CSR Advanced manufacturing hub - Modification 3

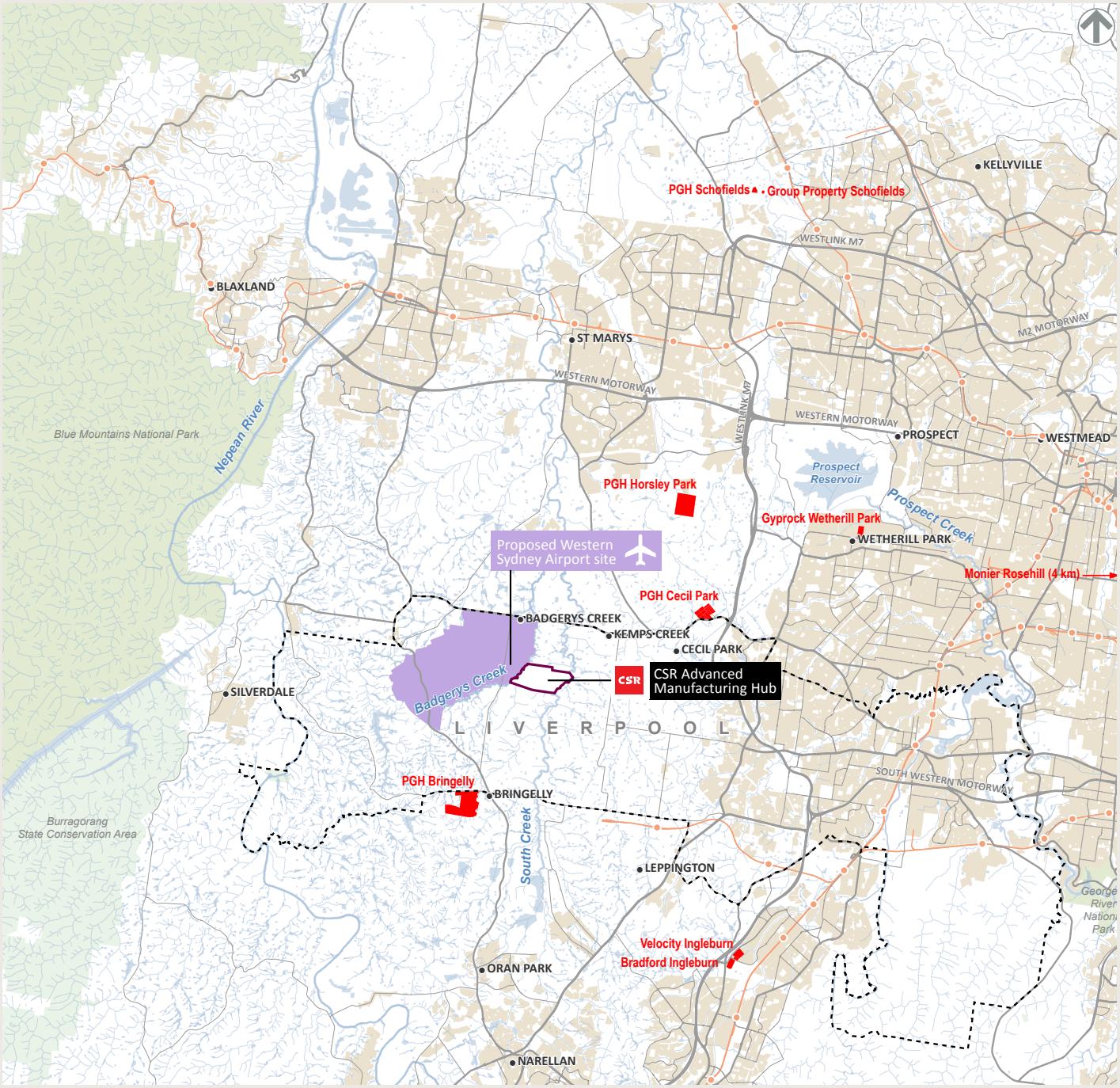
RESPONSE TO SUBMISSIONS

Prepared for CSR Building Products Limited - October 2019



"Developing CSR's first Advanced Manufacturing Hub is a culmination of years of strategic business planning, to ensure CSR are well placed to continue as one of the leading organisations that creates environments where people, live, work and play. Successfully delivering the Advanced Manufacturing Hub will be a major catalyst for generating employment outcomes to the Western Sydney Aerotropolis."

Allison Basford
Senior Development Manager - Australia & New Zealand
CSR - Group Property



CSR Advanced Manufacturing Hub

MODIFICATION 3 ENVIRONMENTAL ASSESSMENT | RESPONSE TO SUBMISSIONS AND PREFERRED PROJECT REPORT

Prepared for CSR Building Products Limited
30 September 2019

PR30

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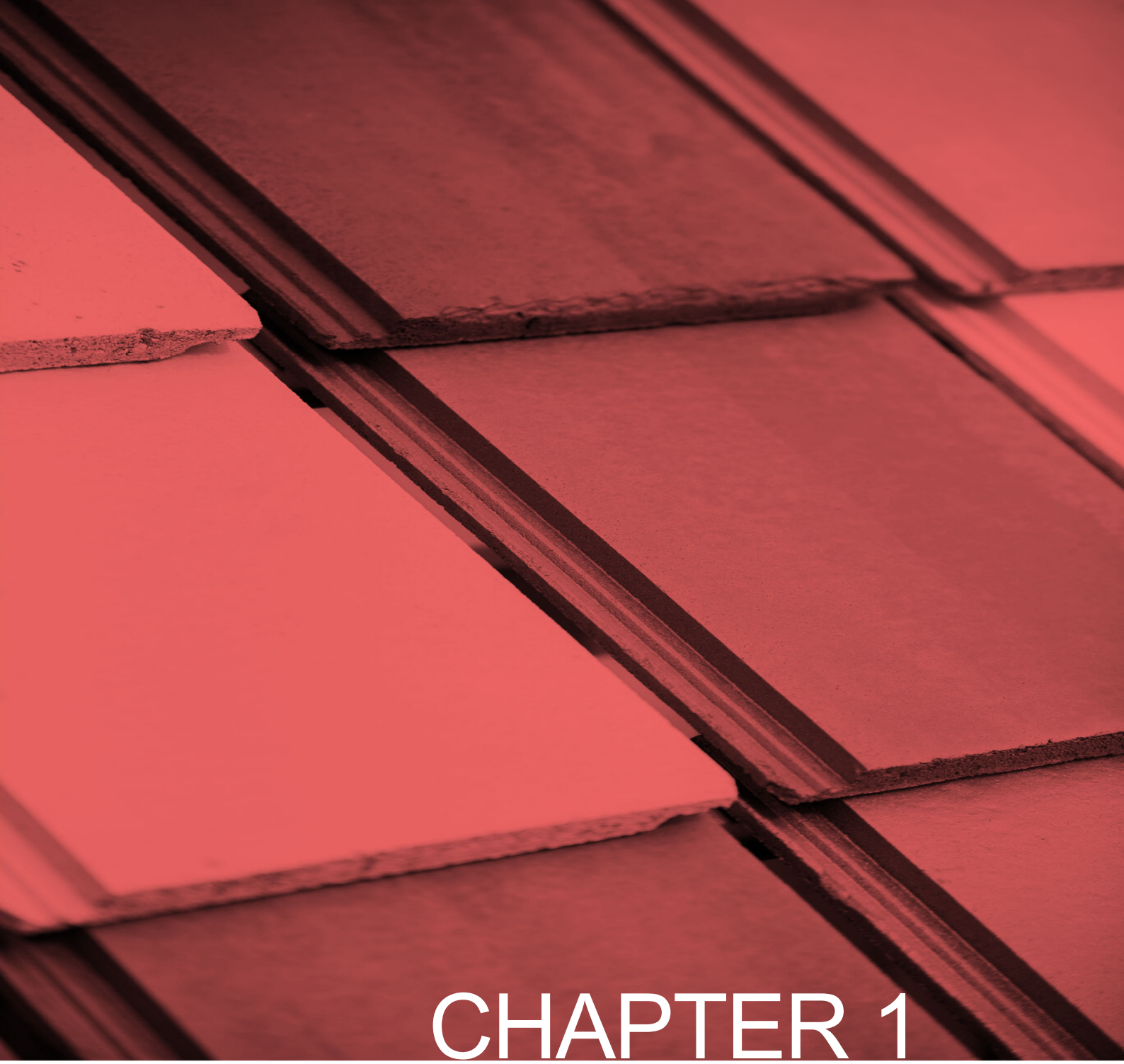
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CHAPTER 1
INTRODUCTION

1 INTRODUCTION

This report provides a response to submissions (RTS) on the environmental assessment (EA) for CSR Building Products Limited's (CSR) proposal to modify Project Approval (PA) – 10_0014 and Concept Plan (CP) – 10/0033 (Modification 3 - the modification).

