the region have been agriculture, forestry and fishing, health care and social assistance, and retail trade. A more detailed analysis of the region in terms of its competitive industrial advantages is provided by AgEcon Plus (2018). Its Location Quotients (LQ) analysis (see **Figure 7**) provides an understanding of the region's competitive advantages. It does so by measuring the employment concentration in industry sectors within the economy, compared with the same sectors across the NSW economy.

In relation to the LQ data displayed in **Figure 7**, AgEcon Plus (2018, p.9) explain that:

- industries with a larger 'bubble' employed more people;
- industries further above the horizontal line are more specialised when compared to NSW (i.e. an LQ greater than 1.25), industries below the line are less specialised when compared to NSW;
- industries to the right of the vertical line grew faster between 2011 and 2016 than comparable industries across NSW, industries on the left grew more slowly; and
- sectors with an employment specialisation are coloured blue and red, whilst specialisation sectors, or potentially emerging specialisations, are coloured green.

**Figure 7: Southern Tablelands Location Quotients (LQ) analysis (AgEcon Plus, 2018)**



A selection of the results for the Southern Tablelands indicate that:

- sheep, Beef Cattle and Grain Farming is a large sector in the region, employing 8.6% of the workforce. It is also an industry in which the region specialises when compared to the rest of NSW;
- accommodation and Food Services (indicative of tourism), Public Order and Safety, and Residential Care Service experienced employment growth less than the average growth of these sectors across the NSW economy;
- construction is another of the region's large sectors, employing around 7.3% of the workforce in 2016. However, the region does not have a specialisation in this sector; and
- non-Metallic Mineral Mining and Quarrying is an outlier. It exhibited a very high level of specialisation (LQ of 14.4). It is also a capital-intensive sector that provided 1.1% of employment in the region in 2016, and exhibited very strong growth relative to NSW.

## 6.2 Existing population (local context)

### 6.2.1 Local government

The mine is located in the Southern Tablelands of NSW, and within the GMC Local Government Area (LGA). This area is situated adjacent to the Hume Highway and the South Tablelands Railway Line.

### 6.2.2 Community profile

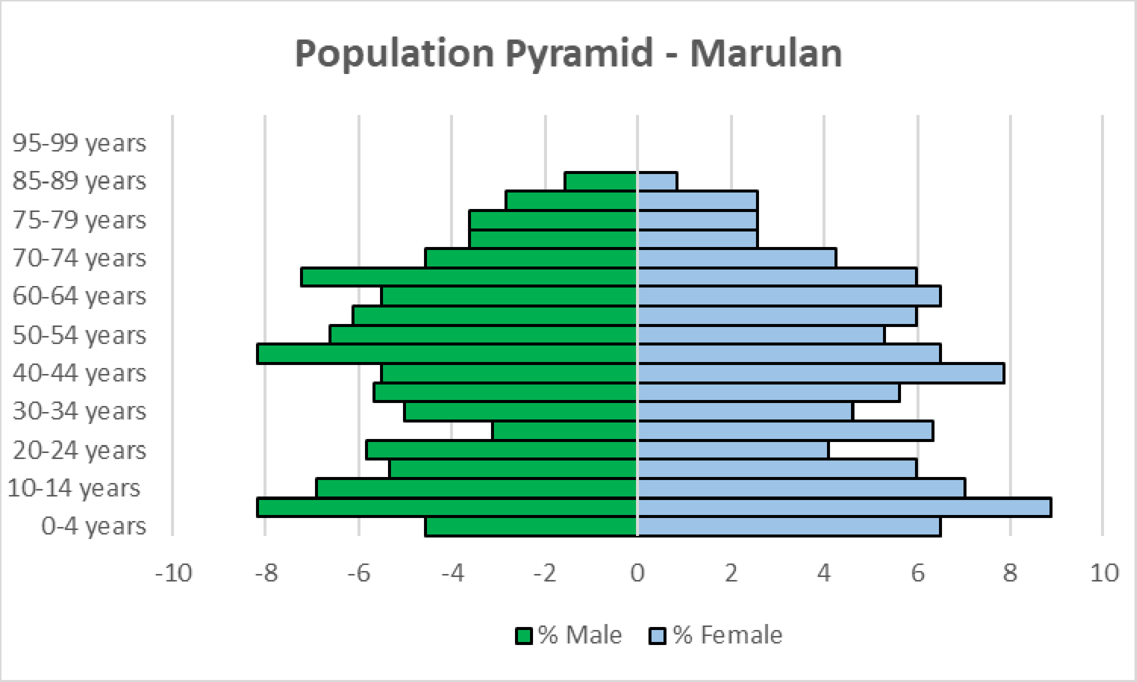
Socio-economic data from the census provides a snapshot of the population profile in the local area. **Table 15** provides a summary of socio-economic indicators for the area. It indicates that Marulan correlates strongly with the general statistics for NSW. Deviation occurs primarily in lower median weekly household income and mortgage repayments in comparison to NSW.

**Table 15: Socio-economic indicators**

| Socio-economic indicator | Marulan | NSW |
|---|---|---|
| Male | 51.5% | 49.3% |
| Female | 48.5% | 50.7% |
| Median age | 41 | 38 |
| Average children per family for families with children | 2.0 | 1.9 |
| Average people per household | 2.6 | 2.6 |
| Median weekly household income | $1,143.00 | $1,486.00 |
| Median monthly mortgage repayments | $1,517.00 | $1,986.00 |
| Median weekly rent | $280.00 | $380.00 |
| Average motor vehicles per dwelling | 2.1 | 1.7 |

The population pyramid in **Figure 8** illustrates the age and sex composition of the Marulan population. It indicates a reduction in the population (both male and female) from 5-9 years old and 20-24 years old, likely to be outward migration. The opposite is true from the ages 25-29 years old and 49-50 years old.

Figure 8: Marulan population pyramid (age vs sex)



## 6.2.3 Population projections

Population projections produced by DPE, estimate that the GMC area could have a population of 37,202 by 2036. The census established that the 2016 population (30,156) is estimated to climb to 32,167 in 2021, 32,863 in 2026, 35,567 in 2031 and 37,202 in 2036.

## 6.2.4 Mobility

In Marulan, on the day of the census, the most common methods of travel to work (**Table 16**) for employed people were by car (as the driver; 66.7%), as passenger in a car (6.4%) and includes 5.4% of the population working from home. The statistic of private use of motor vehicles correlates with the fact that there was an average of 2.1 cars per household. Other modes of transport included walking only (4.1%) and truck (3.5%). Less than 1% of employed people used public transport (train, bus, ferry, tram/light rail) as at least one of their methods of travel to work, and 73.6% used car (either as driver or as passenger).

Table 16: Mode of travel to work

| Travel to Work | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Car (as driver) | 332 | 66.7 | 1,953,399 | 57.8 |
| Car (as passenger) | 31 | 6.4 | 144,820 | 4.3 |
| Worked at home | 26 | 5.4 | 163,026 | 4.8 |
| Walked only | 20 | 4.1 | 130,957 | 3.9 |
| Truck | 17 | 3.5 | 32,908 | 1.0 |
| People who travelled to work by public transport | 4 | 0.8 | 540,215 | 16 |
| People who travelled to work by car as driver or passenger | 359 | 73.6 | 2,182,854 | 64.6 |

## 6.2.5 Family composition

Of the families in Marulan, 39.1% were couple families with children, 45.1% were couple families without children and 15.8% were one parent families (**Table 17**).

**Table 17: Family composition**

| Family Composition | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Couple family without children | 143 | 45.1 | 709,524 | 36.6 |
| Couple family with children | 124 | 39.1 | 887,358 | 45.7 |
| One parent family | 50 | 15.8 | 310,906 | 16.0 |
| Other family | 0 | 0.0 | 32,438 | 1.7 |

Unpacking the family composition of Marulan further, 34.0% of single parents were male and 66.0% were female (**Table 18**). This aspect has been discussed further in Section 6.2.6 below.

**Table 18: Single Parents**

| Single (or lone) Parents | Marulan (%) | NSW (%) |
|---|---|---|
| Male | 34 | 17.8 |
| Female | 66 | 82.2 |

## 6.2.6 Indigenous Population

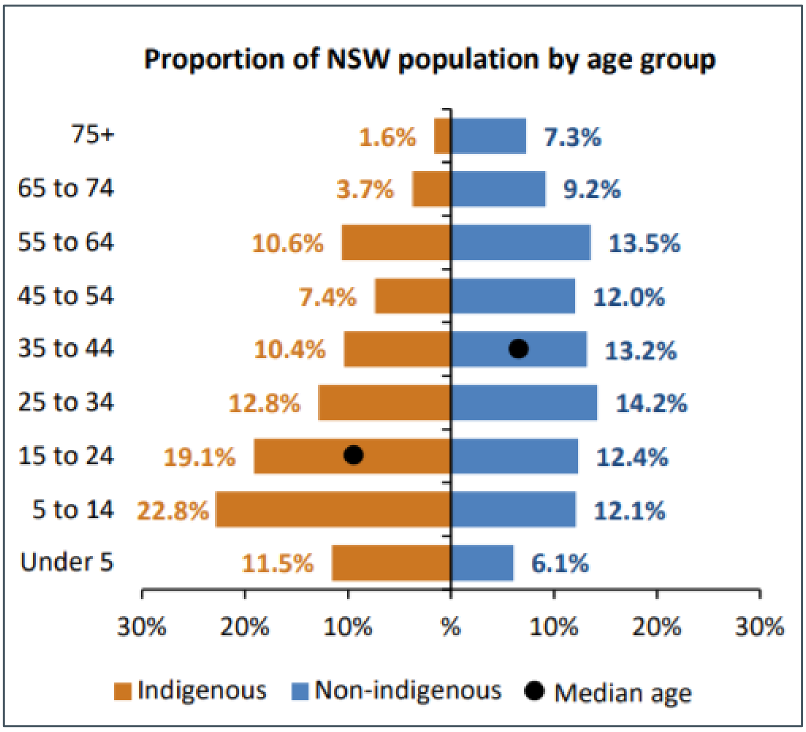
As a marginalised social group nationally, it is important to provide insight into the Aboriginal and Torres Strait Islander population of the Marulan area. The 2016 Census data (Australian Bureau of Statistics, 2018) illustrated that Indigenous people comprise approximately 3.9% of the Marulan population. Interestingly, the majority of this population is female (63%) with a comparatively low median age of 14 (**Table 19**).

**Table 19: Characteristics of the Marulan Aboriginal and Torres Strait Islander population**

| Aboriginal and Torres Strait Islander People Characteristics | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Male | 17 | 37.0% | 107,368 | 49.6% |
| Female | 29 | 63.0% | 108,809 | 50.4% |
| Median age | 14 | - | 22 | - |

The NSW Indigenous community has a much younger age profile than the non-Indigenous profile, with 53% of the Indigenous population being under the age of 25. The NSW Parliamentary Research Service provided an assessment of the Indigenous community, based on the 2016 Census data. This report was published in March 2018 and confirms that the median age (14 year old) of the Marulan Indigenous population correlates with the population profile of this community in NSW (**Figure 9**).

Figure 9: Proportion of the NSW Indigenous population by age group



With regard to sex, the 2016 Census recorded 108,811 females (50.3%), and 107,365 males (49.7%) of Indigenous ancestry in NSW. The NSW Parliamentary Service noted that there are regions with higher female populations in comparison to males, but the structure of the Marulan community profile is likely to be the result of single parent families. It has been established that 70.1% of Indigenous single parent families had children under the age of 15 years. Like the non-Indigenous population, most of single parents in NSW are women (**Table 20**).

Table 20: Single parents in NSW by sex

| NSW Single parents by Sex | Indigenous | | Non-Indigenous | |
|---|---|---|---|---|
| | Total | Percentage | Total | Percentage |
| Male | 2,446 | 14% | 52,250 | 18% |
| Female | 15,068 | 86% | 238,576 | 82% |

## 6.2.7 Education, employment and training

Of people aged 15 and over in Marulan, 10.8% reported having completed Year 12 as their highest level of educational attainment, 24.4% had completed a Certificate III or IV and 6.6% had completed an Advanced Diploma or Diploma. **Table 21** provides this data.

Table 21: Level of highest educational attainment

| Level of Highest Educational Attainment | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Bachelor Degree level and above | 75 | 8.3 | 1,424,716 | 23.4 |
| Advanced Diploma and Diploma Level<br>Specialised knowledge and skills. Moving into highly skilled work | 60 | 6.6 | 543,142 | 8.9 |
| Certificate Level IV<br>Broad factual, technical and theoretical knowledge | 23 | 2.5 | 167,947 | 2.8 |
| Certificate Level III | 198 | 21.9 | 730,498 | 12.0 |

| Level of Highest Educational Attainment | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Theoretical and practical knowledge | | | | |
| Year 12<br>Senior secondary school | 98 | 10.8 | 930,654 | 15.3 |
| Year 11<br>Senior secondary school | 38 | 4.2 | 203,574 | 3.3 |
| Year 10<br>Secondary school | 177 | 19.6 | 702,178 | 11.5 |
| Certificate Level II<br>Basic factual, technical and procedural knowledge or a defined area of work and learning | 0 | 0.0 | 4,849 | 0.1 |
| Certificate Level I<br>Skills for initial work, community involvement and further learning | 0 | 0.0 | 625 | 0.0 |
| Year 9 or below | 120 | 13.3 | 513,209 | 8.4 |
| No educational Attainment | 5 | 0.6 | 54,870 | 0.9 |
| Not Stated | 99 | 10.9 | 627,465 | 10.3 |

The data presented in the table above, correlates with the types of employment people aged 15 years and over are engaged in. The bulk of the population have specialised knowledge and skills obtained through technical institutions and colleges affording them the opportunity to pursue careers as tradespersons and related workers (**Table 22**). The most common occupations in Marulan included Technicians and Trades Workers (16.9%), Labourers (16.7%), Machinery Operators and Drivers (14.1%), Community and Personal Service Workers (11.6%), and Managers (11.4%).

**Table 22: Occupation fields**

| Occupation<br>Employed people aged 15 years and over | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Technicians and Trades Workers | 83 | 16.9 | 429,239 | 12.7 |
| Labourers | 82 | 16.7 | 297,887 | 8.8 |
| Machinery Operators and Drivers | 69 | 14.1 | 206,839 | 6.1 |
| Community and Personal Service Workers | 57 | 11.6 | 350,261 | 10.4 |
| Managers | 56 | 11.4 | 456,084 | 13.5 |
| Clerical and Administrative Workers | 54 | 11.0 | 467,977 | 13.8 |
| Sales Workers | 44 | 9.0 | 311,414 | 9.2 |
| Professionals | 33 | 6.7 | 798,126 | 23.6 |

The top responses for industries of employment include Road Freight Transport (5.5%), Construction Material Mining (5.3%), Takeaway Food Services (4.8%), Site Preparation Services (3.4%), and Automotive Repair and Maintenance (3.2%).

With respect to employment, a minority of the Marulan population is either Away from Work (6.8%) or Unemployed (5.7%). In contrast, 57.3% of the community Worked Full-time, and 30.2% Worked Part-time. These statistics are comparable to NSW, which is represented in **Table 23**.

**Table 23: Employment in Marulan**

| Employment | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Worked Full-time | 302 | 57.3 | 2,134,521 | 59.2 |

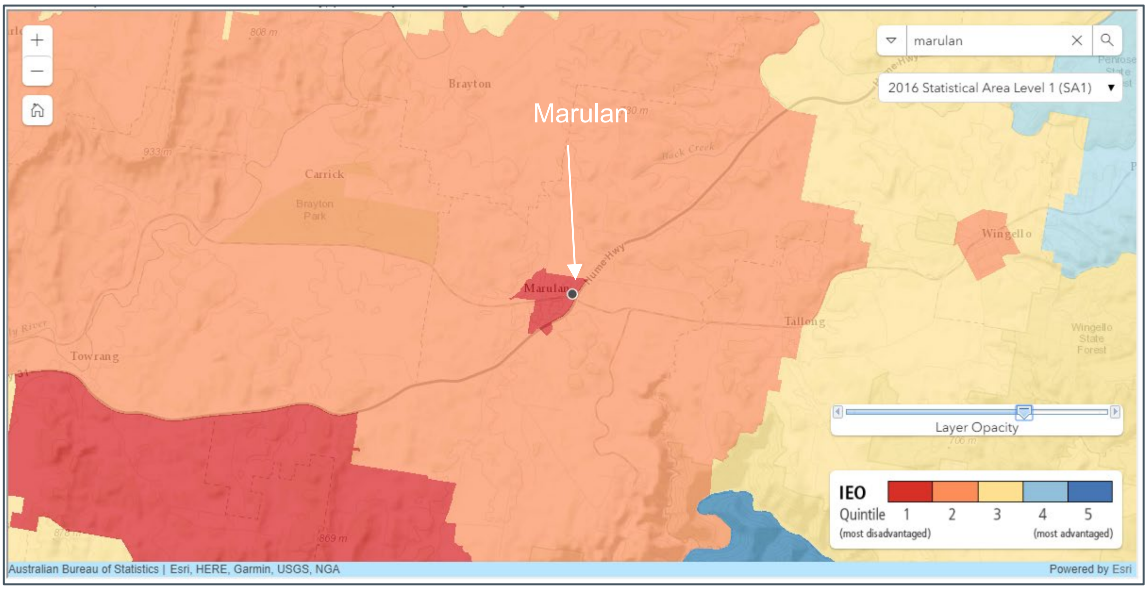
| Employment | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Worked Part-time | 159 | 30.2 | 1,071,151 | 29.7 |
| Away from Work | 36 | 6.8 | 174,654 | 4.8 |
| Unemployed | 30 | 5.7 | 225,546 | 6.3 |

### 6.2.8 Educational status

The Index of Education and Occupation (IEO) is designed to reflect the educational and occupational level of communities. The education variables in this index show either the level of qualification achieved or whether further education is being undertaken. The occupation variables classify the workforce into the major groups and skill levels of the Australian and New Zealand Standard Classification of Occupations (ANZSCO) and the unemployed. This index does not include income variables.