In addition to responding to submissions, this report provides a revised project description (preferred project – referred to as the project) and summarises the assessment of the revised project. As described in Chapter 2, the project has been revised since exhibition in response to the Western Sydney Planning Partnership's (WSPP) and the NSW Department of Planning, Industry and Environment's (DPIE) submissions on the compatibility of the modification with DPIE's (2018) *Western Sydney Aerotropolis Land Use and Infrastructure Plan – Stage 1: Initial Precincts* (LUIIP).

The purpose of Modification 3 is to allow CSR to realise the full potential of the site and meet the strategic needs of their brick business.

1.1 Overview

CSR is seeking approval to recommence site activities, upgrade the brick making facility and construct new ancillary infrastructure (refer to Chapter 2 for description). As described in 2.2, construction and operation of a new roof products manufacturing facility is no longer a component of the project.

To allow for these changes to the PA, approval is required under Section 75W of the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act).

Element Environment prepared an EA report on behalf of CSR, which summarised the potential impacts from the project.

The DPIE placed the EA report on public exhibition, which concluded on 13 May 2019. DPIE requested an RTS detailing responses to the issues raised in submissions.

Eighteen submissions were received from DPIE, various government agencies and one community organisation.

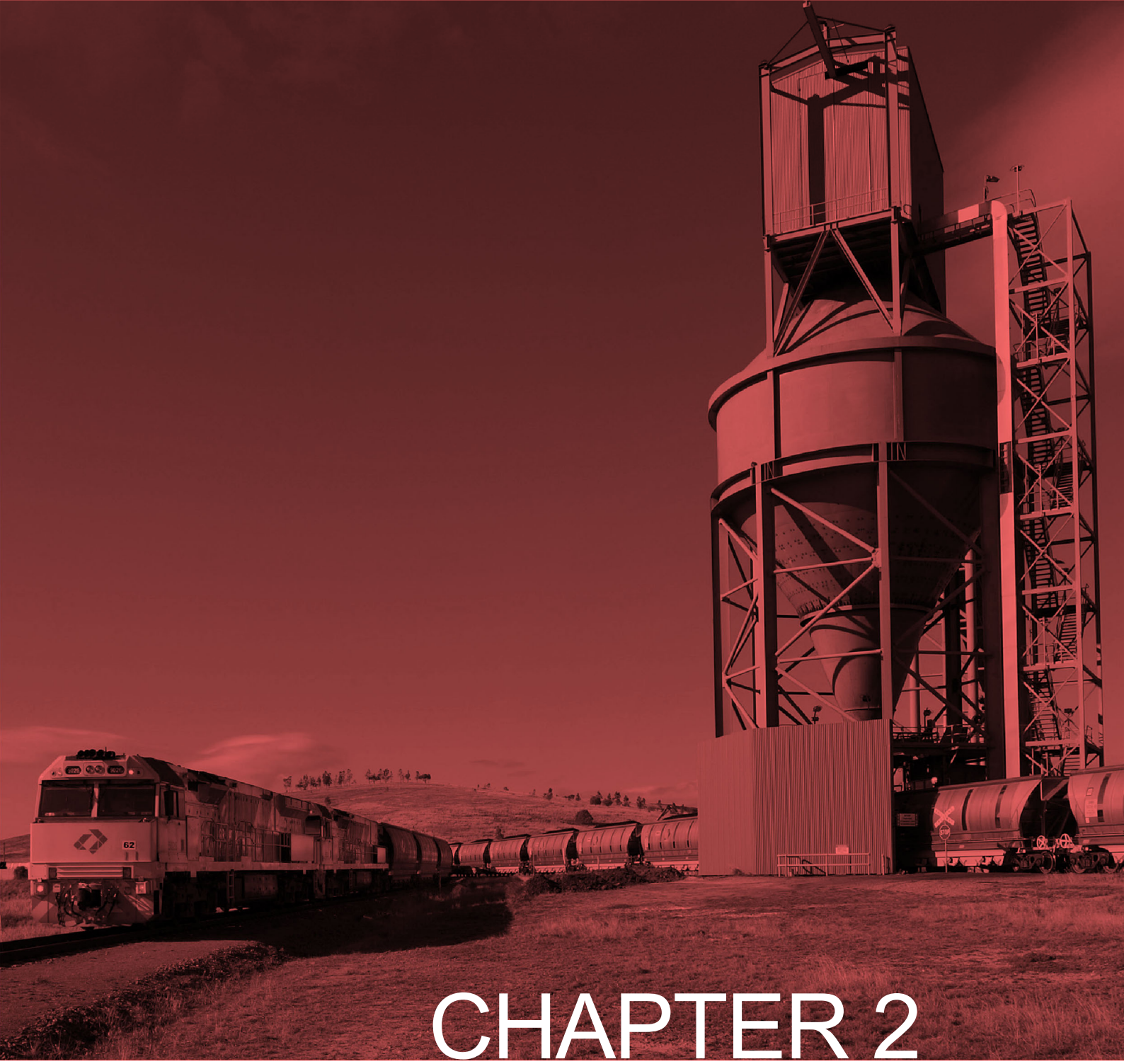
CSR submitted an additional Section 75W application and EA to modify the PA and consent (Modification 4), covering the following:

- Pit dewatering and clay extraction.
- Importation of virgin excavated natural material.
- Revision of the 30-year quarry staging plans.
- Construction and operation of a solar farm.

Public exhibition of the EA concluded on 16 May 2019 and DPIE requested an RTS report be prepared on 21 May 2019. Components of Modification 4 are summarised in this report as the project includes changes to that modification, which have been assessed under the assessment of the project described in this report. Refer to 2.2 for a description of the project and how it relates to modifications 3 and 4.

1.2 Purpose of this report

This report has been prepared in accordance with the DPIE's (2017) *Draft Environmental Impact Assessment Guidance Series: Responding to Submissions.* The purpose of the document is to summarise and respond to agency and public submissions and provide clarification of project components where relevant.



CHAPTER 2

OVERVIEW OF THE EXHIBITED PROJECT

2 OVERVIEW OF THE EXHIBITED AND PREFERRED PROJECTS

2.1 Key components of the exhibited project

In October 2016, CSR acquired Boral Bricks Pty Limited's (Boral) brick business along the eastern seaboard of Australia including the Badgerys Creek Brick Making Facility site (the site). The site is strategically placed in the Western Sydney Priority Growth Area and borders the proposed Western Sydney Airport (WSA) precinct.

CSR initially sought to modify the PA and CP to achieve the activities described below and presented in Figure 2.1. As described in Section 2.2, some components of the project have been revised in response to submissions from the WSPP and DPIE.

2.1.1 Advanced manufacturing – brick production

Construction and operation of the brick production component of the proposed advanced manufacturing hub will comprise:

- Removal of most of the existing brick manufacturing equipment and replacement with new brick manufacturing equipment in the existing brick making facility.
- Increase in the building footprint of the existing brick making facility.
- Increase in the building footprint of the existing administration building.
- A National Association of Testing Authorities (NATA) accredited advanced testing laboratory.
- Extension to the existing visitor's carpark.
- An innovation centre.
- A weighbridge.
- Factory staff parking.
- A new access road to the factory staff parking area and for bulk material deliveries and dispatch.
- New rainwater tanks.

2.1.2 Advanced manufacturing – roof products production

Construction and operation of the roof products production component of the proposed advanced manufacturing hub will comprise:

- Construction and operation of a roof products manufacturing facility on CSR owned land, outside the approved project boundary, immediately east of Pit 4.
- Modification to the approved project boundary to include the proposed roof products manufacturing facility, located on the adjacent property.
- The processing of sandstone (burden material not used in brick production) for use in the manufacture of roof products on-site.

2.1.3 Other

Other aspects of the project will comprise:

- Re-commence previously approved operations at the site, thus removing the current 'mothballed' status of the site.
- Amendment to the extent of Pit 5 to include a 200 m buffer zone to neighbouring residential properties required under the NSW *Mining Act 1992*.

- An increase in the importation of raw materials from off-site for use in both the brick making and roof products manufacturing facilities.
- Modifications to the approved noise bunds.
- Upgrade of the existing Martin Road-Elizabeth Drive intersection to a signalised intersection.

The modification constitutes Modification 3 to the PA. The Minister for Planning is the consent authority for the project.

Backfill of the pits and establishment of a grid connected solar farm are subject to a separate modification application (Modification 4).

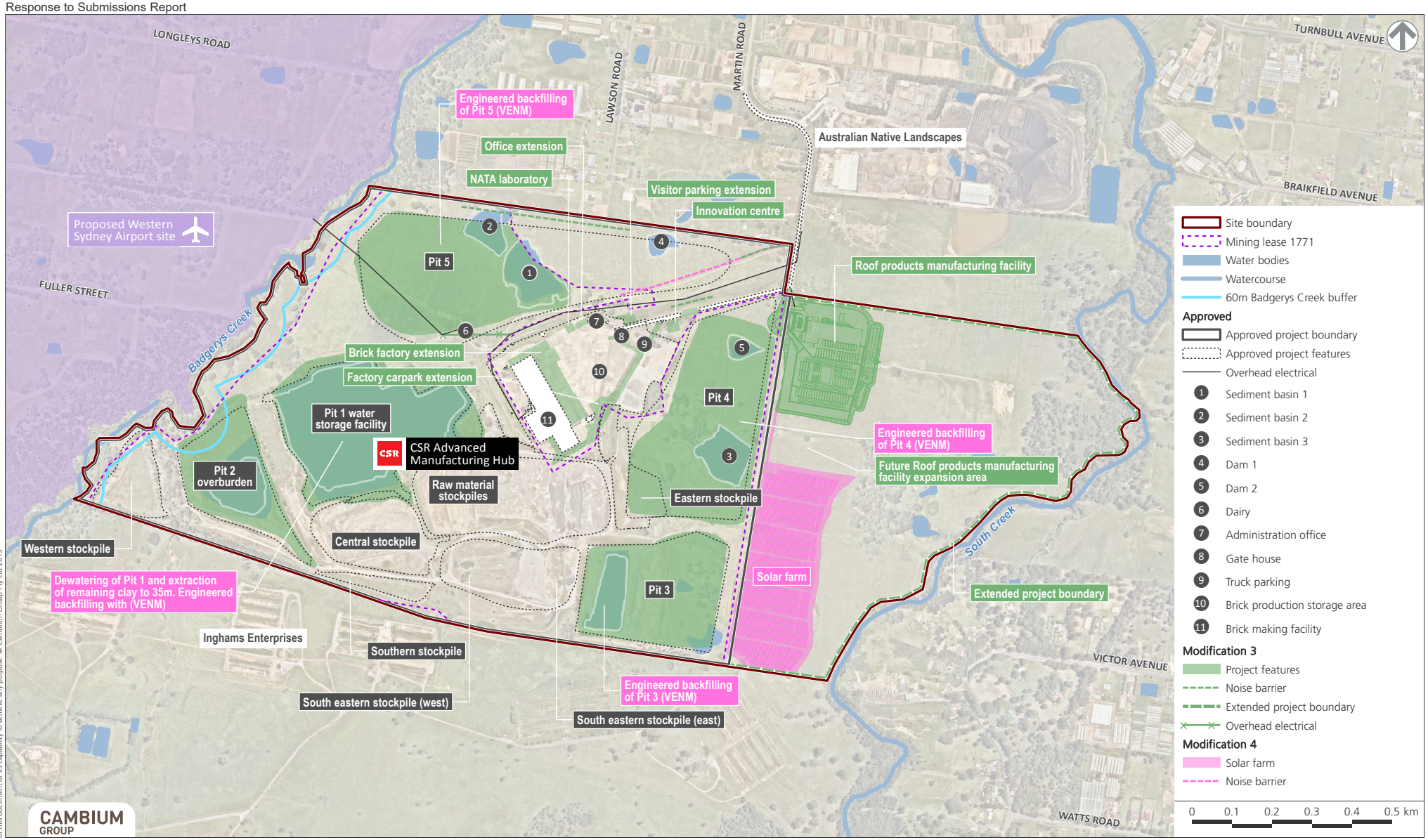
The EA was prepared to inform the public, government authorities and other stakeholders about the project and the measures that will be implemented to mitigate, manage and/or monitor potential impacts, together with a description of residual social, economic and environmental impacts.

Figure 2.1

Overview of exhibited Modifications 3 and 4

CSR ADVANCED MANUFACTURING HUB

Response to Submissions Report



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Source: LPI (2017), Nearmap (2018), Department of Infrastructure and Regional Development - Western Sydney Airport - Draft Environmental Impact Statement (2015), VGT (2018), Wilkinson Murray (2018), BECA (2018), Crossmuller Technology (2018), SBA Architects (2018), Cambium Group (2019).

2.2 Key components of the preferred project

2.2.1 Background

The WSPP provided a submission to both CSR's Advanced Manufacturing Hub modification applications (3 and 4) (refer to Section 5.3), raising concern that the proposed modifications were inconsistent with the LUIIP.

CSR met with DPIE and WSPP on 3 July 2019 to discuss concerns raised in WSPPs submission on the consistency of the modification with the LUIIP. It was agreed in this meeting that the modifications would need to:

- discuss how and when parts of the site could be made available for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- that a 40m wide easement for the future realignment and extension of Martin Road through the site can be accommodated.

Following the 3 July meeting, CSR revisited its proposed project and developed a 'preferred project' which:

- reduces the extent and duration of quarrying on the site, thereby reducing the volume of virgin excavated natural material (VENM) and the duration of VENM importation required to backfill quarry pits on the site;
- removes the proposed Monier roof products manufacturing facility and solar farm;
- frees up all but a 30 hectare (Ha) portion of the 200 Ha site for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- accommodates a six lane road within a 40m wide easement for the future realignment and extension of Martin Road through the site.

CSR met with DPIE as described in Section 4.2.1 to present the preferred project and agree on the best process to change the proposed modifications as currently presented in the modification 3 and 4 EAs and response to submissions report. The following description of the preferred project is based on the outcomes of the meeting.

2.2.2 Overview of the preferred project

Key components of the preferred project are:

Modification 3:

- Construction and operation of the brick making facility comprising:
  - removal of most of the existing brick manufacturing equipment and replacement with new brick manufacturing equipment in the existing brick making facility;
  - increase in the building footprint of the existing brick making facility;
  - increase in the building footprint of the existing administration building;
  - a National Association of Testing Authorities (NATA) accredited advanced testing laboratory;
  - extension to the existing visitor's carpark;
  - an innovation centre;
  - a weighbridge;
  - factory staff parking;
  - a new access road to the factory staff parking area and for bulk material deliveries and dispatch; and
  - new rainwater tanks.

- Construction of a 3 m high landscaped earth bund around the western, southern and eastern sides of the brick making facility's raw material stockpile area (refer to Figure 2.6 for a typical cross-section of the landscaped earth bund).
- Landscaping (including screening plants) around the northern and eastern sides of the brick making facility.
- Extraction of the remaining clay from Pit 3 for up to a maximum of 10 years.
- Landscaping (including screening plants) around the western and part of the northern and southern sides of Pit 3.
- Upgrade of the existing Martin Road-Elizabeth Drive intersection to a signalised intersection.

Modification 4:

- Dewatering of Pit 1 with use of water for onsite processes and irrigation, transfer offsite for use by other parties (eg WSA and Australian Native Landscapes) or discharge to local creeks.
- Importation of VENM to backfill quarry pits 1, 2 and 3 to allow for future development consistent with the objectives of the Western Sydney Aerotropolis.

The following aspects, previously included in the modification 3 and 4 applications will not form part of the preferred project:

- Monier roof products manufacturing facility (Modification 3);
- quarry pits 4 and 5 (extraction of burden, clay and sandstone) (Modification 3);
- quarry pits 4 and 5 (backfilling with VENM) (Modification 4);
- solar farm (Modification 4); and
- extraction of the remaining clay from Pit 1 (Modification 4).

Overview of phases

The four phases of the preferred project in terms of each modification are summarised below.

A comparison of the approved project against the proposed preferred project and the variance between the preferred project and combined modification 3 and 4 components is shown in Table 2.1. A comparison of the approved project operating hours against the proposed preferred project operating hours is shown in Table 2.2. Changes to the number of heavy vehicle movements associated with the preferred project are shown in Table 2.3.

The previously proposed Monier roof products manufacturing facility, the solar farm, pits 4 and 5 and further extraction in Pit 1 have been removed from the below scenarios.

Modification 3

Phase 1

This phase represents years one to six (approximately end of 2019 to end of 2025 – refer to Figure 2.2):

- Pits 2 and 3 are dewatered into Pit 1 over seven weeks and three weeks respectively.
- Pit 2 is backfilled (engineered fill) with existing fill in Pit 2 (405,000 m^3), unusable/burden stockpiles located in the southern part of the site (500,000 m^3) and burden yet to be extracted from Pit 3 (115,000 m^3).