A low score indicates a relatively lower education and occupation status of the people in the areas of assessment. In the case of Marulan (**Figure 10**), this corresponds with the occupational fields where residents find employment as technicians, tradespersons, labourers and machinery operators and drivers.

**Figure 10: Marulan Education and Occupation Index**



### 6.2.9 Weekly income individual and household

The median weekly personal income for people aged 15 years and over in Marulan was $562. **Table 24** contains the income data.

**Table 24: Median weekly income**

| Median weekly income | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Personal | $562 | - | $664 | - |
| Family | $1,380 | - | $1,780 | - |
| Household | $1,143 | - | $1,486 | - |

## 6.2.10 Housing and accommodation

In Marulan 77.8% of private dwellings were occupied at the time of the census, and 97.9% of the population occupy these private dwellings. The majority of the private dwellings contained three (39.4%), or four or more Bedrooms (40.8%). Less than 1% of the community occupy flats or apartments and other dwelling types. Consequently, the average number of bedrooms per occupied private dwelling was 3.2, accommodating an average household size of 2.6 people. **Table 25** presents this data.

**Table 25: Dwelling Structures**

| Dwelling Structure | Marulan | Percentage | NSW | Percentage |
|---|---|---|---|---|
| Separate House | 422 | 97.9 | 1,729,820 | 66.4 |
| Semi-detached, row or terrace house, townhouse etc | 0 | 0 | 317,453 | 12.2 |
| Flat or apartment | 3 | 0.7 | 519,390 | 19.9 |
| Other dwelling | 3 | 0.7 | 23,580 | 0.9 |

## 6.2.11 Housing opportunity

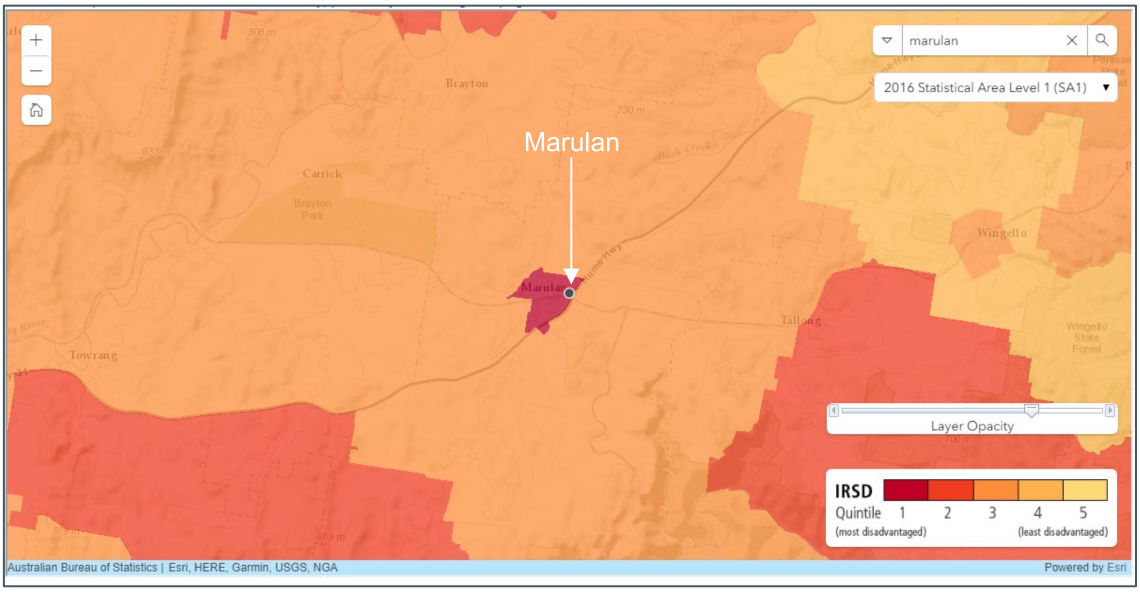
The land use and development policies of the Goulburn Mulwaree LGA are guided by the Local Environmental Plan 2009 in conjunction with the Sydney to Canberra Corridor Regional Strategy (NSW Department of Planning, 2008). The critical goal of this strategy is to provide up to 25,200 new homes for the 46,350 additional people expected to be living in the region by 2031.

## 6.2.12 Social disadvantage

According to the Australian Bureau of Statistics, the Index of Relative Disadvantage identifies and ranks areas in terms of their relative socio-economic disadvantage. Relative socio-economic advantage and disadvantage refers to people’s access to material and social resources, including their ability to participate in society. The Statistical Area Level 1 category is a geographical unit designed to reflect small populations that are either predominately rural or predominately urban in nature. Data for areas with small populations should be used cautiously because they may not correspond accurately with the State Suburbs or Postal Areas.

However, from this data it can be seen that Marulan (**Figure 11**) is a location with a high level of relative socio-economic disadvantage.

Figure 11: Marulan Index of Relative Socio-economic Disadvantage



## 6.3 Existing social infrastructure

Social infrastructure refers to facilities and services that enhance the social capacity of communities and may include infrastructure related to health, housing, youth, aged care, leisure, community safety facilities and road safety (Franks, 2012). As with the social indicators presented above, the social infrastructure identified in Marulan and surrounding areas prior to SSD approval will provide a reference point against which social impacts may be measured if the mine continues to operate. Such impacts can take the form of a decrease in the quantity, diversity or capacity of the existing social infrastructure, courtesy of demand from an expanded workforce and relatives relocating to an area. Conversely, an influx of staff and their families, or changes to the footprint of a project may stimulate new social attributes of the communities, bolster organisational capacities, and contribute to the supply of services.

The analysis conducted for this study identified a range of essential social infrastructure which underpin the social wellbeing of the population. Such infrastructure includes:

- education facilities and child care centres;
- libraries;
- community centres and town halls;
- art and cultural facilities;
- emergency and justice institutions;
- health facilities;
- open space; and
- sport and recreation facilities.

The next section of this report identifies schools and education facilities surrounding the Project, and the following section identifies the balance of the social infrastructure listed above (or ‘other facilities’).

### 6.3.1 Schools and education facilities

There are 28 educational facilities in the Goulburn Mulwaree region shown in **Figure 12**, which are public schools, pre-schools and tertiary education facilities. The type of educational facility can be further broken down in terms of the following:

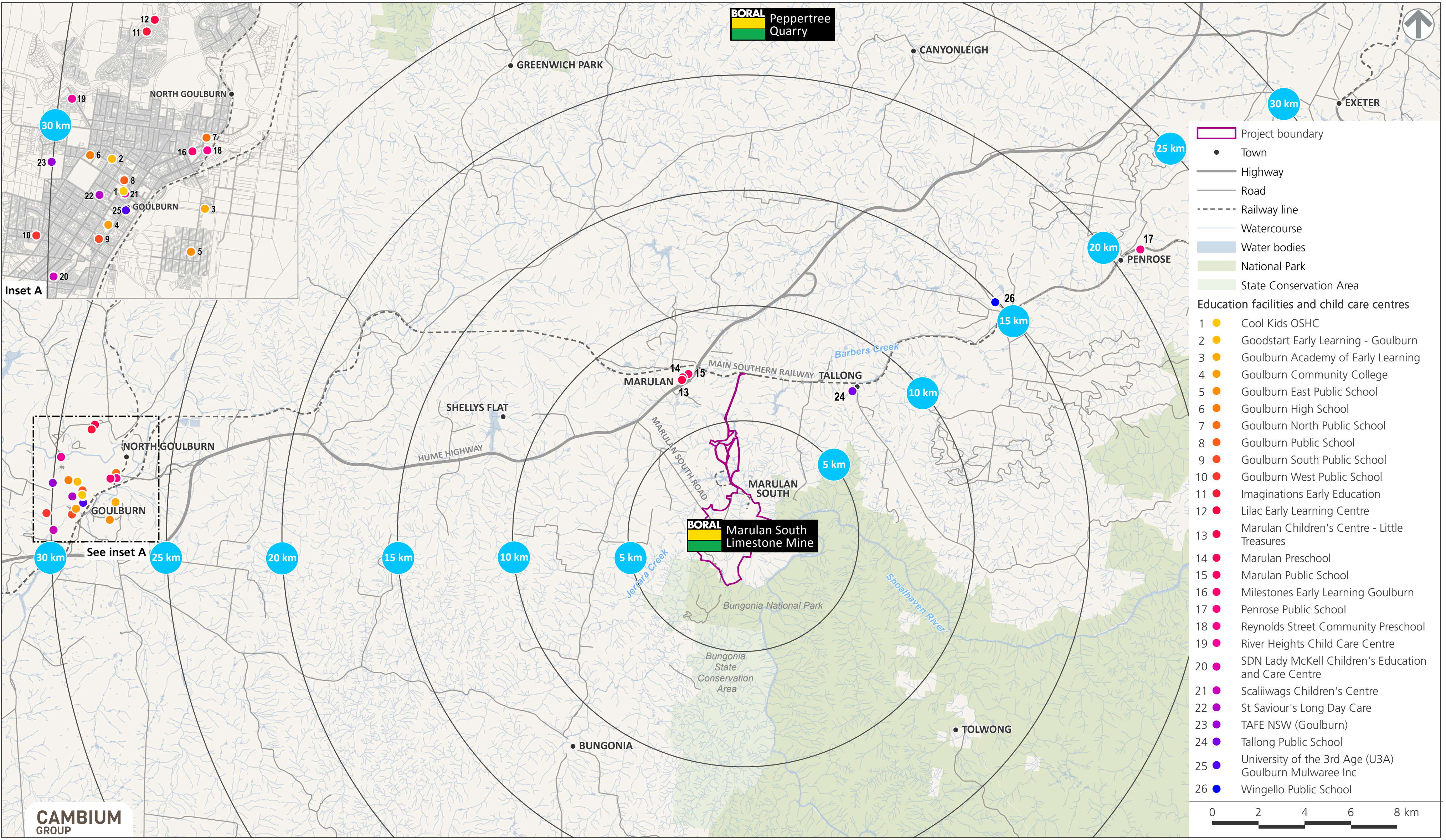
- 10 are public schools (35%);
- 3 higher learning institutions (1%); and
- 15 preschool facilities (64%).

During 2016, NSW Department of Education school utilisation data attracted attention in a *Sydney Morning Herald* (Robertson, 2016) news article. The data showed that two schools in the region were over-utilised, with Goulburn East Public School recording a 120% utilisation rate, and Goulburn West Public School recording a 106% utilisation rate. There were 180 NSW schools recognised as being over-utilised at the time, a fact which makes the Goulburn school statistic less pessimistic. However, they may suggest that an imbalance exists between the student volume demands placed on the schools, and the supply of teaching resources. This is a scenario which can be explored via baseline monitoring.

Figure 12

## Existing social infrastructure - education facilities and child care centres

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
ENVIRONMENTAL IMPACT STATEMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Element Environment (2019), Cambium Group (2019).

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## Other facilities

Of the other facilities which comprise the social infrastructure in Marulan and its surrounds (see **Figure 13**), the health facilities category should be emphasised in the baseline. Goulburn Base Hospital and a small medical practice in Marulan are the two entities which comprise the main health infrastructure for the Marulan community. The hospital will obviously be the sole provider of more complex medical procedures and services. The hospital's emergency department data (Health Information Exchange, 2016) indicates that patients are often waiting longer to start treatment and be transferred for care in comparison to other hospitals in the Southern NSW Local Health District. **Table 26** contains the former of these two datasets. It highlights this scenario whereby Goulburn Base Hospital has shorter waiting times than only one hospital across the triage categories – the South East Regional Hospital (Triage 4 and Triage 5).

**Table 26: Southern NSW Local Health District emergency department treatment waiting times during April to June 2016**

| Hospital | Triage 2 | Triage 3 | Triage 4 | Triage 5 |
|---|---|---|---|---|
| | Median waiting time (minutes) | | | |
| Bateman's Bay District Hospital | 8 | 18 | 26 | 21 |
| Goulburn Base Hospital | 9 | 27 | 39 | 28 |
| Moruya District Hospital | 8 | 18 | 26 | 28 |
| Queanbeyan Health Service | 9 | 21 | 28 | 25 |
| South East Regional Hospital | 8 | 24 | 41 | 50 |
| Other SNSWLHD | 7 | 15 | 23 | 21 |
| **Total NSW** | **8** | **20** | **25** | **23** |

Other data associated with the health facilities and Goulburn Base Hospital in particular, provides a more positive result. **Table 27** compares Goulburn Base with other 'medium regional hospitals' across NSW, in relation to the percentage of patients arriving at the hospital's emergency department, who commenced treatment within the maximum recommended time during 2016-17 (Australian Institute of Health and Welfare, 2018). Goulburn Base Hospital performed better than most of the hospitals listed in Triage 2 and Triage 3. The currently planned major renovation of Goulburn Base Hospital may have a further positive effect on the emergency department services offered to the regional population.

**Table 27: Patients who commenced treatment within the maximum recommended time (2016-17)**

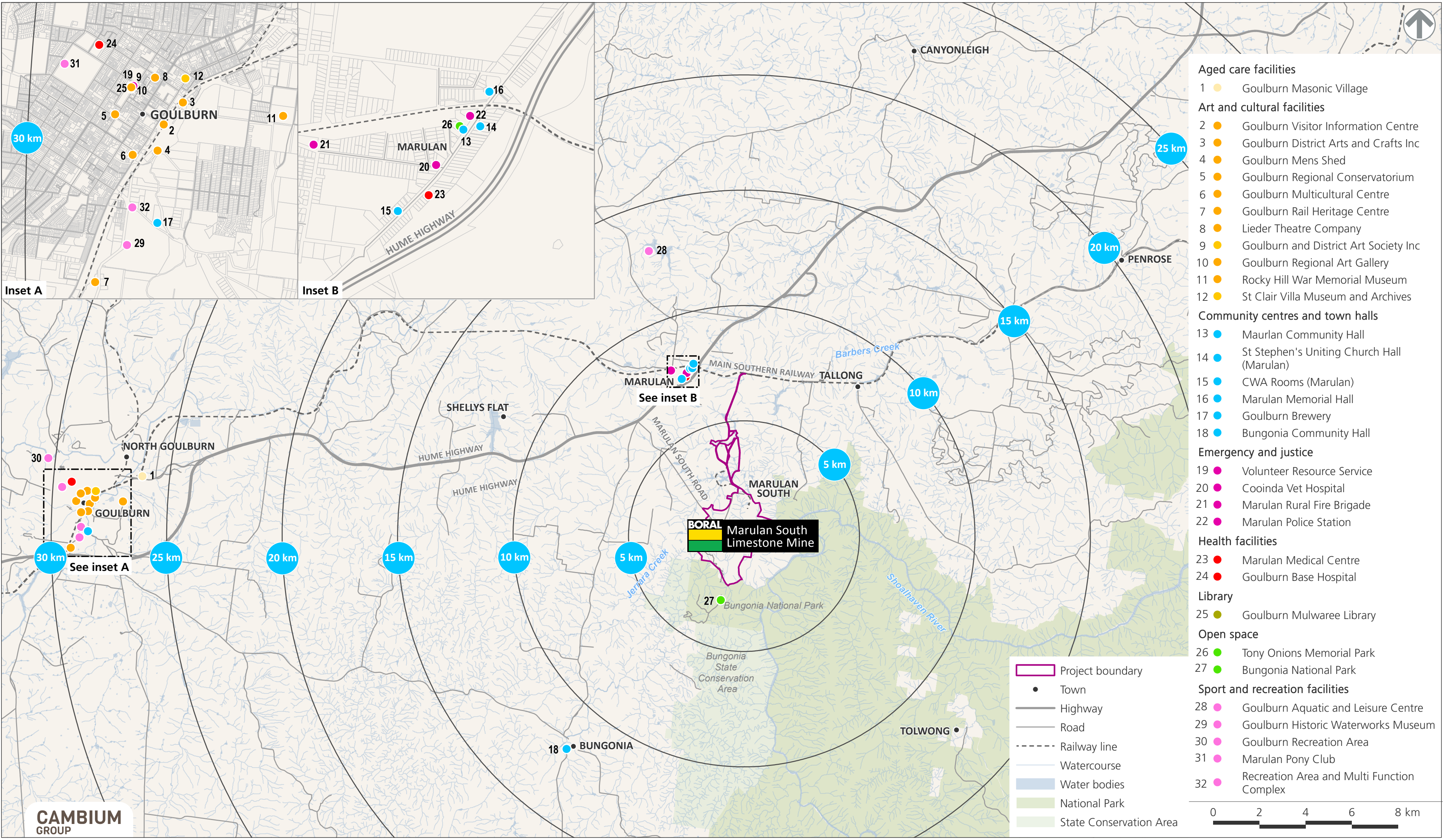
| Hospital | Triage category | Percentage of patients seen within maximum recommended time |
|---|---|---|
| Armidale Hospital | Triage 2. Emergency | 74% |
| | Triage 3. Urgent | 66% |
| Bowral Hospital | Triage 2. Emergency | 83% |
| | Triage 3. Urgent | 80% |
| Broken Hill Hospital | Triage 2. Emergency | 89% |
| | Triage 3. Urgent | 84% |
| Goulburn Hospital | Triage 2. Emergency | 86% |
| | Triage 3. Urgent | 79% |
| Grafton Base Hospital | Triage 2. Emergency | 69% |
| | Triage 3. Urgent | 70% |
| Kempsey Hospital | Triage 2. Emergency | 80% |
| | Triage 3. Urgent | 79% |

| Hospital | Triage category | Percentage of patients seen within maximum recommended time |
|---|---|---|
| South East Regional Hospital | Triage 2. Emergency | 82% |
| | Triage 3. Urgent | 75% |

Figure 13

## Existing social infrastructure - Other facilities

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
ENVIRONMENTAL IMPACT STATEMENT



Source: LPI (2017), Gordon Atkinson & Associates Pty Ltd (2018), Element Environment (2019), Cambium Group (2019).