  It will take approximately two years to extract and re-emplace the existing fill in Pit 2 and five to six months to backfill the remainder of Pit 2.

- 420,000 t/year of clay is extracted from Pit 3.
- 275,000 t/year of clay is exported from site to other PGH brick making facilities.
- 215,000 t/year of clay is imported to site for manufacturing bricks.

- 300,000 t/year of bricks are manufactured.
- 330,000 t/year of bricks are dispatched from site.
- Landscaped earth bund constructed around the western, southern and eastern sides of the brick making facility's raw material stockpile area by end of year 6.
- Landscaping (including screening plants) around the northern and eastern sides of the brick making facility by end of year 6.
- Landscaping (including screening plants) around the western and part of the northern and southern sides of Pit 3 by end of year 6.

The approved pit 4 and 5 areas and previously proposed Monier roof products manufacturing facility and solar farm areas (65.72 ha) will be available for development in accordance with the LUIIP at the start of Phase 1 (Figure 2.2).

The pit 1 and 2 areas and land between the site's southern boundary and the raw material stockpile area (38.49 ha) will available for development in accordance with the LUIIP at the end of Phase 1 (Figure 2.2). 104.21 ha will be available for development from the end of 2025 onwards.

It is assumed that TfNSW would realign and extend Martin Road southwards through the site in the first six years ie by end of 2025.

An underpass can be constructed under the extended Martin Road if the road is built before extraction of clay from Pit 3 is complete. This underpass will enable haulage of extracted clay from Pit 3 to the raw material stockpile area.

Phase 2

This phase represents years seven to 10 (approximately end of 2029 – refer to Figure 2.3):

- 420,000 t/year of clay is extracted from Pit 3.
- 275,000 t/year of clay is exported from site to other PGH brick making.
- 215,000 t/year of clay is imported to site for manufacturing bricks.
- 300,000 t/year of bricks are manufactured.
- 330,000 t/year of bricks are dispatched from site.

Phase 3

This phase represents years 11 to 13 (approximately end of 2032 – refer to Figure 2.4):

- 360,000 t/year of clay are imported to site for manufacturing bricks.
- 300,000 t/year of bricks are manufactured.
- 330,000 t/year of bricks are dispatched from site.

Phase 4

This phase represents year 14 onwards (approximately end of 2032 onwards – refer to Figure 2.5):

- 360,000 t/year of clay are imported to site for manufacturing bricks.
- 300,000 t/year of bricks are manufactured.
- 330,000 t/year of bricks are dispatched from site.

The Pit 3 area (12.67 Ha) will be available for development in accordance with the LUIIP at the end of Phase 4 and approximately 30 ha of the 200 ha site will be used for ongoing brick manufacturing. 116.88 ha will be available for development from approximately year 14 onwards.

Modification 4

Modification 4 will comprise the following and assumes Modification 3 is approved and operating.

Phase 1

This phase represents years one to six (approximately end of 2019 to end of 2025 – refer to Figure 2.2):

- Pit 1 is dewatered over one to three years by pumping water to the WSA site or alternative water disposal options or a combination (it will take a minimum of one year if pumping directly to Badgerys Creek at 100,000 L/hr 24hrs/7days a week, but is likely to take longer if pumping to WSA).
- The realigned VENM haul road will be constructed.
- Pit 1 is backfilled (engineered fill) with a combination of unusable/burden stockpiles located in the southern part of the site (500,000 m^3), burden yet to be extracted from Pit 3 (115,000 m^3) and imported VENM.
  It will take two to two and a half years to backfill Pit 1 with imported VENM at the maximum rate of VENM importation.
- VENM is imported to backfill pits 1 and 2 at 200 trucks per weekday, 130 trucks per Saturday and 100 per Sunday.

It is assumed that TfNSW would realign and extend Martin Road southwards through the site in the first six years ie by end of 2025. In the early years of Phase 1 the VENM haul route traverses the proposed future Martin Road corridor. However, pits 1 and 2 should be backfilled in the first four years after which this VENM haul route will only need to continue to Pit 3 and will not need to traverse the future Martin Road corridor. If the construction of the extended Martin Road commences before completion of backfilling of pits 1 and 2 then an underpass or alternative temporary intersection can be constructed under/across the extended Martin Road.

Phase 2

This phase represents years seven to 10 (approximately end of 2029 – refer to Figure 2.3) – VENM is imported to backfill Pit 3 (engineered fill) at 200 trucks per weekday, 130 trucks per Saturday and 100 per Sunday. This will allow the start of backfilling of the western part of Pit 3 whilst clay extraction continues in the east of the pit.

Phase 3

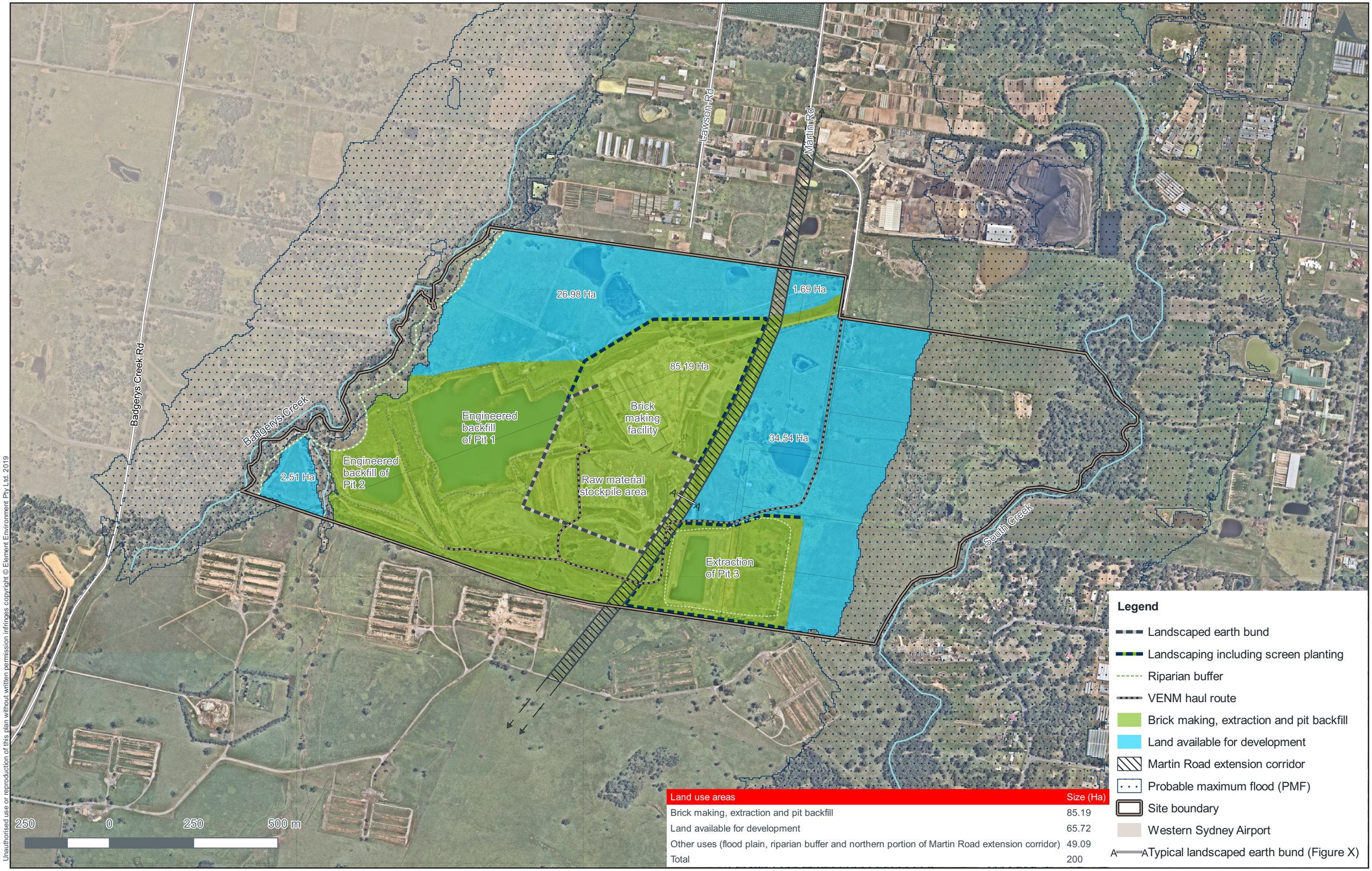
This phase represents years 11 to 13 (approximately end of 2032 – refer to Figure 2.4) – VENM is imported to backfill Pit 3 (engineered fill) at 200 trucks per weekday, 130 trucks per Saturday and 100 per Sunday.