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# 7 IMPACT ASSESSMENT

In this chapter an assessment of the potential negative social impacts associated with the Project has been completed on the assumption there is no mitigation. Predicted positive impacts associated with the Project are also assessed below. Outcomes of the assessments are discussed according to the Social Risk Matrix contained in Appendix C3 of the Guideline (see Appendix C).

## 7.1 Way of life

As a subset of the 'Way of Life' social impact category, the livelihood of individuals and families in Marulan was assessed for the SIA. As part of the EIS a specialist study in the form of an economic assessment, conducted by Gillespie Economics (Marulan South Limestone Mine Continued Operations Economic Assessment, 2018) addresses the livelihood topics revealed during the SIA process. The HIA method was implemented as a supplementary method for the purposes of the SIA. Results of the HIA are discussed below.

### 7.1.1 Impacts of the continued operations of the mine on nearby property values

In relation to the likely impacts of the Project on property values, Gillespie Economics (2018, p.99) concluded that the "existence of property value impacts and the distance gradient of these impacts are expected to be related to actual or expected physical impacts from the site rather than a simple distance relationship. Where noise, dust, vibration, odour and visual impacts are contained, no impacts would be expected to occur. Where impacts are significant, larger property value impacts would likely occur". The specialist studies that investigated noise, dust, vibration, odour and visual impacts as part of the EIS, separately concluded that no significant impacts would be created by the Project.

Investigations conducted during the SIA process suggest that concern about the impact of the Project on property values is not widespread. In relation to this topic, one communication was submitted to the Project team during the community workshop in 2015 and a follow-up conversation was held with the Marulan South Road resident. The topic is not evident in historic complaint records associated with the operating mine and was not raised during the doorknocks conducted by the Project team. Furthermore, concerns about the Project impacts on property values was not evident in the media articles collected and analysed during the ECA.

Based on the above findings, the impact for the local resident at all stages of the project life-cycle, is predicted to have a **low social risk rating.** It is considered to be immaterial and not requiring the implementation of a mitigation measure.

### 7.1.2 The provision of employment opportunities to the regional population

Regional employment opportunities derived from the Project would be an obvious, positive social impact. The specialist economic assessment (Gillespie Economics, 2018), found that non-market benefits associated with employment provided by the Project would accrue at the local or state level while market values of employment would accrue to employees, the majority of which live in the local area. Other benefits highlighted in the specialist study include:

- the Project will provide continued direct employment for approximately 191 full time personnel in connection with the mine, including lime manufacturing, administration and logistics. This includes 118 personnel on-site (excluding contractor personnel) and another 73 that are employed at other locations e.g. Berrima and Maldon Cement Works and North

Ryde that would otherwise not be employed if it weren't for the mine. It will also provide indirect employment in the regional economy from employee and Project expenditure. 92% of the existing on-site workforce live in the Goulburn Mulwaree Region, and hence a material component of their expenditure would flow-on to local businesses; and
- Boral has identified that it spends considerable operational expenditure with local firms and it is active in supporting local community events (e.g. annual support for the Tallong Apple Day Festival).

Additionally, in semi-structured interviews Boral staff nominated heavy vehicle contractors as being among those who would realise a commercial benefit across the region. The baseline data (refer Chapter 6) identified machinery operators and drivers as being the third largest occupation field for the population aged 15 years and over in Marulan. 69 people (or 14.1% of the population) were estimated to be employed in this field, and this number would potentially increase as a result of the Project. It is logical that similar benefits might accrue to the sales workers occupation field. Employees from this group would support increased sales activity for companies and small businesses (particularly those in the road transport sector) across the region.

Aside from the above findings, feedback collected at the 2018 toolbox talk (staff briefing) at the mine also highlights the livelihood benefits that the Project would yield. Employees showed an interest in the longer-term future of the mine and longevity of their employment. This is not surprising given the toolbox talk participants, however it is an affirmation of how the Project would support livelihoods in the community and maintain the Way of Life for existing employees.

Considering the information obtained for this aspect of the SIA, a positive social impact for the regional population is predicted. The level of interest, scale of benefit, equity in the distribution of the benefit, and likelihood of the benefit is forecast to be **high**.

### 7.1.3 Perceived decrease in supply of raw materials to a local business reliant on the mine

There is no definitive construction phase associated with the Project, and as a result the economic assessment (Gillespie Economics, 2018) focused on the revenue, expenditure and employment associated with the continued operation of the Project. A local business raised concern that the proposed increase in road transportation from the mine meant that Boral was increasing their supply of limestone products to other clients, and was potentially not going to be able to supply their business that relies 100% on the mine for their raw materials. This concern that the businesses financial viability would be compromised by the Project was determined to be a misconception, dispelled at a meeting between the business owners and Boral. Therefore, this matter was dismissed from the SIA and does not require further analysis. Contrary to the perception held by the business owners, the economic assessment suggests the Project would provide economic activity for the regional economy, as well as for the NSW economy. The Project is estimated to make up to the following annual contribution to the regional economy for 30 years:

- $137M in annual direct and indirect regional output or business turnover;
- $74M in annual direct and indirect regional value added;
- $27M in annual direct and indirect household income; and
- 364 direct and indirect jobs.

Production induced and consumption induced flow-on impacts from the Project are likely to affect a number of different sectors of the regional economy. The sectors most impacted by output, value-added and income flow-ons are likely to be the:

- other repairs and maintenance sector;
- retail trade sector;
- specialised and other Machinery and Equipment Manufacturing;

- road transport sector;
- food and beverage services sector; and
- wholesale trade sector.

Businesses that can provide the inputs to the production process required by the Project and/or the products and services required by employees would directly benefit from the Project by way of economic activity. However, because of the interactions between sectors, many indirect businesses may also benefit.

Despite the quantitative results of the economic assessment dispelling any suggestion of local business revenue impacts, the *perception* of those impacts held by the local business was an additional social impact that required attention. A meeting between the principals of the relevant business and a member of the Project team was held to address this impact. The business representatives left the meeting with a better understanding of the Project and indicated their support of the SSD application.

A review of the historical complaints records confirmed that no complaint about this matter had been raised by other businesses in the past. An article discovered during the ECA (see assessment of dust impacts below) did make mention of this matter however the business was located approximately 25 km from the mine and appears to be an isolated case when considering the collection of data analysed for the SIA.

Accordingly, the loss of revenue impact for local businesses at all stages of the Project life-cycle, is predicted to have a **low social risk rating.** Again, it is considered to be immaterial and not require the implementation of a mitigation measure. Conversely, a positive Project impact is predicted. This prediction is made on the basis that the level of interest, scale of benefit (region and NSW wide), equity in the distribution of the benefit, and likelihood of the benefit is forecast to be **high.**

### 7.1.4 Health impact ratings

For each of the livelihood ('Way of Life') matters above, the health impact ratings determined via the HIA are presented in **Table 28**.

**Table 28: Health impact ratings for the livelihood matters**

| Livelihood ('Way of Life') matter | Health impact rating | Description |
|---|---|---|
| Impact on property values | Neutral | Effect is not perceptible/influential on livelihood. |
| Impact on employment opportunities | High positive | Effect results in moderate improvements to well-being, the likelihood of injuries/illness, or livelihood. |
| Impact on business viability | High positive | Effect results in moderate improvements to well-being, the likelihood of injuries/illness, or livelihood. |

## 7.2 Community

Consistent with the Guideline, 'Community', including its composition, cohesion, character, how it functions, and sense of place, was considered in the SIA study. The matter was considered as part of the scoping exercise and determined to be a social impact not affected by the SSD. Refer to the scoping tool results (section 4.4) for an explanation regarding its disqualification from the SIA.

## 7.3 Access to and use of infrastructure, services and facilities

The social impact category related to access and use of infrastructure (per the Guideline), was identified in the SIA as being relevant to the SSD. The social matter subsets of this category that required assessment, include impacts to the 1) Road and rail network and 2) Public infrastructure.

The EIS study includes a comprehensive Traffic Impact Assessment (Transport and Urban Planning, 2018). It is a specialist study which addresses the two matters above. To supplement the traffic assessment, ECA and interview methodologies were applied for the purpose of the SIA.

### 7.3.1 Road and rail network

Impacts only to the road network (as opposed to the rail network) emerged as a topic of interest in the SIA. Feedback from stakeholders during the scoping phase and further engagement activities focussed solely on Marulan South Road. In particular, the following traffic issues were identified in relation to heavy vehicles:

- traffic impacts between the Project and Hume Highway along the Marulan South Road;
- traffic changes and increased traffic volumes on Marulan South Road; and
- the use Marulan Creek Road for haulage, instead of the proposed route along an upgraded Marulan South Road.

The specialist traffic assessment conducted by Transport and Urban Planning (2018) explored these issues and arrived at the following conclusions, which ultimately describe minor traffic impacts:

- Boral currently transports around 330,000tpa of limestone and clay shale by road from the mine via Marulan South Road to the Hume Highway where it then travels either north or south along the Hume Highway. Boral’s truck fleet, which transports the Product, includes truck and dog combinations as well as a small number of B-doubles;
- up to an additional 120,000tpa is transported from the mine to the Aglime Fertiliser facility which is located approximately 1km south west of the entrance to the mine, along Marulan South Road;
- this existing road transportation will continue under the Project. Boral proposes to transport an additional 120,000tpa of limestone and clay shale as well as 150,000tpa of aggregate/sand products from the Peppertree Quarry via Marulan South Road and the Hume Highway;
- overall, the Project seeks to transport up to 600,000tpa between the mine and the Hume Highway, along Marulan South Road, as well as tup to 120,000tpa of lime product to the Aglime Fertiliser facility;
- Boral currently transport 500,000tpa of manufactured limestone sand to Peppertree Quarry via a dedicated internal haul road that crosses Marulan South Road east of the rail level crossing and the main vehicle truck entry to the mine. Boral are proposing to increase this by up to 500,000tpa resulting in an additional four one-way truck loads per hour (i.e. 8 additional truck trips with the return movement). These vehicles will cross Marulan South Road. Traffic volumes using this section of Marulan South Road are relatively low (i.e. less than 40 two-way vph) and the impact of the additional trucks at the intersection will be relatively small and satisfactory traffic conditions will be maintained;
- Boral is proposing to realign a section of Marulan South Road to accommodate the northwards extension of the existing Western Overburden Emplacement, while Council is now requesting Boral to both fund and carry out the widening of the pavement of Marulan South Road in the narrower sections to meet Goulburn Mulwaree Council’s DCP requirements. In addition, a new intersection and associated works in Marulan South Road adjacent to the Road Sales Stockpile Area are proposed;

- The Project will result in a small increase in heavy vehicle trips in the order of 2-3 heavy vehicle loads per hour (total of 4-6 two way trips) on an average day using the Marulan South Road access to the Hume Highway; and
- The assessment of the traffic impacts of the additional product truck movements on the adjoining road network and intersections has concluded that the impacts would be relatively minor and there will be minimal changes to the Level of Service and vehicle delays on the road network, including at all key intersections.

The impacts identified by Transport and Urban Planning (2018) obviously apply to all road users that travel on Marulan South Road, and also the owners of property on Marulan South Road. Residents and other property owners would have greater exposure to the impacts, however minor.

The use of Marulan Creek Road (as opposed to Marulan South Road) for haulage was not considered in the traffic study. Boral considered the alternate route and determined it is not viable because of its:

- potential to pass close to, and impact on additional receivers;
- requirement for substantial new ground disturbance, including clearing of native vegetation in a less modified environment;
- high construction cost comparative to the Marulan South Road upgrade;
- associated regulatory requirements which would cause Project delays; and
- potential road/rail interchange complications at Peppertree Quarry.

It was therefore disqualified from further assessment in the SIA.

An assessment of this social impact matter via the ECA revealed a range of discourses conveyed by the community. The search string “Marulan South Road + trucks” was implemented to obtain 20 media articles (see protocol sheet in Appendix D) for the assessment. Eight were disqualified from the ECA on the basis that no series of representations was revealed in their text content, or that the article was irrelevant to the social impact matter. The mine was not the exclusive subject of any single article, however Marulan South Road did feature in a small number of them. On this basis a social impact appears to be present in the community, and one that is exclusively cumulative in nature.

The discourses manifest in the ECA results are as follows:

- unjustified increase to the number of trucks using the road network;
- trucks cause delays for motorists;
- truck volumes are excessive for the capacity of the local road network;
- truck haulage compromises safety of network; and
- trucks are part of social life in Marulan.

The presence of these discourses in the community, and the associated community sentiment, was confirmed in an interview with the GMC Director of Operations. Statements made by the Council representative include:

*“Once there is a perception or an understanding rather, that there is going to be an output increase from a quarry, people quickly jumped to more trucks on the road….and they next want to know – well, how is it going to be dealt with? And a road upgrade is obviously the way…the community expect it”.*

Based on these ECA and interview results, there are obvious community concerns about the impact of heavy vehicles on the regional road network. Of most importance to the SIA for the Project, is the management of these concerns on Marulan South Road, as this is primarily where the social impacts exist.

This social impact was assessed to have a **moderate social risk** rating during the operational Project life-cycle stage. This rating was applied on the prediction that the additional heavy vehicle traffic would likely contribute to the cumulative social impact reported by stakeholders, even if the impact is exclusively perceptual. The small increase in heavy vehicles (2-3 heavy vehicle loads per hour) would have only a minor consequence on the level of service of Marulan South Road. However, there is still a need to upgrade sections of Marulan South Road to improve safety.

### 7.3.2 Public infrastructure

Public infrastructure was identified as a social matter relevant to the SIA, subsequent to the receipt of feedback in the scoping exercise about dips and narrow sections along Marulan South Road. The traffic assessment summaries Boral's commitment to the proposed upgrade of Marulan South Road, which would widen sections of the road, assess any significant dips that are unsafe and need to be improved and will provide a remedy to pavement condition where required. GMC had originally advised that they would design and construct the road upgrades and the realignment of the section of Marulan South Road to accommodate the Western Overburden Emplacement. However, GMC has since changed their position and wishes for Boral to design, construct and fund the realignment and upgrade of Marulan South Road in accordance with the DCP requirements.