Phase 4

There will not be any activities associated with Modification 4 in Phase 4 as VENM importation would have concluded by the end of Phase 3.

Figure 2.2
Preferred Project: Phase 1 - Years 1 to 6 (End 2019 to end 2025)

CSR ADVANCED MANUFACTURING HUB
Response to Submissions Report



Land use areas	Size (Ha)
Brick making, extraction and pit backfill	85.19
Land available for development	65.72
Other uses (flood plain, riparian buffer and northern portion of Martin Road extension corridor)	49.09
Total	200

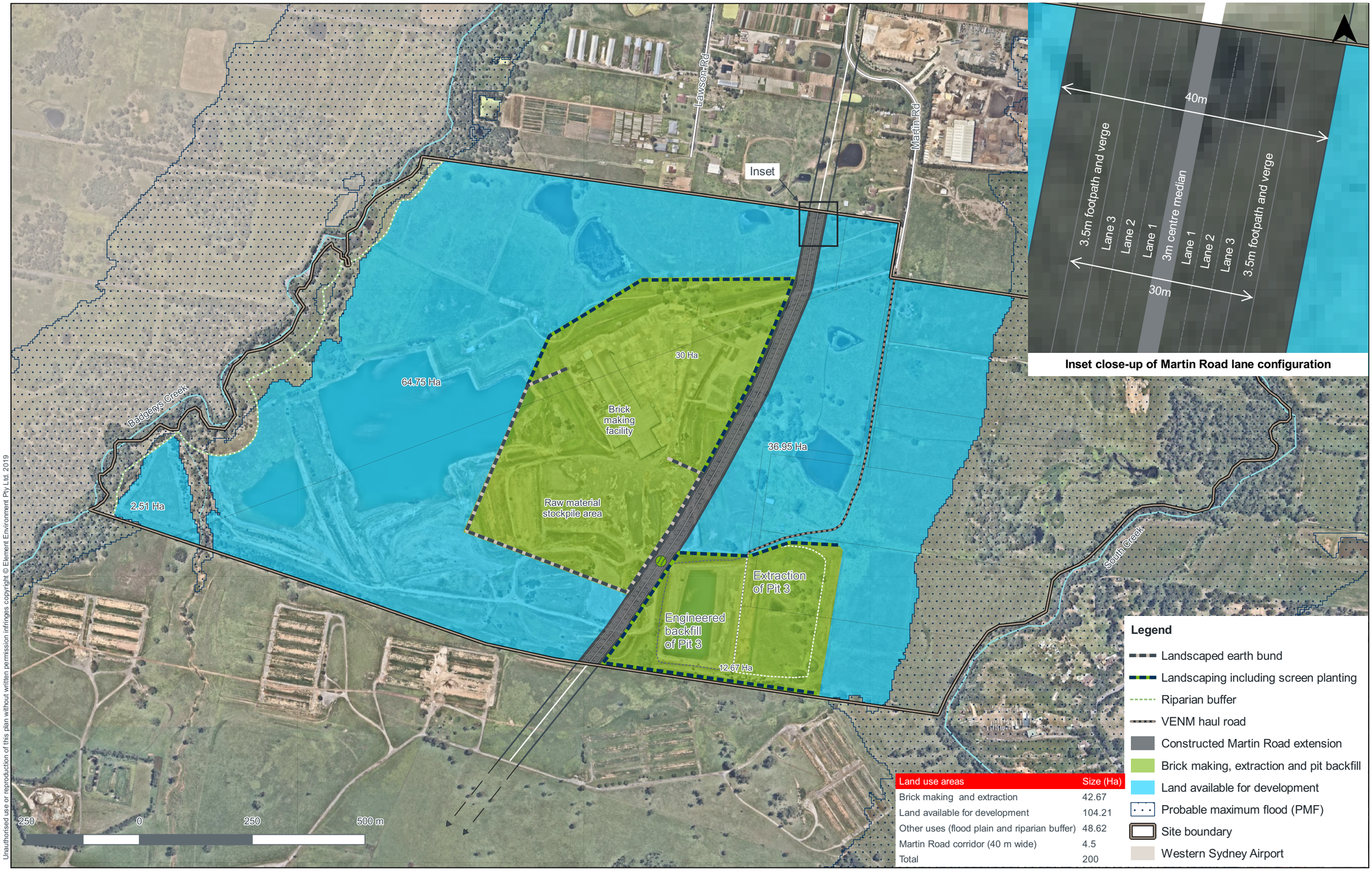
Legend

- Landscaped earth bund
- Landscaping including screen planting
- Riparian buffer
- VENM haul route
- Brick making, extraction and pit backfill
- Land available for development
- Martin Road extension corridor
- Probable maximum flood (PMF)
- Site boundary
- Western Sydney Airport
- A—A Typical landscaped earth bund (Figure X)

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Figure 2.3
Preferred Project: Phase 2 Year 7 to 10 (end of 2025 to end of 2029)

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Response to Submissions Report

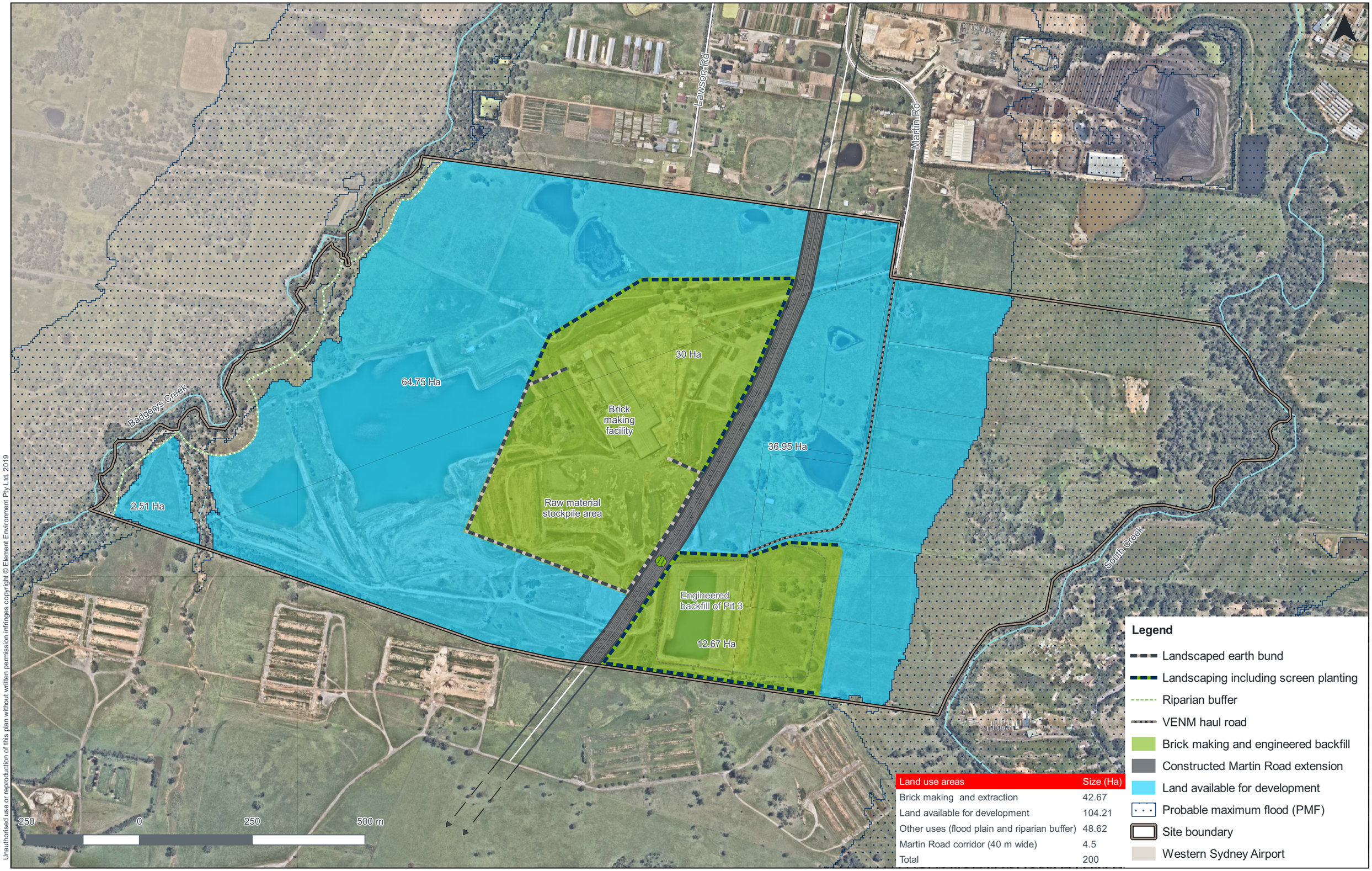


Land use areas	Size (Ha)
Brick making and extraction	42.67
Land available for development	104.21
Other uses (flood plain and riparian buffer)	48.62
Martin Road corridor (40 m wide)	4.5
Total	200

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Figure 2.4
Preferred Project: Phase 3 - Year 11 to 13 (end of 2029 to end of 2032)

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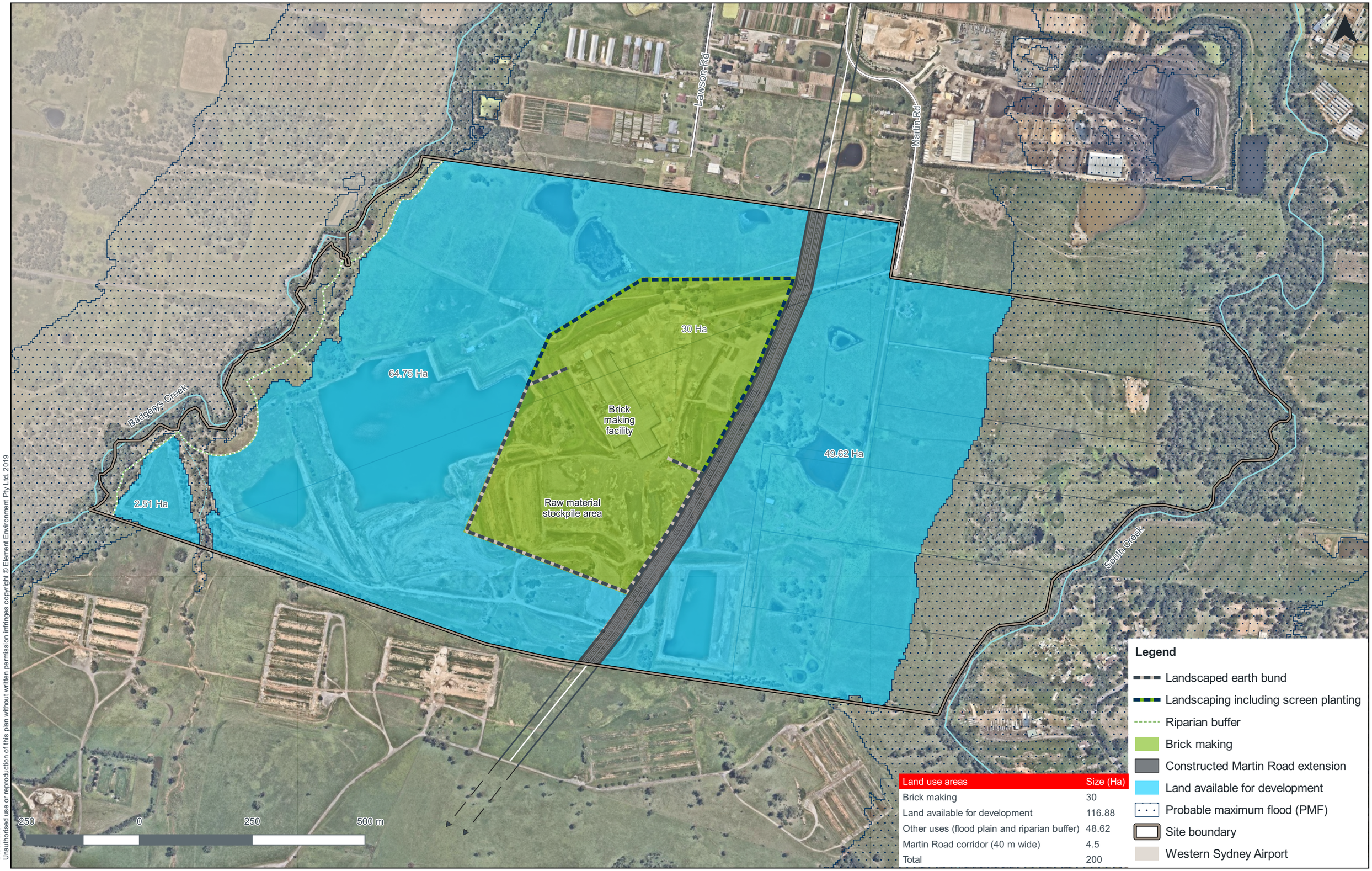


Land use areas	Size (Ha)
Brick making and extraction	42.67
Land available for development	104.21
Other uses (flood plain and riparian buffer)	48.62
Martin Road corridor (40 m wide)	4.5
Total	200

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Figure 2.5
Preferred Project: Phase 4 - Year 14 onwards (approximately end of 2032 onwards)

CSR ADVANCED MANUFACTURING HUB
Response to Submissions Report



Land use areas	Size (Ha)
Brick making	30
Land available for development	116.88
Other uses (flood plain and riparian buffer)	48.62
Martin Road corridor (40 m wide)	4.5
Total	200

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Figure 2.6
Cross Section of typical landscaped earth bund

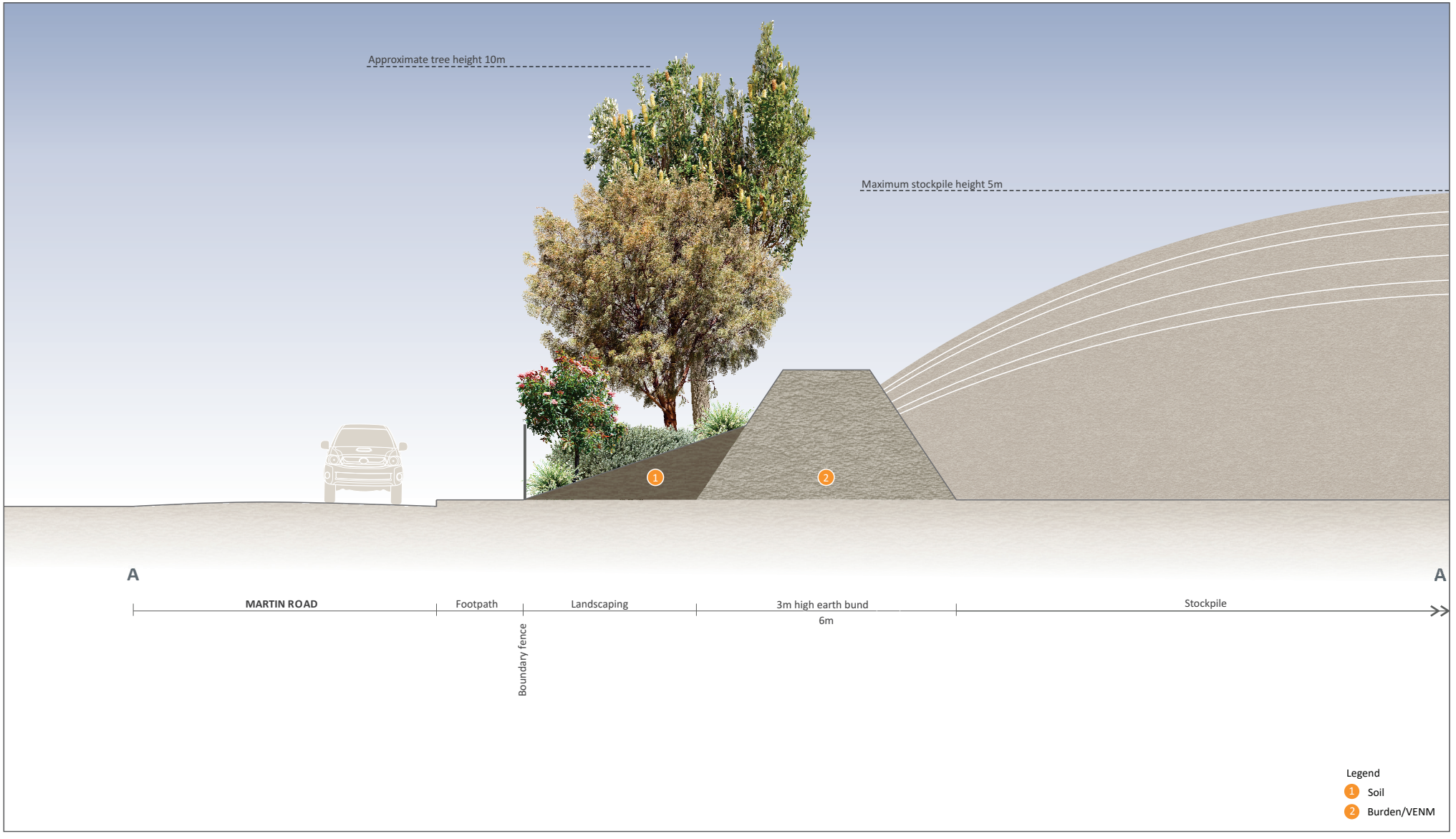


Table 2.1 Comparison of approved project, preferred project and modifications 3 and 4