An ECA was conducted to supplement the traffic assessment and provided a means to assess the social impacts of this matter. The search string "Marulan South Road + trucks" was again adopted for this ECA exercise. Subsequently, the twenty articles that were analysed to assess the road and rail network social impacts were analysed again, albeit with a focus on discourses about the physical condition and structural integrity of roads. The protocol sheet completed for the ECA is shown in Appendix D. It illustrates that fifteen articles were disqualified as they did not contain discourses about the condition of road pavements. The following two discourses did emerge from the collection of articles however, which indicate that social unease exists in relation to the cumulative impact of heavy vehicles using local roads (not specifically Marulan South Road):

- road maintenance funding and duty dispute; and
- trucks are responsible for pavement damage.

Results from the interview with Goulburn Mulwaree Council Director of Operations aligned with the assessment of social impacts via the ECA. He stated:

*"Roads in Marulan are typical of what we have across the LGA. The Marulan Roads I guess, are an interesting one [sic] because the roads in general across the rest of LGA have not been constructed for heavy traffic unless they were initially built for that purpose".*

*"The condition of South Marulan Road is typical, much of its narrow, there's some undulations which we would like to address in time".*

*"I guess what we're finding is that, as these roads evolve and improve over the years, they are done so for lighter vehicles. When a quarry opens up nearby and they start hitting those roads with trucks, then often they are not fundamentally designed for that reason".*

Taken together, the ECA and interview results suggest that a social impact exists in relation to public infrastructure. Again, the impact obviously applies to all road users that travel on Marulan South Road, and also the owners of property on Marulan South Road who would likely have greater exposure to the impact. From a social impact perspective a **moderate social risk rating** was determined in relation to the matter, applicable during the operational Project life-cycle stage. The reasons for this determination are the same as those that applied to the determination of the public infrastructure social risk rating (above).

## 7.4 Culture

Consistent with the Guideline, ‘Culture’, including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country), was considered in the SIA study. The matter was considered as part of the scoping phase and determined to be a social impact not affected by the SSD. Refer to the scoping tool results (Section 4.4) for an explanation regarding its disqualification from the SIA.

## 7.5 Health and wellbeing

The ‘Health and Wellbeing’ social impact category defined in the Guideline is relevant to the SIA from an acoustic impact point of view. A specialist noise and blasting assessment (Wilkinson Murray, 2018) was developed for the EIS and provides an analysis of the Project’s predicted acoustic impacts. The Project team undertook consultation with residents to supplement the specialist assessment, and explore the following concerns raised by residents during the SIA process:

- low frequency, night time, and cumulative noise impacts;
- Methodology and efficacy of monitoring; and
- Use of truck air brakes outside of normal business hours.

The study by Wilkinson Murray (2018) assessed noise from ongoing operations, construction, blasting, rail and road traffic generation, against the latest guidelines published by NSW authorities. Noise trigger levels (criteria) at surrounding residential receivers were derived from a review of all noise monitoring undertaken to date around the mine, as well as available data from the nearby Peppertree Quarry. Noise modelling was done based on the typical worst-case equipment locations provided by Boral for four stages during the life of the mine. Noise source levels were based in part on extensive noise surveys at the mine.

The study concluded that predicted noise levels were less than the Project noise trigger levels at all sensitive receiver locations for all stages of the proposed 30-year mine operations. As such, it is considered that the mine would have no significant noise impacts on neighbouring communities.

Consultation occurred with three residents following receipt of their feedback about acoustic impacts. The following outcomes were reached:

- Resident 1 (Long Point Road property owner): the reporting of low frequency noise was discussed. The resident was provided with copies of noise monitoring results undertaken at the residence. This enabled the resident to confirm that noise levels are compliant, and the methodology was robust. Compliance aside, the Project team provided a commitment to the resident to discuss noise impacts on a quarterly basis. Feedback was welcomed on a forward basis. It was confirmed that plant operations on site would be scheduled to accommodate prevailing wind conditions (where feasible), and be investigated in the event of acoustic disturbance.
- Resident 2 (Marulan South Road): concerns about the use of air brakes and the associated acoustic impacts were received by the Project team in person. The Project team stated that vehicles involved were likely to be owned and operated by contractors, rather than the Boral fleet. The Project team committed to sharing concerns of the resident with all staff and contracted personnel, and emphasising the need to observe it through appropriate driving behaviour.
- Resident 3 (Marulan South Road): at the third resident meeting held in relation to acoustic impacts, it was determined that the noise source was not Project related. The source of the disturbance was identified, confirmed by the reporting neighbour, and the Project team considers the issue ‘closed’.

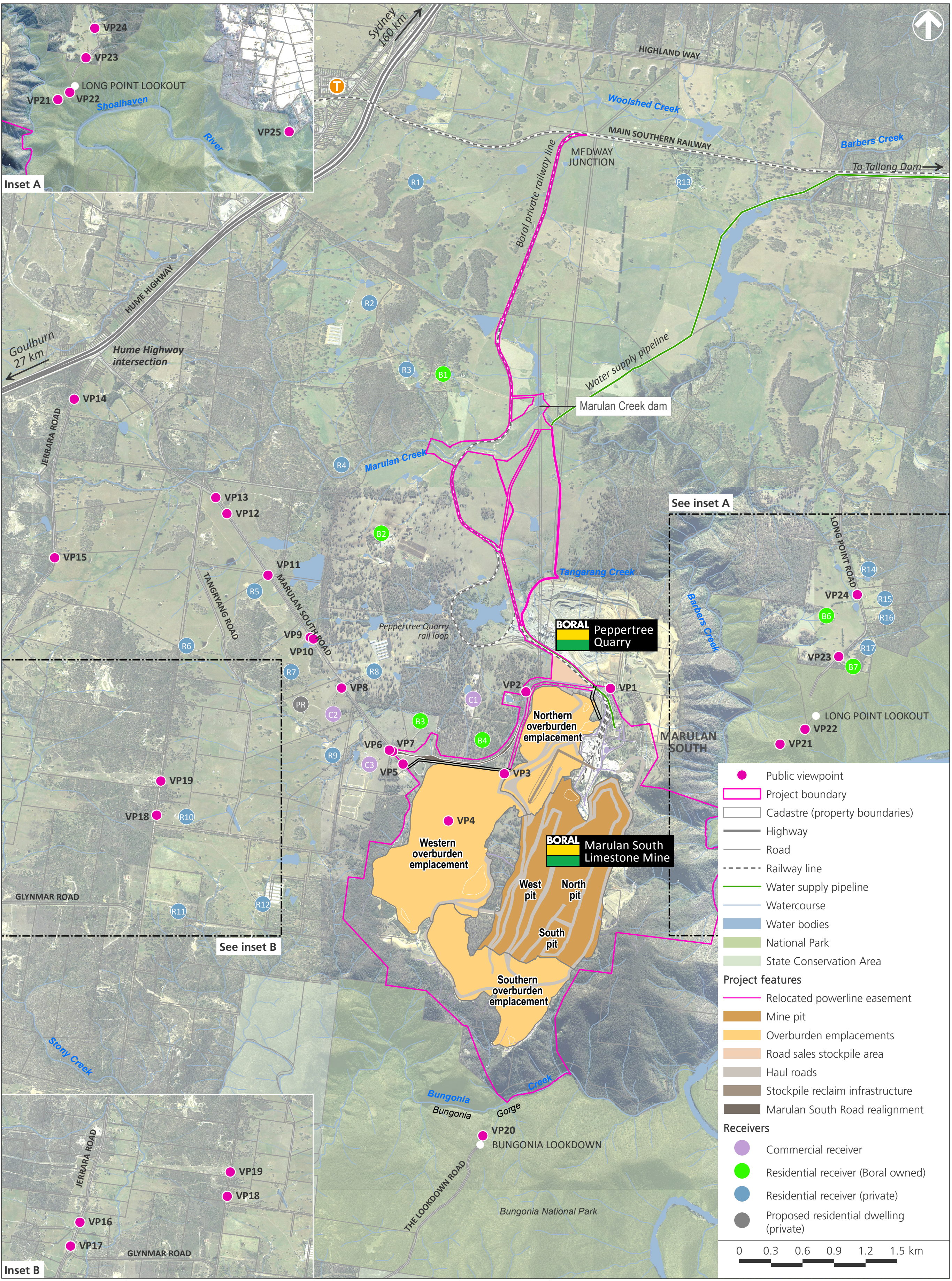
The prediction following the assessment of this social matter is that a **moderate** social risk rating would apply for the construction and operational Project life-cycle stage. It is likely that the use of air brakes and the sensation of low-level noise (even perceived) at the receiving property would continue post-SSD approval, and that the consequence would be moderate. Note that in making this determination, the effort Boral has made in relation to driver behaviour was disregarded (this effort is a mitigation factor considered in the conclusion chapter).

## 7.6 Surroundings

As a subset of the 'Surroundings' social impact category, visual impacts of the Project are relevant to the SIA. A specialist VIA (RLA, 2018) conducted for the EIS was relied upon for the SIA. To supplement the specialist visual assessment, consultation with residents was also undertaken and the visual assessment method demonstrated by Andrews et. al. (2012) was applied. RLAs (2018) assessment thoroughly addresses the visual impact feedback obtained from stakeholders during the SIA process. The viewpoint location plan (**Figure 14**) developed for the study provides context. Visual observations made at some locations in the figure enabled an exploration of the visual impact feedback obtained from stakeholders. **Table 29** describes these locations and the relevant stakeholder feedback.

Figure 14
## Viewpoint locations

MARULAN SOUTH LIMESTONE MINE CONTINUED OPERATIONS - SSD APPLICATION
**ENVIRONMENTAL IMPACT STATEMENT**



Source: LPI (2018), Photomapping (2014, 2018), Gordon Atkinson & Associates Pty Ltd (2018), Richard Lamb & Associates (2018), Cambium Group (2018).

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**Table 29: The Viewpoint Location Plan items related to the relevant stakeholder visual impact feedback**

| Viewpoint Location Plan item | Stakeholder feedback about visual impacts (SIA matters) |
|---|---|
| VP20 | What will the rehabilitated South Pit overburden emplacements look like form the Bungonia Lookdown, and are there any cumulative visual impacts from the Lookdown Peppertree associated with Peppertree Quarry. |
| PR | Headlight spill from vehicles using Marulan South Road towards existing businesses, residences and proposed residences to the south of Marulan South Road. Construction of a bund and/or retention of vegetation on the southern side of Marulan South road for visual screening of headlights. |

The VIA conclusions reached by RLA (2018) in relation to the SIA matters are summarised below.

## Visual impacts from Bungonia Lookdown

- Parts of the existing operations are of high exposure to medium to distant views from the east and south (part of the McCauleys Flat track from Long Point Lookout), the Bungonia Lookdown area and parts of the Morton National Park). This will initially continue to be the situation in the Project.
- In the views from the Bungonia Lookdown area, the proposed northern overburden emplacement, shared with Peppertree Quarry and the majority of the western overburden emplacement will be of minor visibility.
- The overall visual impacts rating of the Project on its total visual catchment was assessed to be low, with initial higher impacts on VP20 (the Bungonia Lookdown) and VP21 (off-track site accessed from the McCauleys Flat Track), rated as medium following rehabilitation.
- The final landform of the southern overburden emplacement will be the most profound mitigation work that has ever been implemented to reduce visual impacts of the mine on views from the Bungonia Lookdown.
- Night time lighting of mining operations in the pit would be most visible from the Bungonia Lookdown (VP20) and McCauleys Flat track (VP21), however night time use of the reserves would be minimal. As a result, the impacts of night lighting on such viewing locations is considered to be minor.

## Visual impacts created by the rehabilitated overburden emplacements (including South Pit)

- By the end of the development consent period (30 years), the view into the mine pit would have been significantly and sequentially reduced as the southern overburden emplacement and its extension to the west occludes the view and replaces it with a rehabilitated infill landform of a natural appearance, vegetated with native woodland species that help blend the emplacement with the surrounding natural landscapes of the Bungonia National Park and Morton National Park.
- The Project features a number of out-of-pit overburden emplacements to ensure the greatest possible flexibility in the operation of the mine over the 30-year development consent period. With the assistance of proposed rehabilitation methods, these overburden emplacements will have only minor effects and impacts on the visual environment.

## Cumulative visual impacts associated with Peppertree Quarry

- There is potential for some cumulative impacts to occur between the Project and the further extraction and development of the adjacent Peppertree Quarry. The two operations are also intended to share the northern overburden emplacement during what would be Stage 1 of the mine's proposed SSD and simultaneously, Modification 5 of the Peppertree Quarry when approved. It is likely, given the probable time frames of the two applications, that the Peppertree Quarry Modification 5 would be approved first.

- For the most part, the effects of the two operations on each other are neutral or positive for the SSD, in that the approved overburden emplacements in Peppertree Quarry would either have no effect or would tend to add screening to the SSD. For example, the approved southern overburden emplacement in modification 4 of Peppertree Quarry would screen the mine's proposed northern overburden emplacement in views from the Long Point Road area, R14 and R15 and from VP21. It would also be likely to screen the last lifts of the western overburden emplacement, which is proposed to be constructed in Stage 3 of the mine's SSD, from views from the same direction.
- Overall, there is a low potential for cumulative impacts and in general the effect would be to reduce, rather than increase, the impacts of the Project.

### Headlight spill impacts from vehicles using Marulan South Road

- The Project will result in a small increase in heavy vehicle trips in the order of 2-3 heavy vehicle loads per hour (total of 4-6 two-way trips) on an average day using Marulan South Road and the Hume Highway.
- Most of the heavy vehicle traffic will be during daylight hours, therefore it is likely that the number of additional heavy vehicles travelling at night along Marulan South Road, as a result of the Project, would be lower.
- Potential visual exposure to light from vehicles would otherwise remain as at present in terms of the number of vehicle movements at night. There would however, be a minor change to the exposure of vehicle lights to the surrounding environment in the vicinity of the proposed Marulan South Road Realignment.
- Travelling south from the proposed terminus of the public road adjacent to the entry to the Aglime Fertiliser facility, the road is proposed to curve westward, to meet the existing Marulan South Road in the vicinity of the east boundary of the Foti Fireworks facility (C3). Light spill to the adjacent landscape compared to the existing situation may be slightly increased by the diversion of the road in Stage 3 and the construction of the northern section of the western overburden emplacement area.
- Relatively dense vegetation to the north and north-west and the western overburden emplacement to the south of the road would tend to largely confine light from headlights to the alignment of the road until vehicles emerge into more open landscape close to the end of the diversion. For a distance of approximately 400 m after passing the western overburden emplacement, vehicle lights would be directed approximately west, before the road re-joins the existing alignment of Marulan South Road.
- The closest residential receiver from the point where the road emerges from between the western overburden emplacement and vegetated area to its north is R9, at a distance of approximately 950 m. Vegetation and topography between R9 and the road are likely to help to screen or diffuse potential light spill and it is unlikely that the re-alignment of the road would significantly change potential light spill to this residential receiver. However, there is the potential for vehicle headlights to shine more directly towards the proposed residence location PR, although this proposed residence is some distance (approximately 1 km) from the merge point of the existing and realigned section of Marulan South Road.

Consultation was held with the property owner associated with PR. The issue raised by the property owner was the provision of screening on Marulan South Road to mitigate vehicle headlight spill, that has the potential to arise from the re-alignment of the road. It should be noted that the receiver of the headlight spill will be a proposed dwelling (i.e. yet to be built). Concerns of the property owner were discussed and Boral committed to developing a solution in collaboration with the property owner. Boral indicated the placement of an overburden bund/berm to mitigate headlight spill will be feasible. After the visual impact results described above were considered in relation to the receiver PR, the Andrews et. al. (2012) visual assessment method was applied to the case for the purposes of the SIA. The conclusion reached was that visual impacts at PR, disregarding the above-mentioned overburden bund, rank as **low**. This decision was made on the basis that the duration of the view and viewer sensitivity type is high, and all other criteria (i.e. number of viewers, view sensitivity and view distance/proximity) is low.

In terms of the social risk rating per the Guideline, the impact of the Project's visual disturbance is predicted to be **moderate,** in the operational Project life-cycle stage. A moderate rating was applied because the headlight spill is predicted to be both likely and of a moderate impact consequence.

## 7.7 Personal and property rights

Under the 'Personal and Property Rights' social impact category in the Guideline, two social matters were identified as requiring assessment for the SIA. The first of these matters is dust, and the second is access to property.

### 7.7.1 Dust impacts

A specialist air quality impact assessment study was completed by Todoroski Air Sciences (Air quality impact assessment: Marulan South Limestone Mine continiued operations, 2018) to specifically address air quality (including dust) impacts associated with the SSD. The ECA was one method implemented to support the air quality assessment as part of the SIA. Consultation with residents was the second method implemented for this purpose.

The specialist assessment conducted by Todoroski Air Sciences (2018, p.3) found there would be a "low potential for any dust impacts to occur at the privately-owned sensitive receptor locations surrounding the mine with dispersion modelling predicting no exceedances of the various dust criteria. Some elevated short-term dust levels are predicted to occur at one of the nearby Boral-owned receiver locations close to the operations. Overall the assessment indicates that adverse air quality impacts are unlikely to arise due to the continued operations of the mine if air emissions from the operations continue to be managed and mitigated effectively".