Aspect	Existing Project Approval	Preferred project	Variance between approved project and preferred project	Variance to proposed Modification 3	Variance to proposed Modification 4
Brick Production	252,000 tonnes of bricks per calendar year	300,000 tonnes of bricks per calendar year	Increased production of 48,000 tonnes of bricks per calendar year	Nil	Nil
Quarrying (approx. year 1 - 10)	Extract 420,000 tonnes of clay shale per calendar year	No change	Nil	Nil	Nil
Quarrying (approx. year 11 onwards)	Extract 420,000 tonnes of clay shale per calendar year	Cease extraction of clay shale by end of year 10 (approx. end of 2029)	Current approval allows quarrying until 27 September 2031	Decrease of 420,000 tonnes of clay shale extracted per calendar year for last 20 years of 30 year quarrying life	Nil
Receival of raw materials (approx. year 1 – 10)	Receive 20,000 tonnes of raw materials for brick production per calendar year	Importation of 215,000 tonnes of raw materials for brick production per calendar year	Increase of 195,000 tonnes of imported raw materials for brick production per calendar year until end of year 10 (approx. 2029)	Nil	Nil
Receival of raw materials (approx. year 11 onwards)	Receive 20,000 tonnes of raw materials for brick production per calendar year	Receive 360,000 tonnes of raw materials for brick production per calendar year	Increase of 340,000 tonnes of imported raw materials for brick production per calendar year from approx. year 11 onwards	Increase of 145,000 tonnes of imported raw materials for brick production compared to Modification 3	Nil
Dispatching of raw materials (approx. year 1 – 10)	Dispatch 275,000 tonnes of raw materials from the site per calendar year	No change	Nil	Nil	Nil
Dispatching of raw materials (approx. year 11 onwards)	Dispatch 275,000 tonnes of raw materials from the site per calendar year	Cease dispatching of raw material by end of year 10 (approx. 2029)	275,000 tonne reduction in dispatched raw material per calendar year	Decrease of 275,000 tonnes of exported raw materials from the site from year 11 onwards compared to Modification 3	Nil
Truck Movements (approx. year 1 – 6) including receival of	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements)	Maximum of 400 trucks entering and exiting the site per day Monday – Friday	This is a combined increase of 340 trucks entering and exiting the site per day	Decrease of 72 trucks entering and exiting the site	Nil

Aspect	Existing Project Approval	Preferred project	Variance between approved project and preferred project	Variance to proposed Modification 3	Variance to proposed Modification 4
215,000 tonnes of raw material, dispatch of 275,000 tonnes of raw materials, dispatch of 330,000 tonnes of finished brick products and importation of VENM to backfill Pits 1 and 2	exiting the site per day Monday to Friday	(i.e. 800 vehicle movements). 200 truckloads are associated with the brick making facility and 200 truckloads are associated with VENM importation.	Monday to Friday (i.e. 680 vehicle movements).	per day Monday – Friday compared to Modification 3	
	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday	Maximum of 179 trucks entering and exiting the site per day on Saturday (i.e. 358 vehicle movements). 49 truckloads are associated with the brick making facility and 130 truckloads are associated with VENM importation.	This is a combined increase of 159 trucks entering and exiting the site per day on Saturday (i.e. 318 vehicle movements).	Decrease of 30 trucks entering and exiting the site per day on Saturday compared to Modification 3	Increase of 30 trucks entering and exiting the site per day on Saturday compared to Modification 4.
	Nil	Maximum of 100 trucks entering and existing the site per day on Sunday	Increase of 100 trucks (VENM only) entering and exiting the site per day on Sunday (i.e. 200 vehicle movements)	Nil	Nil
Truck Movements (approx. year 7 – 10) including receival of 215,000 tonnes of raw material, dispatch of 275,000 tonnes of raw materials, dispatch of 330,000 tonnes of finished brick products and importation of VENM for staged backfill of Pit 3	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 400 trucks entering and exiting the site per day Monday – Friday (i.e. 800 vehicle movements). 200 truckloads are associated with the brick making facility and 200 truckloads are associated with VENM importation.	This is a combined increase of 340 trucks entering and exiting the site per day Monday to Friday (i.e. 680 vehicle movements).	Decrease of 72 trucks entering and exiting the site per day Monday – Friday compared to Modification 3	Nil
	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements)	Maximum of 179 trucks entering and exiting the site per day on Saturday (i.e. 358 vehicle movements). 49	This is a combined increase of 159 trucks entering and exiting the site per day on	Decrease of 30 trucks entering and exiting the site per day on Saturday compared to Modification 3	Increase of 30 trucks entering and exiting the site per day on Saturday

Aspect	Existing Project Approval	Preferred project	Variance between approved project and preferred project	Variance to proposed Modification 3	Variance to proposed Modification 4
	exiting the site per day on Saturday	truckloads are associated with the brick making facility and 130 truckloads are associated with VENM importation.	Saturday (i.e. 318 vehicle movements).		compared to Modification 4
	Nil	Maximum of 100 trucks entering and existing the site per day on Sunday	Increase of 100 trucks (VENM only) entering and exiting the site per day on Sunday (i.e. 200 vehicle movements)	Nil	Nil
Truck Movements (approx. year 11 – 13) including receival of 360,000 tonnes of raw material, dispatch of 330,000 tonnes of finished brick products and importation of VENM to backfill Pit 3	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 383 trucks entering and exiting the site per day Monday – Friday (i.e. 766 vehicle movements). 183 truckloads are associated with the brick making facility and 200 truckloads are associated with VENM importation.	This is a combined increase of 323 trucks entering and exiting the site per day Monday to Friday (i.e. 646 vehicle movements).	Decrease of 89 trucks entering and exiting the site per day Monday – Friday compared to Modification 3	Nil
	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday	Maximum of 179 trucks entering and exiting the site per day on Saturday (i.e. 358 vehicle movements). 49 truckloads are associated with the brick making facility and 130 truckloads are associated with VENM importation.	This is a combined increase of 159 trucks entering and exiting the site per day on Saturday (i.e. 318 vehicle movements).	Decrease of 30 trucks entering and exiting the site per day on Saturday compared to Modification 3	Increase of 30 trucks entering and exiting the site per day on Saturday compared to Modification 4
	Nil	Maximum of 100 trucks entering and existing the site per day on Sunday	Increase of 100 trucks (VENM only) entering and exiting the site per day on Sunday (i.e. 200 vehicle movements)	Nil	Nil

Aspect	Existing Project Approval	Preferred project	Variance between approved project and preferred project	Variance to proposed Modification 3	Variance to proposed Modification 4
Truck Movements (approx. year 14 onwards) including receival of 360,000 tonnes of raw material and dispatch of 330,000 tonnes of finished brick products	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 183 trucks entering and exiting the site per day Monday – Friday (i.e. 366 vehicle movements). 183 truckloads are associated with the brick making facility.	This is a combined increase of 123 trucks entering and exiting the site per day Monday to Friday (i.e. 246 vehicle movements).	Decrease of 289 trucks entering and exiting the site per day Monday – Friday compared to Modification 3	Nil
	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday	Maximum of 49 trucks entering and exiting the site per day on Saturday (i.e. 98 vehicle movements). 49 truckloads are associated with the brick making facility.	This is an increase of 29 trucks entering and exiting the site per day on Saturday (i.e. 58 vehicle movements).	Decrease of 30 trucks entering and exiting the site per day on Saturday compared to Modification 3	Decrease of 100 trucks entering and exiting the site per day on Saturday compared to Modification 4
Duration of Project Approval	27 September 2031	Brick making: Conditions of approval to be amended to have no project lifespan/sunset clause for brick making.	Brick making: Approved project limited to 27 Sept 2031, while proposed preferred project will have no project lifespan/sunset clause for brick making.	Nil. Modification 3 also requested no project lifespan/sunset clause for brick making.	Nil.
		Quarrying (Pit 3): Conditions of approval to be amended to allow quarrying (extraction from Pit 3) for 10 years from the date of modification approval.	Quarrying: Approved project limited to 27 Sept 2031, while proposed preferred project limited to quarrying only in Pit 3 for 10 years. Assuming approval granted in December 2019, quarrying of Pit 3 would cease in December 2019.	Modification 3 allowed for quarrying for 30 years from date of approval i.e. 20 years longer than the preferred project.	Nil
		VENM importation: At peak VENM importation of 200 trucks per day Mon-Fri, 130 per day Sat and 100 per day Sun, Pit 3 could be filled within 2.5 years,	No VENM importation allowed in the approved project.	Nil	Modification 4 allowed for VENM importation for 30 years.