The ECA implemented to supplement the air quality assessment focussed specifically on dust impacts. It involved the analysis on 14 media articles (see Appendix D for protocol sheet) found using the search string "Marulan + dust". Seven articles were disqualified on the basis that no *series* of representations was revealed in the text content. One additional article was disqualified because the subject of the article was a Gunning motorcross park development, unrelated to mining in Marulan and surrounds.

The ECA found that dust impact discourses were present in the media commentary. Although no discourses were derived from articles specifically focussed on the mine, other mining projects in the region did feature in the articles. Therefore, the assessment must be considered more strictly as a cumulative impact assessment, instead of an assessment of impacts exclusively derived from the Project (which would likely continue post-SSD approval). The ECA revealed that the following discourses about the dust impacts of mining are present in the community:

- dust control and compliance – this discourse was often present in articles concerned with mining development applications, or the status of project approvals;
- lack of faith in dust controls/studies – this discourse appeared in commentary from residents or businesses in the region who had experienced dust impacts from a neighbouring mine; and
- business revenue reduction due to dust – this discourse emerged in one article which described the dust impacts felt by a business owner, with business operations occurring nearby to a mine.

These discourses illustrate that community sentiment about mining dust impacts is prominent in the geographic region associated with the Project, and therefore all warrant attention from a social impact management perspective.

Consultation with a fenceline neighbour was the final method implemented to further assess dust impacts from a social impact perspective. The consultation session extended a pre-existing dialogue with the resident. It enabled the Project team to obtain details about the shed reported (by the resident) to be sustaining damage as a result of mine related dust.

Following the assessment of the results above, a **moderate** social risk rating was predicted for the Project during the construction and operational Project life-cycle stage (i.e. impacts are possible at the fenceline neighbour property and consequence is moderate).

### 7.7.2 Access to property (property access impacts)

'Access to Property' is a social impact category relevant to the SSD, courtesy of feedback provided by a resident at the community workshop. In particular, the social matter pertinent to the SIA is property access impacts. A statement was made that any future upgrade of Marulan South Road should include an upgrade of the driveways connected to it. The interview method was selected to explore the matter, which had the potential to be a thoroughly positive impact of the Project.

On the topic of the upgrade, the GMC Director of Operations made the following comments:

*"It [the proposed upgrade of Marulan South Road] would achieve some consistency…I think that's important because, obviously the quarries would look at one another and they would think, well gosh you guys had to do this. We didn't have to do that or vice versa. These conditions, they come at cost obviously, to do these roadworks are generally in the millions of dollars. So there has got to be a reasoning for them but it's got to be an understanding that it's just a consistent requirement".*

*"Once there is a perception or an understanding rather, that there is going to be an output increase from a quarry, people quickly jumped to more trucks on the road….and they next want to know – well, how is it going to be dealt with? And a road upgrade is obviously the right way. The community expect it".*

The above commentary confirms the view of the community and the authority, that the road upgrade as part of the re-alignment is essential and valuable in terms of social outcomes. On the question of driveway access upgrades being included as part of the work, the sentiment was similarly positive:

*"We've got a number of roads which are on quarry haulage routes, including South Marulan Road. We get a lot of feedback from them [local residents and business owners], particularly with trucks – how people can enter and exit their properties safely with trucks running along the road. If there are improvements which may improve the sight distances and visibility of vehicles and trucks for one another, then that's an obvious advantage. It would be an important aspect of the Project and a much-appreciated improvement".*

*"…improvement to property access, where there is going to be increased use of the haulage route by heavy vehicles, is a good thing".*

*"If the road is to be upgraded as proposed, then there will be an amount of vegetation removal as well and that, by itself, improves access, sight distances, and visibility for the road user. It helps the transition off the road into the property".*

In relation to this matter, a positive social impact for the community is predicted pending the Marulan South Road upgrade proceeds with driveway access improvements. This prediction is made on the basis that the level of interest, scale of benefit, equity in the distribution of the benefit, and likelihood of the benefit is forecast to be **high.**

## 7.8 Decision-making systems

Consistent with the Guideline, 'Decision-making systems', including the extent to which people can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms, was considered in the SIA study. The matter was considered as part of the scoping phase and determined to be a social impact not affected by the SSD. Refer to the scoping tool results (Section 4.4) for an explanation regarding its disqualification from the SIA.

## 7.9 Fears and aspirations

According to the Guideline, the final social impact category assessed during the SIA was 'Fears and Aspirations'. The safety sub-set was determined to require assessment from a traffic perspective. As described previously, a specialist traffic assessment (refer Transport and Urban Planning, 2018) was conducted for the EIS and it again was relied upon for this matter. Supplementary interview and HIA methodologies were adopted for the purposes of the SIA.

It was revealed in the scoping exercise that the increased traffic volumes proposed for the Project was a cause of a traffic safety concern in the community. Although beyond their authority, a request to reduce the speed limit from 80 km/h to 60 km/h on Marulan South Road was also made to the Project team. The specialist traffic study indicates that the minor increase in truck movements associated with the continued operation of the mine is unlikely to result in traffic safety impacts, and it makes a recommendation regarding the speed limit, but only at the proposed Road Sales Stockpile Area intersection:

- "The Project is not expected to have any negative impacts on the other road users and or on road safety. As noted above, Boral is proposing upgrades to Marulan South Road as part of the Project. These upgrade works will take into consideration the need for and location of the school bus stopping and turning. In addition, Boral has a Traffic Safety Management Plan for operations at the mine site and holds Safety Toolbox discussions on a regular basis with employees regarding the safe use of Marulan South Road. All Boral drivers are trained to the nationally recognised Certificate III (Transport and Distribution) Qualification. All drivers, including subcontractor drivers travelling to and from the mine along Marulan South Road will be trained on protocols for the interaction with school buses and minimising traffic noise, particularly during night time periods" (Transport and Urban Planning, 2018, p.ii).
- The proposed Road Sales Stockpile Area intersection will be located at/near the change of the speed limit between 60km/h and 80km/h. If this section of Marulan South Road is to remain a public road, then it is recommended that the 60km/h speed limit that applies in the old Marulan South village, be extended 200 metres to the west, so that the new intersection is located in the 60km/h speed limit area. (Transport and Urban Planning, 2018, p.19).

The traffic safety sensitivity raised by the community member in the scoping exercise was echoed by the GMC Director of Operations:

*"South Marulan Road would attract its share of, I guess, input from various community people, road users etc. What I'm aware of on South Marulan Road is the difficulty people have with trucks out there. So, trucks on those narrow roads are rather imposing. People feel that they've got to take evasive action. They often say that trucks are speeding, whether they are or not is a whole different story, but there is a general negative perception about these big trucks being on these narrow country roads which have not necessarily been built for that purpose".*

Considering the community sensitivities about traffic safety, the health impact rating determined via the HIA is negative. That is, the social effect of the SSD results in annoyance, minor injuries, illnesses, or livelihood impacts that do not require intervention (Orenstein, 2018). Obviously, the emphasis of the HIA is placed on annoyance and livelihood impacts (rather than on the occurrence of injury or illness, which the data obtained and analysed for the SIA does not support).

Having considered the above results, there are two separate social risk ratings applicable to this social matter. The first relates to the safety fears in relation to increased traffic volumes, the second relates to the speed limit on Marulan South Road. The predicted social impacts are as follows:

- Traffic volumes: a **low** social risk rating is applicable during the operational Project life-cycle stage. This is due to the fact that the traffic volume increase derived from the Project would be immaterial. The community perception of a safety risk however will likely remain, despite there being a minimal safety consequence. This concern was raised by an older member of the community who conveyed the perceived safety risk, and it is assumed that the perceived risk would exist amongst other people in the older population demographic.
- Speed limit: disregarding the potential speed limit reduction described above, a **low** social risk rating is applicable during the operational Project life-cycle stage. This is due to the fact that the community view about decreasing the speed limit would likely be maintained, regardless of the approval status of the Project. It is considered to be immaterial and not requiring the implementation of a mitigation measure.

# 8 CONCLUSION

This report outlines the process implemented to identify, predict, evaluate, and develop responses to the social impacts of the continued operation of the mine. The report exists as a specialist study developed to support the overall EIS and SSD application.

The mine is a long-standing open cut mine that has produced up to 3.38 million tonnes of limestone based products per year for the cement, steel, agricultural, construction and commercial markets. The mine is a strategically important asset for Boral, as it supplies the main ingredient for the manufacture of cement at Boral's Berrima Cement Works. This is also a strategically important operation for Sydney based consumers of these products as this represents around 60% of the cement sold in NSW and feeds into more than 30% of concrete sold in Sydney.

The ASI for the Project is located in the NSW Southern Tablelands, a region with strong links to Canberra and Sydney (including the road and rail access), mineral resources, lifestyle advantages, and historic heritage and villages. It has well-developed agricultural and extractive industry sectors. The Southern Tablelands has a core advantage in non-metallic mineral mining and quarrying. This sector creates employment and economic activity in the region, is vital for Sydney's ongoing growth, and has scope for expansion. Anecdotal data suggests the strength of this sector may mean that extractive industries are accepted as part of the social fabric in the region. People who work in the region typically live in the region, however almost a third of the employed labour force in the region commutes to a work location outside it. The region has a higher proportion of people in the younger aged groups (under 15 years) and 40-54 years age cohort, and a lower proportion in the 20-34 years age group and over 60 years age group.

In terms of the local socio-economic context, the social baseline illustrates a reduction in the population (both male and female) from 5-9 years old and 20-24 years old, likely to be outward migration. The opposite is true from the ages 25-29 years old and 49-50 years old. Indigenous people comprise approximately 3.9% of the Marulan population, and the majority of this population is female (63%). The NSW indigenous community has a much younger age profile than the non-Indigenous profile, with 53% of the Indigenous population being under the age of 25. The bulk of the local population have specialised knowledge and skills obtained through technical institutions and colleges, affording them the opportunity to pursue careers as tradespersons and related workers. Relative socio-economic disadvantage data indicates the local population faces barriers in terms of access to material and social resources.

Despite the relative socio-economic data, it appears that social infrastructure in Marulan and surrounds is typical of that found in regional NSW. Twenty-eight educational facilities in the Goulburn Mulwaree region were recorded in the baseline. These included public schools, pre-schools and tertiary education facilities. Goulburn Base Hospital is the major health facility which services the population. Government data collected in 2016 suggested overcrowding in two schools across the region and also slower emergency department wait times in comparison to other NSW hospitals. There was data to suggest stronger performance at the hospital however. These details would be relevant for baseline monitoring.

A range of engagement and SIA methods were used to collect and analyse information related to the social impacts of the Project. Results of the SIA analysis were considered according to the social impact categories defined in the Guideline. Of those categories, six were determined to be relevant to the Project:

1. way of life;
2. access to and use of infrastructure, services and facilities;
3. health and wellbeing;
4. surroundings;

5. personal and property rights; and
6. fears and aspirations.

The Project is predicted to yield both positive and negative socio-economic impacts for the regional and local populations across these categories, as identified in **Table 30**. The predicted positive impacts of the Project would likely have far reaching effects, with the potential to provide socio-economic benefit both locally and regionally.

Some of the predicted negative social impacts are localised (i.e. at property). Others are both cumulative and perceptual in nature. Some mitigation measures are available to address the predicted negative Project impacts. These are identified in the recommendations below.

**Table 30: Predicted positive and negative social impacts**

| Social impact type | Social impact category | Predicted social impact |
|---|---|---|
| Positive | Way of life | Local and regional employment opportunity |
| | | Local and regional business opportunity |
| | Personal and property rights | Driveway access improvements (Marulan South Road), benefitting both residents and road users |
| | Access to and use of infrastructure, services and facilities | Marulan South Road widening and upgrade (i.e. removal of dips, and bus-stop provision) for all road users |
| Negative | Access to and use of infrastructure, services and facilities | Cumulative and perceptual risk of increased traffic volume |
| | | Impact to condition of pavement on Marulan South Road |
| | Health and wellbeing | Perceived Low frequency (cumulative) noise |
| | | Disturbance from air brake noise |
| | Surroundings | At property headlight spill from re-aligned Marulan South Road |
| | Personal and property rights | Dust fallout causing damage to property asset (shed) |

# 9 SIA RECOMMENDATIONS

Where negative impacts are forecast, there are measures available to mitigate them, which would improve the social risk ratings allocated in the impact assessment chapter. It is recommended that the measures below be implemented for this purpose.

## 9.1 Access to and use of infrastructure, services and facilities

The increase in truck volumes on Marulan South Road and the condition of the road are social risks identified by this SIA. These social risks have been thoroughly considered and documented in this SIA, the EIS and associated technical studies. The EIS will be placed on public exhibition and all residents that have identified these social risks as well as GMC and the wider community will have the opportunity to view how these social risks have been assessed and the proposed mitigation and management measures to address them. When the EIS is placed on public exhibition it is recommended that:

- fenceline and Marulan South Road neighbours are notified in writing about the availability of the EIS on exhibition, the key social risks that were raised by the local community (including increased truck volumes on Marulan South Road and the condition of the road) and where these matters are addressed in the EIS, SIA and technical studies, how/where they can easily view the documentation, and an offer to contact Boral to meet with them to discuss any residual or additional concerns they may have; and
- Boral places an article in the Goulburn Post as well as on their website and Facebook page (and other media channels typically used throughout the SSD stakeholder engagement process) to notify of the EIS exhibition process as outlined above.

In both of these EIS exhibition phase notification/media release initiatives, Boral should emphasise:

- the minor increase in truck numbers proposed along Marulan South Road and the proposed upgrades to the road;
- aspects of Boral logistics driver training modules;
- behaviours that are designed to promote safe driving practices; and
- specific training for truck drivers using Marulan South Road.

It is recommended that any ongoing design, funding and construction discussions with GMC on the upgrade of Marulan South Road be expedited, finalised and made known to the community.

## 9.2 Health and wellbeing

In relation to perceived low frequency (cumulative) noise at the residence on Long Point Road it is recommended that the following measures are implemented:

1. undertake noise monitoring in accordance with a noise compliance monitoring program that will be outlined in the operations environment management plan;
2. continue to consult with the resident about any low frequency noise disturbance to determine times, dates and weather conditions; and
3. investigate ways to reduce and ultimately prevent low frequency noise concerns by the resident though changes to operations i.e. timing, location and/or attenuation (where feasible).

Boral is committed to ameliorating any low frequency noise issues if they arise for the Project consistent with the most recent low frequency noise assessment process from the Noise Policy for Industry.

In relation to the property owner that reported air brake disturbance from trucks along Marulan South Road, it is recommended that the commitment made by Boral to address air-braking in driver training be honoured, if not already.

## 9.3 Surroundings

To respond to the potential vehicle headlight impacts at proposed receiver ‘PR’, it is recommended that design adjustments to change the vertical alignment of the realigned section of Marulan South Road or the construction of vegetated earth bunds on the southern side of the road, be investigated during detailed design. This would occur in consultation with the potentially affected land owners, to avoid or at least minimise visual impacts from vehicles from the mine travelling west on the realigned section of Marulan South Road at night.

## 9.4 Personal and property rights

In response to the dust fallout reported to have affected the asset of the fenceline neighbour, it is recommended that the following measures are implemented:

1. continuation of dust monitoring in accordance with the air quality management plan;
2. relocation of the deposited dust gauges to the boundaries of the Project site;
3. consultation with the affected neighbour as to whether they would like further monitoring of deposited dust at the affected asset and agree on where and for how long this monitoring will be conducted;
4. provide deposited dust monitoring results to the neighbour;
5. Maintain the existing open communication channel with the neighbour so they can report any dust fallout on their property so that times, dates and weather conditions can be determined;
6. investigate ways to reduce and ultimately prevent dust fallout at the neighbour though changes to operations i.e. timing, location and/or additional dust suppression (where feasible); and
7. conduct specialist assessment of asset damage and engage with neighbour on rectifying the damage.

## 9.5 Fears and aspirations

The fear of an increased safety risk on Marulan South Road is perceptual and a cumulative social outcome which is related to the social risks of the increase in truck volumes on Marulan South Road and the condition of the road outlined in **Section 9.1**. The community engagement and media campaign outlined in **Section 9.1** is again recommended to counter the fears in the community.

## 9.6 Summary of negative impacts and recommended mitigation measures

The negative social impacts predicted for the Project, their description, and recommendations outlined to address them are summarised in **Table 31**. Should the recommendations be implemented, low social risk ratings would be achieved. Some low residual risks would remain. Of these risks, most would be immaterial whilst a smaller number would need to be addressed by compliance monitoring.

**Table 31: Summary of negative impacts and recommended mitigation measures**

| Social Impact Category | Impact Description | | | Impact without mitigation | | Impact with mitigation | | |
|---|---|---|---|---|---|---|---|---|
| | **Impact** | **Timing** | **Affected parties** | **Impact characteristic** | **Social risk rating** | **Mitigation** | **Social risk rating** | **Residual risk description** |
| **Way of life** | Impact to property values | All stages | Nearby residents | Reduced property values | Low | N/A | N/A | N/A |
| | Impact to business revenue | All stages | Nearby businesses | Reduced business revenue | Low | N/A | N/A | N/A |
| **Access to and use of infrastructure, services and facilities** | Impact to road network | Operational | Fenceline neighbours<br>Road users (Marulan South Road) | Cumulative and perceptual risk of increased traffic volume | Moderate | 1) written notification about the availability of the EIS on exhibition, and offer of meeting to fenceline neighbours; and<br>2) Facebook and local print media campaign to counter perception of increased heavy vehicle traffic | Low | Low and immaterial |
| | Impact to public infrastructure | Operational | Road users (Marulan South Road) | Impact to condition of pavement on Marulan South Road | Moderate | Marulan South Road upgrade | Low | Low and immaterial |
| **Health and wellbeing** | Acoustic impacts | Construction and operation | Fenceline and nearby residents | Perceived Low frequency (cumulative) noise | Moderate | 1) undertake noise monitoring;<br>2) continue to consult with the resident about any low frequency noise disturbance to determine times, dates and weather conditions; and<br>3) investigate ways to reduce and ultimately prevent low frequency noise concerns of the resident | Low | Low and immaterial |
| | | | | Disturbance from air brake noise | Moderate | 1) Honour commitment to address air braking in driver training. | Low | Low, however residual impacts will |

| Social Impact Category | Impact Description | | | Impact without mitigation | | Impact with mitigation | | |
|---|---|---|---|---|---|---|---|---|
| | Impact | Timing | Affected parties | Impact characteristic | Social risk rating | Mitigation | Social risk rating | Residual risk description |
| | | | | | | | | remain if compliance with training is not observed. |
| **Surroundings** | Visual impacts | Operational | Fenceline neighbour (identified as PR) | At property headlight spill from re-aligned Marulan South Road | Moderate | Investigate during detailed design, adjustments the vertical alignment of the realigned section of Marulan South Road, or the construction of vegetated earth bunds | Low | Low and immaterial |
| **Personal and property rights** | Dust impacts | Construction and operation | Fenceline neighbour | Dust fallout causing damage to property asset (shed) | Moderate | 1) Continuation of dust monitoring;<br>2) Relocation of the deposited dust gauges to the boundary of the Project site;<br>3) Consultation with the affected neighbour about further dust monitoring at the asset;<br>4) provide deposited dust monitoring results to the neighbour;<br>5) Maintain the existing open communication channel with the neighbour so they can report any dust fallout on their property;<br>6) investigate ways to reduce and ultimately prevent dust fallout; and<br>7) Conduct specialist assessment of asset damage and engage with neighbour on rectifying the damage | Low | Low, however residual risk will remain given the reported damage that has occurred. A specialist assessment would need to confirm the damage is related to dust fallout, and suggest a property treatment option, if feasible and warranted. Any treatment would reduce the residual risk to an |

| Social Impact Category | Impact Description | | | Impact without mitigation | | Impact with mitigation | | |
|---|---|---|---|---|---|---|---|---|
| | Impact | Timing | Affected parties | Impact characteristic | Social risk rating | Mitigation | Social risk rating | Residual risk description |
| | | | | | | | | immaterial level. |
| **Fears and aspirations** | Impact to personal safety | Operational | Road users | Cumulative and perceptual safety risk from increased heavy vehicle volume | Low | 1) written notification about the availability of the EIS on exhibition, and offer of meeting to fenceline neighbours; and<br>2) Facebook and local print media campaign to counter perception of increased heavy vehicle traffic | Low | Low and immaterial |
| | | | | Excessive speed limit on Marulan South Road | Low | N/A | N/A | N/A |

# 9.7 Management and monitoring framework

The mitigation measures summarised in **Table 31** should be implemented as part of a broader management and monitoring framework for the mine. Each social impact category and the associated impacts will be managed via a management plan, developed as part of the mine operations. Examples include the:

- traffic safety management plan (to address the impacts associated with the “Access to and use of infrastructure, services and facilities” social impact category);
- operations environment management plan (“Health and wellbeing”);
- air quality management plan (“Personal and property”); and
- safety management plan (“Fears and aspirations”).

In addition to these plans, the Peppertree Quarry and Marulan South Limestone Mine Community Plan will continue to be revised and implemented. The plan outlines a range of activities that enable the collection of stakeholder feedback, and therefore, the measurement of community sentiment. These activities include the Project website and feedback form, community newsletter, information stalls and static displays, and presentations upon request. The activities will foster a dialogue with stakeholders and provide a means to measure the social impacts that involve community perception.

Aside from the various management plans, performance measures applicable to the management framework are listed in **Table 32**, along with the measure type defined in the DPE assessment and mitigation framework (NSW Department of Planning and Environment, 2017). Community sentiment derived from stakeholder feedback exists as a performance measure, additional to those listed in **Table 32**.

**Table 32 – Performance measures**

| Social impact category | Objectives | Affected parties | Actions | Performance measures | Measure type |
|---|---|---|---|---|---|
| **Access to and use of infrastructure, services and facilities** | Counter cumulative and perceptual risk of increased heavy vehicle volumes<br>Maintain condition of Marulan South Road | Nearby residents | Written EIS exhibition notification to neighbours | Distribution of notifications to neighbours during EIS exhibition | Performance-based[3] |
| | | | Facebook and local print media campaign | Distribution of social media post and print media | Prescriptive[4] |
| | | | Marulan South Road upgrade | Completion of the upgrade | Prescriptive |
| **Health and wellbeing** | Counter perception of cumulative low frequency noise<br>Minimise disturbance of truck brake noise | Fenceline and nearby residents | Monitor noise | Noise level compliance per the Operations Environment Management Plan | Performance-based |
| | | | Continue to consult with the resident about any low frequency noise disturbance | The delivery of ongoing consultation | Management-based[5] |
| | | | Investigate ways to reduce and ultimately prevent low frequency noise | Carry-out investigations per Operations Environment Management Plan | Prescriptive |
| | | | Honour commitment to address air-braking in driver training | Develop and include in training sessions, content to address air-braking behaviours | Prescriptive |
| **Surroundings** | Minimise potential vehicle headlight impacts | Fenceline neighbour (identified as PR) | Consult with the potentially affected land owner, to avoid or at least minimise visual impacts from vehicles from the mine travelling west on the realigned | Ongoing consultation<br>Light spill following the completion of the upgrade | Prescriptive |

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[3] Performance criteria that must be complied with to achieve an appropriate outcome but do not specify how the outcome is to be achieved.
[4] Actions that need to be taken or things that must not be done, for example, adopt a known best-practice technology, design or management approach to mitigate the impact.
[5] Where the potential impacts can be satisfactorily avoided or mitigated by implementing known operational or technical approaches.

| Social impact category | Objectives | Affected parties | Actions | Performance measures | Measure type |
|---|---|---|---|---|---|
| | | | section of Marulan South Road at night | | |
| **Personal and property rights** | Minimise dust impacts | Fenceline neighbour | Continuation of dust monitoring | Dust level compliance per the air quality management plan | Performance-based |
| | | | Relocation of the deposited dust gauges to the boundaries of the Project site | Successful relocation of gauges | Prescriptive |
| | | | Consultation with the affected neighbour as to whether they would like further monitoring of deposited dust at the affected asset | Ongoing consultation and outcome regarding preference for further monitoring | Management-based |
| | | | Provide deposited dust monitoring results to the neighbour | Provision of results to neighbour | Prescriptive |
| | | | Maintain the existing open communication channel with the neighbour | Ongoing communication | Management-based |
| | | | Investigate ways to reduce and ultimately prevent dust fallout at the neighbouring property | Carry-out investigations per the air quality management plan | Prescriptive |
| | | | Conduct specialist assessment of asset damage and engage with neighbour on rectifying the damage | Ongoing consultation, following the completion of the assessment | Prescriptive |
| **Fears and aspirations** | Counter cumulative and perceptual risk of safety issues on Marulan South Road | Road users | Written EIS exhibition notification to neighbours | Distribution of notifications to neighbours during EIS exhibition | Performance-based |
| | | | Facebook and local print media campaign | Distribution of social media post and print media | Prescriptive |

### 9.7.1 Monitoring

A social impact monitoring framework will apply to all phases of the Project life-cycle, including during the construction of the Marulan South Road re-alignment. Monitoring results will be disclosed via the submission of an annual environmental management report (the principal reporting mechanism for the Project). The report will be prepared and submitted to DPE–Division of Resources and Geoscience's in accordance with conditions of the new mining lease and will include reporting on all key matters assessed in the EIS.

**Table 33** outlines the social issues which will be monitored to ensure compliance and meet the social objectives. In accordance with the Guideline, the table outlines the:

- key social issues to be monitored;
- how and when monitoring data will be collected; and
- community participation.

Although not included in **Table 33**, there are two additional data sources that apply to each social issue and provide value to the monitoring framework. The first is the Project complaints register which will continue to operate and provide data in relation to each social issue should a complaint be submitted.

The second is the Peppertree Quarry Community Consultative Committee (CCC). The CCC is an advisory group which consists of a representative of Goulburn Mulwaree Council and at least three local residents. Boral also supplies two representatives to the CCC.

Independently chaired, the role of the CCC is to offer Boral input from a community perspective on matters of environmental performance and community relations. Although established exclusively for the Peppertree Quarry, the CCC inadvertently yields feedback about the current Mine operations. Meetings include the review of environmental data and any feedback provided to the site from the local community. Issues of concern can be raised by the CCC representatives and it therefore will assist the monitoring program.

**Table 33 – Monitoring framework**

| Social impact category | Social issue | Data source | Data availability / frequency |
|---|---|---|---|
| **Access to and use of infrastructure, services and facilities** | Road user satisfaction | Council feedback | As available |
| | | Feedback received via Boral corporate communications channels (as outlined in the Peppertree Quarry and Marulan South Limestone Community Plan) | |
| **Health and wellbeing** | Noise disturbance | Environmental monitoring results (air quality) | Per the monitoring program specified in the air quality management plan |
| **Surroundings** | Visual disturbance | Fenceline neighbour (identified as PR) Consultation results | At least once during detailed design of the Marulan South Road re-alignment |
| | | Visual assessment | Once, post-completion of the Marulan South Road re-alignment |
| **Personal and property rights** | Dust impacts | Environmental monitoring results (air quality) | Per the monitoring program specified in the |

| Social impact category | Social issue | Data source | Data availability / frequency |
|---|---|---|---|
| | | | air quality management plan |
| **Fears and aspirations** | | Feedback received via Boral corporate communications channels (as outlined in the Peppertree Quarry and Marulan South Limestone Community Plan) | As available |

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# APPENDIX A: SOCIAL IMPACT CATEGORIES

**Social impact categories – extract from section 1.1. of the Guideline** (NSW Department of Planning and the Environment, 2017)

## 1.1 What are social impacts?

In the context of this guideline, a social impact is a consequence experienced by people[5] due to changes associated with a State significant resource project. As a guide[6], social impacts can involve changes to people's:

- **way of life**, including:
    - how people live, for example, how they get around, access to adequate housing
    - how people work, for example, access to adequate employment, working conditions and/or practices
    - how people play, for example, access to recreation activities
    - how people interact with one another on a daily basis
- **community**, including its composition, cohesion, character, how it functions and sense of place
- **access to and use of infrastructure, services and facilities**, whether provided by local, state, or federal governments, or by for-profit or not-for-profit organisations or volunteer groups
- **culture**, including shared beliefs, customs, values and stories, and connections to land, places, and buildings (including Aboriginal culture and connection to country)
- **health and wellbeing**, including physical and mental health[7]
- **surroundings**, including access to and use of ecosystem services[8], public safety and security, access to and use of the natural and built environment, and its aesthetic value and/or amenity[9]
- **personal and property rights**, including whether their economic livelihoods are affected, and whether they experience personal disadvantage or have their civil liberties affected
- **decision-making systems**, particularly the extent to which they can have a say in decisions that affect their lives, and have access to complaint, remedy and grievance mechanisms
- **fears and aspirations** related to one or a combination of the above, or about the future of their community.

# APPENDIX B: MEDIA

**20 May 2015 media release regarding the SSD**

Build something great™

## MEDIA RELEASE

20 May 2015

## Boral looks to continue local century-old mining tradition

Work is underway to secure a State Significant Development (SSD) planning approval for the continued operation of the Boral Marulan South Limestone operations, in line with legislative changes.

The operations, with origins dating as far back as 1871, produce around three million tonnes of limestone annually. The majority of this material is incorporated into cement manufacturing at Boral's Berrima Cement Works, supplier of around 60 percent of the overall need for cement in NSW and the ACT.

Until now, the limestone site has relied upon 'continuing use rights' and a range of other approvals for its day-to-day operation. However, as a result of amendments to both mining and planning laws in the last 10 years, an SSD approval is now the appropriate pathway.

Marulan South Limestone Mine Manager, Les Longhurst, said Boral had already commenced the task of gathering the wide variety of information needed for the SSD application, which would seek to extend the operations into the future.

"As it has for much of the past century, Marulan South Limestone plays a key role in the growth and development of NSW and the ACT. The resource is there to continue this role and Boral is committed to obtaining the necessary approval to secure the site's future," Mr Longhurst said.

"We have had experts looking at things such as air quality, water management, flora and fauna, heritage, transport and a range of other relevant topics. The information we have gathered will help shape the eventual SSD application we'll submit to the NSW Department of Planning and Environment."

Apart from the 30-year continuation, Boral's proposal will seek approval to mine up to 3.5 million tonnes of limestone per year, with an associated broadening and deepening of the existing mine pit.

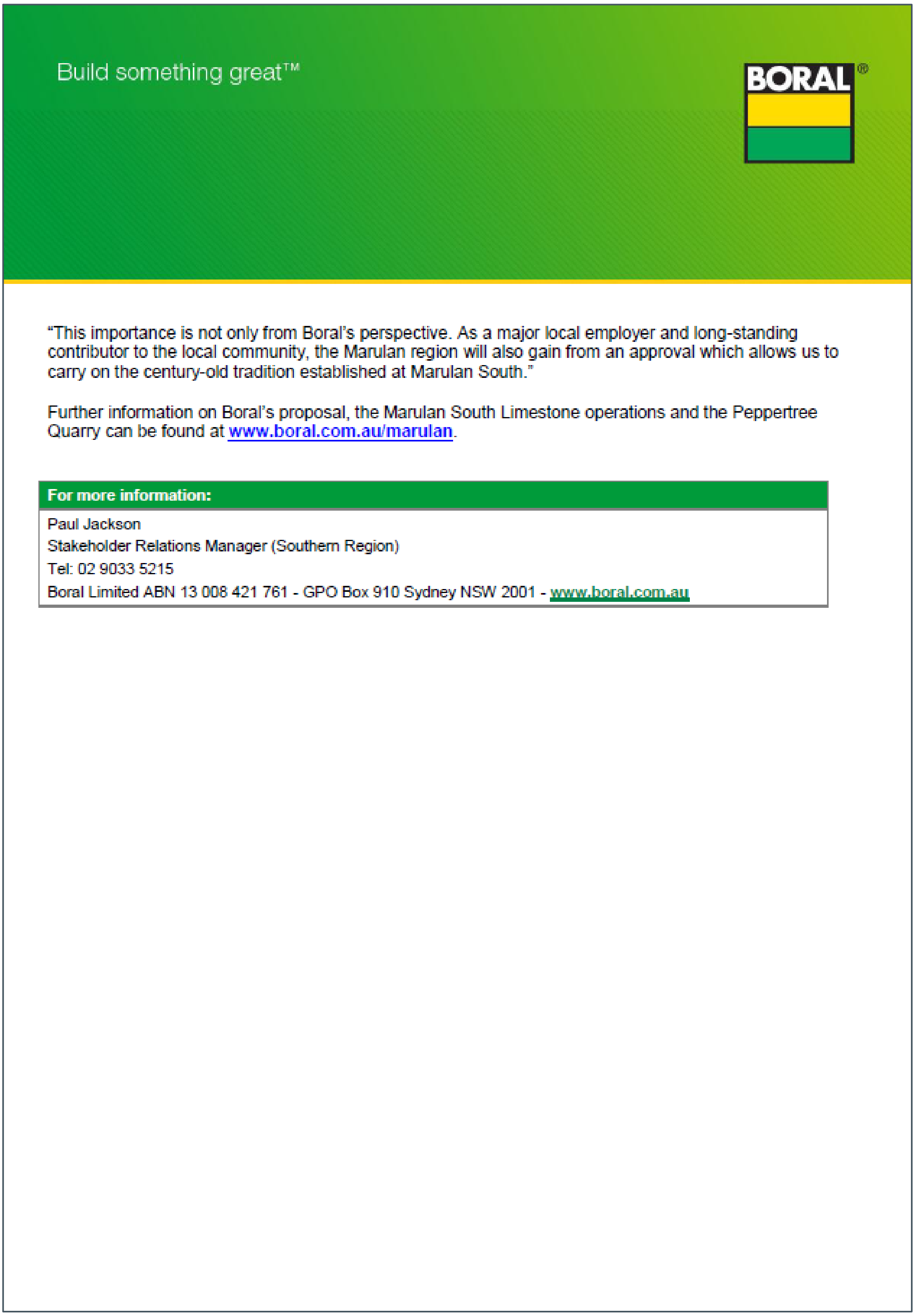
The application will also outline plans for the transfer of the resulting 'overburden' into the 'south pit' of the mine, which is to be filled and rehabilitated. In addition, new overburden emplacements will be proposed for the west and north-west of the limestone operations and for the neighbouring Boral Peppertree Quarry.

Negotiations with Goulburn Mulwaree Council in respect of upgrade measures and ongoing maintenance levies for the repair and maintenance of Marulan South Road are planned for inclusion in the application. Also included is the re-routing of the road near Boral's operations to allow for the new overburden emplacements.

In a separate application foreshadowed by Boral, Departmental approval will be sought for some minor changes at the Peppertree Quarry, needed to enhance the new quarry's production rate in the face of increased demand from the building and construction market.

These changes include permission for an additional six hours of 'in pit' activities per day at the 24-hour operation, establishing an additional overburden emplacement area, and confirmation of a combined annual 600 000 tonnes of material from both sites being moved along Marulan South Road.

"The two applications and the detail required in order to submit them is reflective of the importance of the Marulan South Limestone and Peppertree Quarry sites," Mr Longhurst said.



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"This importance is not only from Boral's perspective. As a major local employer and long-standing contributor to the local community, the Marulan region will also gain from an approval which allows us to carry on the century-old tradition established at Marulan South."

Further information on Boral's proposal, the Marulan South Limestone operations and the Peppertree Quarry can be found at www.boral.com.au/marulan.

**For more information:**

Paul Jackson
Stakeholder Relations Manager (Southern Region)
Tel: 02 9033 5215
Boral Limited ABN 13 008 421 761 - GPO Box 910 Sydney NSW 2001 - www.boral.com.au

## 25 May 2015 *Goulburn Post* news article

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**Goulburn Post, Goulburn NSW**
25 May 2015, by David Cole

General News, page 1 - 808.00 $\text{cm}^2$
Regional - circulation 2,967 (M-W-F--)

ID 411871228 BRIEF #BORAL MNT INDEX 1 PAGE 1 of 2

# THE LIME IS RIGHT

## BORAL APPLIES TO STATE FOR ANOTHER 30 YEARS AT MARULAN SOUTH

**DIGGING IN:** An aerial shot of Boral's Marulan South Limestone mine.

By **DAVID COLE**

BORAL is applying for State Significant Development (SSD) planning approval for the continued operation of its Marulan South Limestone operations for the next 30 years.

Mining began in the area back in 1871 and the mine now produces about three million tonnes of limestone annually.

The majority of this material is incorporated into cement manufacturing at Boral's Berrima Cement Works, a supplier of around 60 per cent of the overall need for cement in NSW and the ACT.

Until now, the limestone mine has relied upon 'continuing use rights' and a range of other approvals for its day-to-day operation.

However, as a result of amendments to both mining and planning laws in the last 10 years, an SSD approval is now the appropriate pathway.

Marulan South Limestone Mine Manager Les Longhurst said Boral had already commenced the task of gathering the wide variety of information needed for the application, which would seek to extend the mine's operations.

"As it has for much of the past century, Marulan South Limestone plays a key role in the growth and development of NSW and the ACT," Mr Longhurst said.

"The resource is there to continue this role and Boral is committed to obtaining the necessary approval to secure the site's future.

"We have had experts looking at things such as air quality, water management, flora and fauna, heritage, transport and a range of other relevant topics. The information we have gathered will help shape the eventual SSD application we'll submit to the NSW Department of Planning and Environment."

Mr Longhurst said apart from the 30-year continuation, Boral's proposal will seek approval to mine up to 3.5 million tonnes of limestone per year, with an associated broadening and deepening of the existing mine pit.

Continued page 3

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**Goulburn Post, Goulburn NSW**
25 May 2015, by David Cole

General News, page 1 - 808.00 cm²
Regional - circulation 2,967 (M-W-F--)

ID 411871228 BRIEF #BORAL MNT INDEX 1 PAGE 2 of 2

# Boral wants three more decades at Marulan South

From page 1

"The application will also outline plans for the transfer of the resulting 'overburden' into the 'south pit' of the mine, which is to be filled and rehabilitated. In addition, new overburden emplacements will be proposed for the west and north-west of the limestone operations and for the neighbouring Boral Peppertree Quarry," he said.

The application will also include the upgrade measures and ongoing maintenance levies for the repair and maintenance of Marulan South Road are planned. These are currently being negotiated with Goulburn Mulwaree Council. Also included is the re-routing of the road near Boral's operations to allow for the new overburden emplacements.

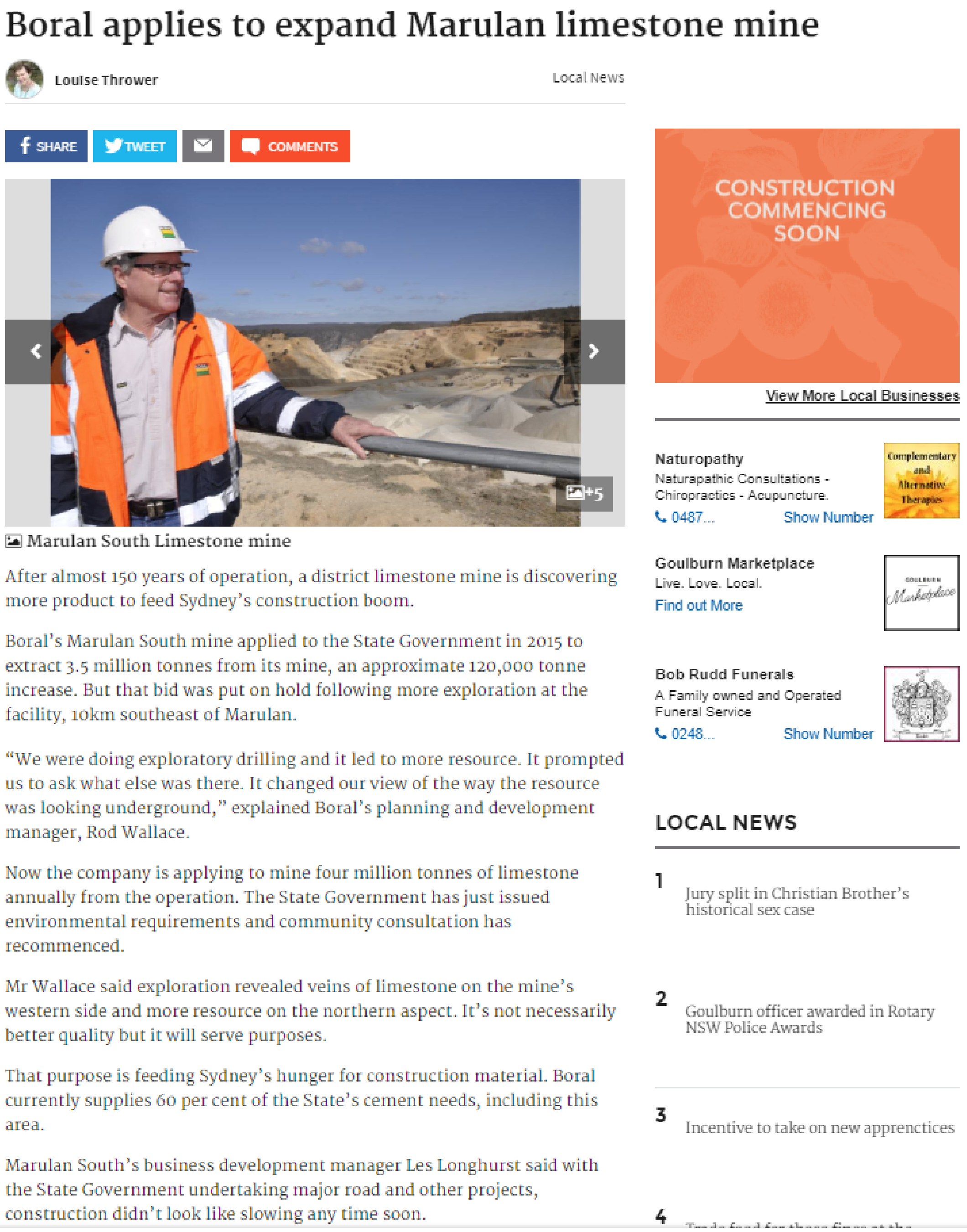
Mr Longhurst said a separate application by Boral, would seek departmental approval for some minor changes at the Peppertree Quarry needed to enhance the new quarry's production rate in the face of increased demand from the building and construction market.

"These changes include permission for an additional six hours of 'in pit' activities per day at the 24-hour operation, establishing an additional overburden emplacement area, and confirmation of a combined annual 600,000 tonnes of material from both sites being moved along Marulan South Road," he said.

"The two applications and the detail required in order to submit them is reflective of the importance of the Marulan South Limestone and Peppertree Quarry sites.

"Boral's is a major local employer and long-standing contributor to the local community, the Marulan region will also gain from an approval which allows us to carry on the century-old tradition established at Marulan South."

**20 August 2018 Goulburn Post article extract**



# Boral applies to expand Marulan limestone mine

Louise Thrower

Local News

Marulan South Limestone mine

After almost 150 years of operation, a district limestone mine is discovering more product to feed Sydney's construction boom.

Boral's Marulan South mine applied to the State Government in 2015 to extract 3.5 million tonnes from its mine, an approximate 120,000 tonne increase. But that bid was put on hold following more exploration at the facility, 10km southeast of Marulan.

"We were doing exploratory drilling and it led to more resource. It prompted us to ask what else was there. It changed our view of the way the resource was looking underground," explained Boral's planning and development manager, Rod Wallace.

Now the company is applying to mine four million tonnes of limestone annually from the operation. The State Government has just issued environmental requirements and community consultation has recommenced.

Mr Wallace said exploration revealed veins of limestone on the mine's western side and more resource on the northern aspect. It's not necessarily better quality but it will serve purposes.

That purpose is feeding Sydney's hunger for construction material. Boral currently supplies 60 per cent of the State's cement needs, including this area.

Marulan South's business development manager Les Longhurst said with the State Government undertaking major road and other projects, construction didn't look like slowing any time soon.

## LOCAL NEWS

1 Jury split in Christian Brother's historical sex case

2 Goulburn officer awarded in Rotary NSW Police Awards

3 Incentive to take on new apprenctices

4

### 6 and 8 August 2018 community drop-in session advertisement in the *Goulburn Post*

# Boral consults on expansion proposal

TWO public information sessions will be held in Marulan this week about Boral's plans to expand its limestone mine.

The Marulan South mine, 10km southeast of the main town, will soon lodge a revised Environmental Assessment (EA) to the State Government.

The company proposes to increase production from 3.5 million to four million tonnes per annum and to relocate over-burden material.

Stakeholder relations manager Paul Jackson said the application had been put on hold since 2015 as the company undertook more detailed exploration of the available resource. The realisation that there was more limestone available on the northern and western sides of the mine triggered a revision of environmental impact studies.

An information kiosk for interested people will be set up in the Marulan Hall on Wednesday from 2.30pm to 5.30pm and Thursday 9.30am to 1pm.

**BIG OPERATION:** Boral's limestone mine at Marulan South supplies 60 per cent of the state's cement needs. **Photo: Louise Thrower**

### 28 August 2018 social media post

**Boral**
28 August ·

Boral's Marulan South Limestone site has been providing materials which have helped build NSW and the ACT for almost 150 years. Up to 60% of all cement used across the state starts its life here...

We're now planning for the next 30 years of operations at the mine. Find out more at www.boral.com.au/marulan

96 · 5 Comments 6 shares

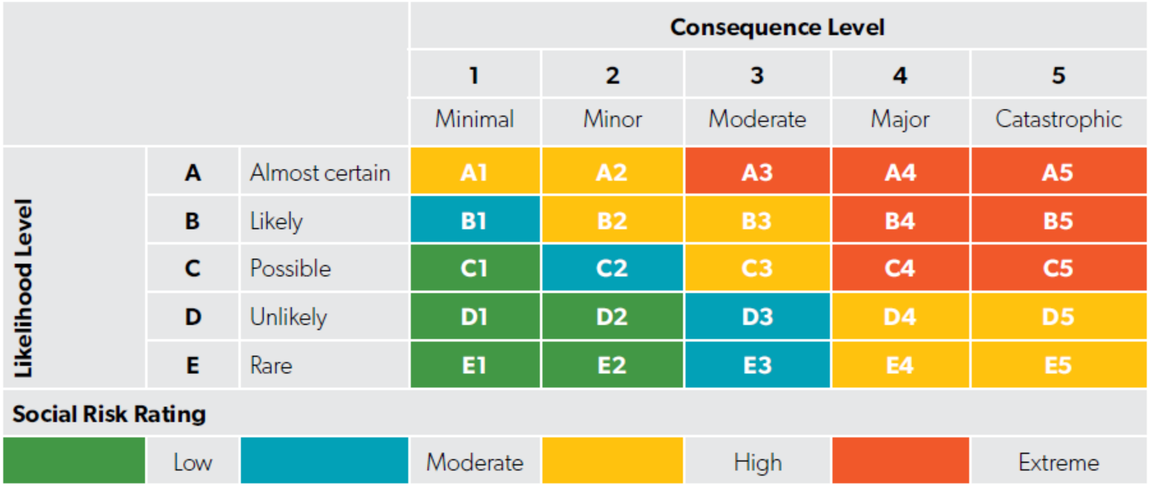
**Katrina Buckley** Baldy Baldman · 1
Like · Reply · 10w · 0

**Beefa Brian** Got nothing on Gunlake 😉
Like · Reply · 9w · 0
1 Reply

**Mark Mcnamara** Thanks to Crampy 🤣 · 1
Like · Reply · 9w · 0

**Meracious Arabians** Its great for the tourists when they come to the National Park and look across the gorge. Not to mention Bungonia creek which flows into the Shoalhaven river · 1
Like · Reply · 9w · 0

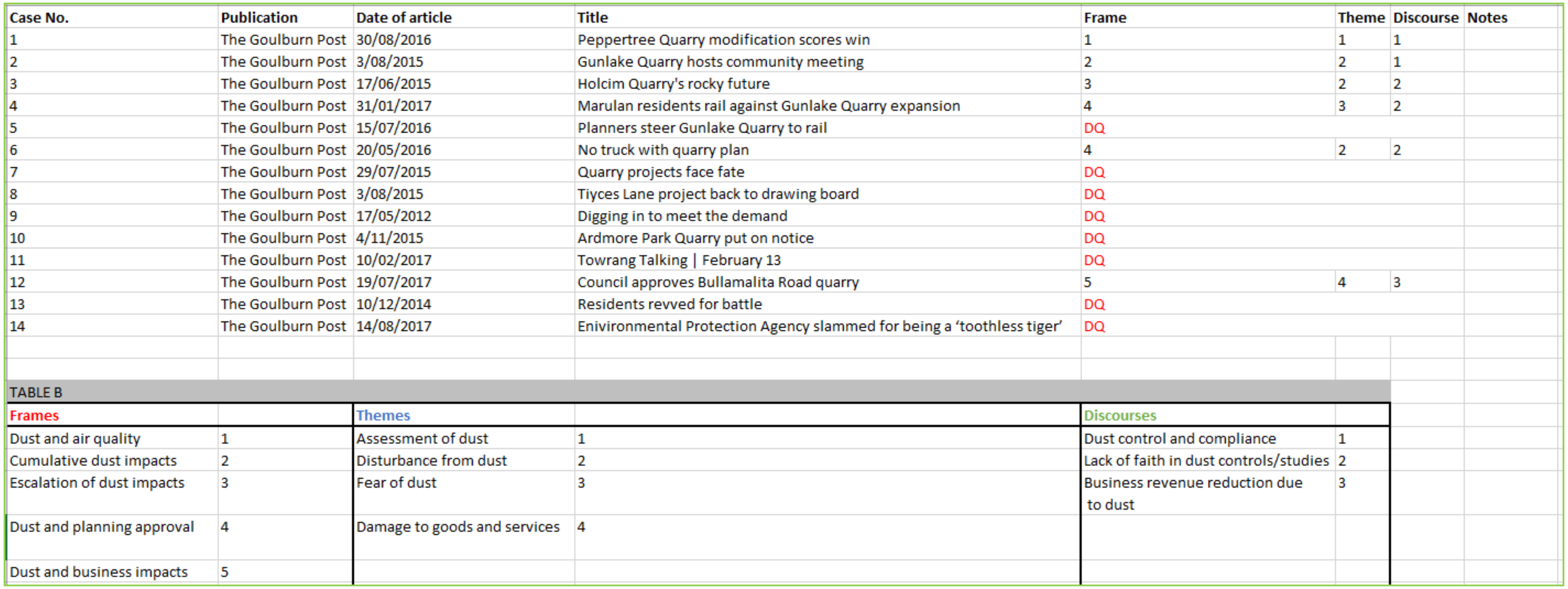
# APPENDIX C: SOCIAL RISK MATRIX



| | | | **Consequence Level** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| | | | Minimal | Minor | Moderate | Major | Catastrophic |
| **Likelihood Level** | **A** | Almost certain | **A1** | **A2** | **A3** | **A4** | **A5** |
| | **B** | Likely | **B1** | **B2** | **B3** | **B4** | **B5** |
| | **C** | Possible | **C1** | **C2** | **C3** | **C4** | **C5** |
| | **D** | Unlikely | **D1** | **D2** | **D3** | **D4** | **D5** |
| | **E** | Rare | **E1** | **E2** | **E3** | **E4** | **E5** |
| **Social Risk Rating** | | | | | | | |
| 🟩 | Low | 🟦 | Moderate | 🟨 | High | 🟥 | Extreme |

# APPENDIX D: ECA PROTOCOLS

## ECA protocol for dust impacts

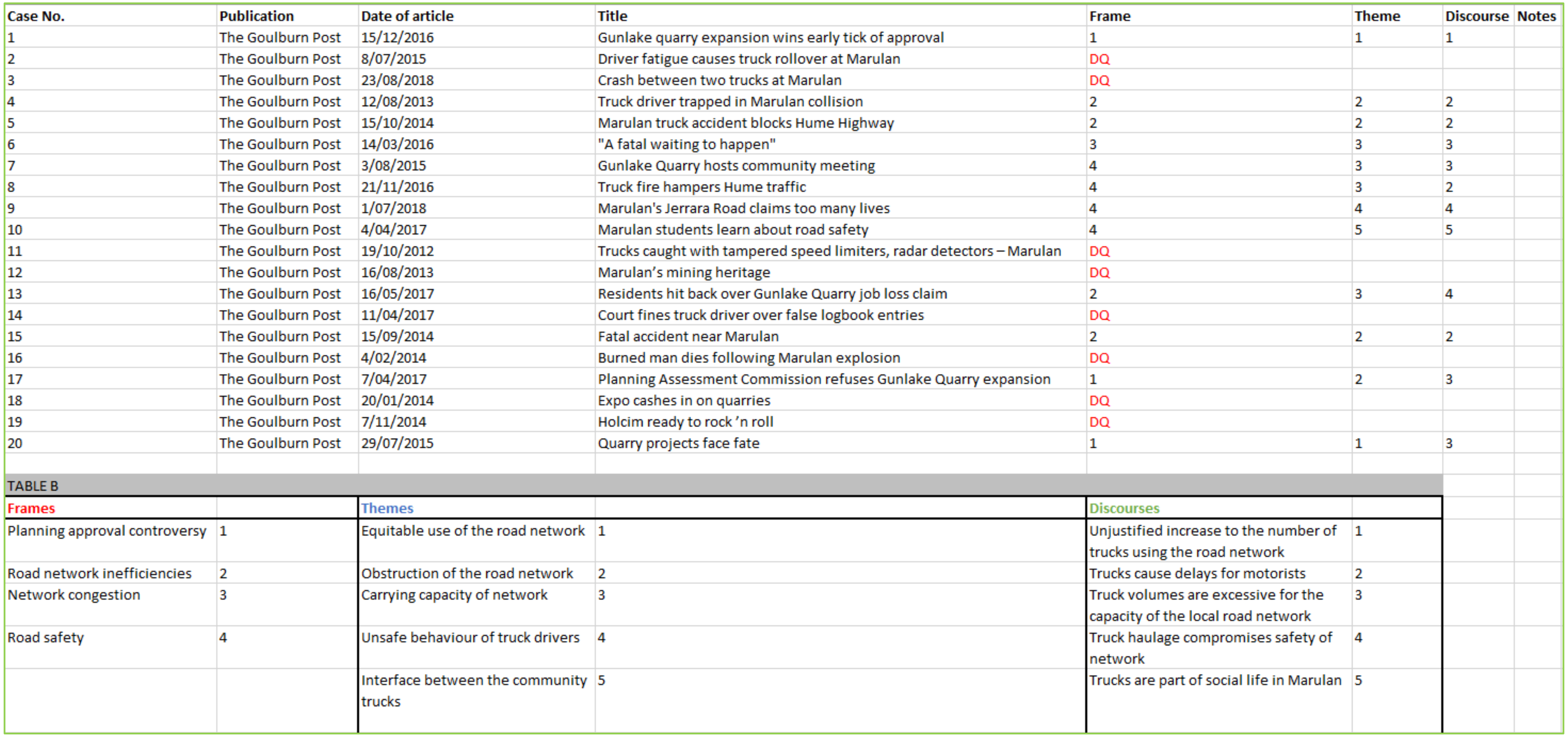


| Case No. | Publication | Date of article | Title | Frame | Theme | Discourse | Notes |
|---|---|---|---|---|---|---|---|
| 1 | The Goulburn Post | 30/08/2016 | Peppertree Quarry modification scores win | 1 | 1 | 1 | |
| 2 | The Goulburn Post | 3/08/2015 | Gunlake Quarry hosts community meeting | 2 | 2 | 1 | |
| 3 | The Goulburn Post | 17/06/2015 | Holcim Quarry's rocky future | 3 | 2 | 2 | |
| 4 | The Goulburn Post | 31/01/2017 | Marulan residents rail against Gunlake Quarry expansion | 4 | 3 | 2 | |
| 5 | The Goulburn Post | 15/07/2016 | Planners steer Gunlake Quarry to rail | DQ | | | |
| 6 | The Goulburn Post | 20/05/2016 | No truck with quarry plan | 4 | 2 | 2 | |
| 7 | The Goulburn Post | 29/07/2015 | Quarry projects face fate | DQ | | | |
| 8 | The Goulburn Post | 3/08/2015 | Tiyces Lane project back to drawing board | DQ | | | |
| 9 | The Goulburn Post | 17/05/2012 | Digging in to meet the demand | DQ | | | |
| 10 | The Goulburn Post | 4/11/2015 | Ardmore Park Quarry put on notice | DQ | | | |
| 11 | The Goulburn Post | 10/02/2017 | Towrang Talking \| February 13 | DQ | | | |
| 12 | The Goulburn Post | 19/07/2017 | Council approves Bullamalita Road quarry | 5 | 4 | 3 | |
| 13 | The Goulburn Post | 10/12/2014 | Residents revved for battle | DQ | | | |
| 14 | The Goulburn Post | 14/08/2017 | Enivironmental Protection Agency slammed for being a 'toothless tiger' | DQ | | | |

TABLE B

| Frames | | Themes | | Discourses | |
|---|---|---|---|---|---|
| Dust and air quality | 1 | Assessment of dust | 1 | Dust control and compliance | 1 |
| Cumulative dust impacts | 2 | Disturbance from dust | 2 | Lack of faith in dust controls/studies | 2 |
| Escalation of dust impacts | 3 | Fear of dust | 3 | Business revenue reduction due to dust | 3 |
| Dust and planning approval | 4 | Damage to goods and services | 4 | | |
| Dust and business impacts | 5 | | | | |

## ECA protocol for road and rail network impacts



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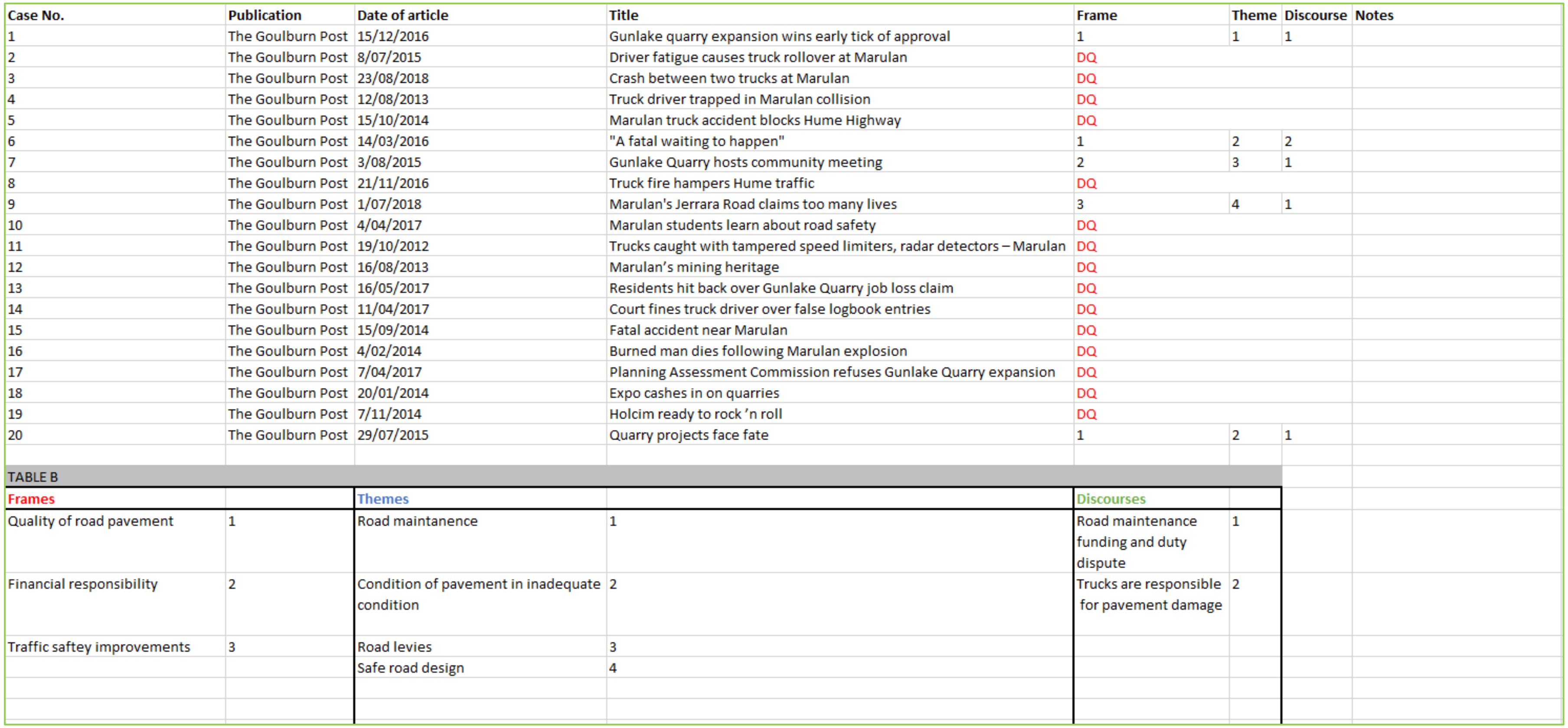
| 2 | The Goulburn Post | 8/07/2015 | Driver fatigue causes truck rollover at Marulan | DQ | | | |
| 3 | The Goulburn Post | 23/08/2018 | Crash between two trucks at Marulan | DQ | | | |
| 4 | The Goulburn Post | 12/08/2013 | Truck driver trapped in Marulan collision | 2 | 2 | 2 | |
| 5 | The Goulburn Post | 15/10/2014 | Marulan truck accident blocks Hume Highway | 2 | 2 | 2 | |
| 6 | The Goulburn Post | 14/03/2016 | "A fatal waiting to happen" | 3 | 3 | 3 | |
| 7 | The Goulburn Post | 3/08/2015 | Gunlake Quarry hosts community meeting | 4 | 3 | 3 | |
| 8 | The Goulburn Post | 21/11/2016 | Truck fire hampers Hume traffic | 4 | 3 | 2 | |
| 9 | The Goulburn Post | 1/07/2018 | Marulan's Jerrara Road claims too many lives | 4 | 4 | 4 | |
| 10 | The Goulburn Post | 4/04/2017 | Marulan students learn about road safety | 4 | 5 | 5 | |
| 11 | The Goulburn Post | 19/10/2012 | Trucks caught with tampered speed limiters, radar detectors – Marulan | DQ | | | |
| 12 | The Goulburn Post | 16/08/2013 | Marulan's mining heritage | DQ | | | |
| 13 | The Goulburn Post | 16/05/2017 | Residents hit back over Gunlake Quarry job loss claim | 2 | 3 | 4 | |
| 14 | The Goulburn Post | 11/04/2017 | Court fines truck driver over false logbook entries | DQ | | | |
| 15 | The Goulburn Post | 15/09/2014 | Fatal accident near Marulan | 2 | 2 | 2 | |
| 16 | The Goulburn Post | 4/02/2014 | Burned man dies following Marulan explosion | DQ | | | |
| 17 | The Goulburn Post | 7/04/2017 | Planning Assessment Commission refuses Gunlake Quarry expansion | 1 | 2 | 3 | |
| 18 | The Goulburn Post | 20/01/2014 | Expo cashes in on quarries | DQ | | | |
| 19 | The Goulburn Post | 7/11/2014 | Holcim ready to rock 'n roll | DQ | | | |
| 20 | The Goulburn Post | 29/07/2015 | Quarry projects face fate | 1 | 1 | 3 | |

TABLE B

| Frames | | Themes | | Discourses | |
|---|---|---|---|---|---|
| Planning approval controversy | 1 | Equitable use of the road network | 1 | Unjustified increase to the number of trucks using the road network | 1 |
| Road network inefficiencies | 2 | Obstruction of the road network | 2 | Trucks cause delays for motorists | 2 |
| Network congestion | 3 | Carrying capacity of network | 3 | Truck volumes are excessive for the capacity of the local road network | 3 |
| Road safety | 4 | Unsafe behaviour of truck drivers | 4 | Truck haulage compromises safety of network | 4 |
| | | Interface between the community trucks | 5 | Trucks are part of social life in Marulan | 5 |



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| 5 | The Goulburn Post | 15/10/2014 | Marulan truck accident blocks Hume Highway | DQ | | | |
| 6 | The Goulburn Post | 14/03/2016 | "A fatal waiting to happen" | 1 | 2 | 2 | |
| 7 | The Goulburn Post | 3/08/2015 | Gunlake Quarry hosts community meeting | 2 | 3 | 1 | |
| 8 | The Goulburn Post | 21/11/2016 | Truck fire hampers Hume traffic | DQ | | | |
| 9 | The Goulburn Post | 1/07/2018 | Marulan's Jerrara Road claims too many lives | 3 | 4 | 1 | |
| 10 | The Goulburn Post | 4/04/2017 | Marulan students learn about road safety | DQ | | | |
| 11 | The Goulburn Post | 19/10/2012 | Trucks caught with tampered speed limiters, radar detectors – Marulan | DQ | | | |
| 12 | The Goulburn Post | 16/08/2013 | Marulan's mining heritage | DQ | | | |
| 13 | The Goulburn Post | 16/05/2017 | Residents hit back over Gunlake Quarry job loss claim | DQ | | | |
| 14 | The Goulburn Post | 11/04/2017 | Court fines truck driver over false logbook entries | DQ | | | |
| 15 | The Goulburn Post | 15/09/2014 | Fatal accident near Marulan | DQ | | | |
| 16 | The Goulburn Post | 4/02/2014 | Burned man dies following Marulan explosion | DQ | | | |
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| 18 | The Goulburn Post | 20/01/2014 | Expo cashes in on quarries | DQ | | | |
| 19 | The Goulburn Post | 7/11/2014 | Holcim ready to rock 'n roll | DQ | | | |
| 20 | The Goulburn Post | 29/07/2015 | Quarry projects face fate | 1 | 2 | 1 | |

TABLE B

| Frames | | Themes | | Discourses | |
|---|---|---|---|---|---|
| Quality of road pavement | 1 | Road maintanence | 1 | Road maintenance funding and duty dispute | 1 |
| Financial responsibility | 2 | Condition of pavement in inadequate condition | 2 | Trucks are responsible for pavement damage | 2 |
| Traffic saftey improvements | 3 | Road levies | 3 | | |
| | | Safe road design | 4 | | |

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