Aspect	Existing Project Approval	Preferred project	Variance between approved project and preferred project	Variance to proposed Modification 3	Variance to proposed Modification 4
		However due to uncertainty on the rate at which suitable VENM will be available, it is to be requested that VENM importation does not have a lifespan/sunset clause.			

Table 2.2 Comparison of approved hours of operation and proposed preferred project

Activity	Existing Project Approval	Preferred project	Proposed Modification 3	Proposed Modification 4	Variance to Approved Project
Quarrying operations (excluding removal of overburden, truck arrival, loading and dispatch)	Monday-Saturday 7:00 am to 6:00 pm Sunday and public holidays None	No change	No change	No change	Nil
Removal of overburden and construction of noise bunds	Monday-Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm Sunday and public holidays None	No change to hours, however, noise bunds will not be constructed	No change	No change	No change to hours, however, noise bunds will not be constructed
Brick making facility and storage yard	Monday-Sunday 24 hours	No change	No change	No change	Nil
Truck arrival and dispatch (excluding finished building products i.e. raw materials)	Monday-Friday 6:00am to 10:00pm Saturday 6:00am to 6:00pm Sunday and public holidays None	No change	No change	No change	Nil

Activity	Existing Project Approval	Preferred project	Proposed Modification 3	Proposed Modification 4	Variance to Approved Project
Truck arrival and dispatch (finished building products only)	Monday-Saturday 7:00am to 10:00pm Sunday and public holidays None	Monday-Friday 5:00 am to 10:00 pm Saturday 6:00 am to 6:00 pm Sunday and public holidays None	Monday-Friday 5:00 am to 10:00 pm Saturday 6:00 am to 6:00 pm Sunday and public holidays None	N/A	Deliveries and dispatch to be extended by two hours earlier in the morning on a week day (Monday to Friday) and one hour earlier in the morning on a Saturday to allow finished product trucks (Modification 3 and preferred project) to arrive at site, load, and dispatch between 5:00 am and 6:00 am
Truck arrival and dispatch (VENM Importation)	Nil	Monday - Sunday 7:00 am – 6:00 pm	N/A	Monday - Sunday 7:00 am – 6:00 pm	Importation of VENM to backfill open voids (Modification 4 and preferred project)
Sales Selection / Cash Sales	Nil	Monday-Saturday 6:00 am to 6:00 pm Sunday and public holidays None	Monday-Saturday 6:00 am to 6:00 pm Sunday and public holidays None	N/A	Additional operating hours for sales selection and cash sales activities for finished brick products (Modification 3 and preferred project)
Customer Display Centre	Nil	Monday-Sunday 8:00 am to 5:00 pm Public Holidays None	Monday-Sunday 8:00 am to 5:00 pm Public Holidays None	N/A	Additional operating hours for customer display centre for finished brick products (Modification 3 and preferred project)

Table 2.3 Heavy vehicle calculations for preferred project

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
Heavy Vehicle Movements for Modification 3 and 4 (per business).	Dispatch of Finished Roof Products: 42 laden (84 movements) per day Mon to Fri 15 laden (30 movements) per day Sat Incoming Raw Materials and misc.: 27 laden (54 movements) per day Mon to Fri 14 laden (28 movements) per day Sat Incoming (Finished Roof Products): 3 laden (6 movements) per day Mon to Fri 1 laden (2 movements) per day Sat Total Heavy Vehicles per day (Mon – Fri): 42 + 27 + 3 = 72 Total Heavy Vehicles per day (Sat): 15 + 14 + 1 = 30 Total Heavy Vehicles per average hour: I have assumed 72 / 12hrs (6am – 6pm) = 6 Total Heavy Vehicles per busiest hour: Monier have advised that up to 14 trucks could arrive, load and dispatch within the 1 hour morning period of 5am - 6am and 10 Monier trucks could arrive and depart during PGH's busiest 1 hour period from 8am - 9am (see column K).	Despatch of Bricks & Pavers: 123 laden brick trucks per day Mon to Fri (252 days/annum) 49 laden brick trucks per day Sat 12 services/maintenance trucks per day Mon to Fri Import of Raw Material: 29 trucks per day (252 days/annum) Mon to Fri (manganese trucks and liquid delivery trucks listed in Point 13 are included). (The above truck numbers are calculated as: 215,000 tonnes pa/252 days pa/30 tonnes per truck = 29 trucks per day) Export of Raw Material: Export of raw material - 36 trucks per day (252 days/annum) Mon to Fri Total Heavy Vehicles per day (Mon – Fri): 123 + 12 + 29 + 36 = 200 Total Heavy Vehicles per day (Sat): 49 Total Heavy Vehicles per average hour: I have assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: The busiest hour for the PGH operations is likely to be from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour.	VENM Importation: STAGE 1 - Aiming to complete by December 2026 Pit 1 Volume - 2,050,000 m3 (in situ quantity) / 4,305,000 tonnes (loose quantity) - used 2.2 conversion rate Pit 2 Volume 747,330m3 (in situ) / 1,644,126 tonnes (loose quantity) Total STAGE 1 Volume = 5,949,126 tonnes (loose) - divide by 31 Trucks in total = 191,907.29 - divide by 7 years Year = 27,415.3272 trucks per year Per week = 571.15 trucks (based on 48 week year) Typical VENM Importation Per Day (Mon - Fri) = 115 truck loads (rounded up from 114.23) Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 100 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm) Assumptions: - Truck and Dog carries 31 tonnes - Based on a 48 week year - 5 days per week (Mon - Fri) (conservative) used to calculate the likely

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
			VENM importation volumes per year. Worst case scenario from a traffic modelling perspective is 200 truckloads per day Mon - Fri and 100 truckloads per day on a Sat - Assume trucks are specific for VENM campaign, arriving fully laden to site and departing empty
Heavy Vehicle Movements (total from site).	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 72 + 200 + 200 = 472 TOTAL HEAVY VEHICLES PER DAY (SAT): 30 + 49 + 100 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 6 + 17 + 18 = 41 TOTAL HEAVY VEHICLES PER MONIER BUSY HOUR (5am - 6am): 14 + 15 + 0 = 29 TOTAL HEAVY VEHICLES PER PGH BUSY HOUR (8am - 9am): 10 + 23 + 18 = 51		
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 29 (raw material import trucks) + 36 (raw material export trucks) = 200 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: 23 heavy vehicle loads (46 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour.	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 200 + 200 = 400 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 + 130 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 17 + 18 = 35 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 23 + 18 = 41		
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements, associated with Modification 3 only	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 29 (raw material import trucks) + 36 (raw material export trucks) = 200 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: 23 heavy vehicle loads (46 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour	Nil (No VENM importation under Modification 3)
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements – Total, associated with Modification 3 only	TOTAL HEAVY VEHICLES PER DAY (MON - FRI) = 200 TOTAL HEAVY VEHICLES PER DAY (SAT) = 49 TOTAL HEAVY VEHICLES PER AVERAGE HOUR = 17 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am) = 23		
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements, associated with Modification 4 only	Nil (Monier operations removed from Preferred Project)	Nil (No finished brick product dispatch, or brick raw material import or export under Modification 4.	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
			(200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements – Total, associated with Modification 4 only	TOTAL HEAVY VEHICLES PER DAY (MON - FRI) = 200 TOTAL HEAVY VEHICLES PER DAY (SAT) = 130 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 TOTAL HEAVY VEHICLES PER AVERAGE HOUR = 18 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am) = 18		
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 29 (raw material import trucks) + 36 (raw material export trucks) = 200 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: 23 heavy vehicle loads (46 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour.	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 200 + 200 = 400 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 + 130 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 17 + 18 = 35 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 23 + 18 = 41		
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements, associated with Modification 3 only	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 29 (raw material import trucks) + 36 (raw material export trucks) = 200 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: 23 heavy vehicle loads (46 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour	Nil (No VENM importation under Modification 3)
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements – Total, associated with Modification 3 only	TOTAL HEAVY VEHICLES PER DAY (MON - FRI) = 200 TOTAL HEAVY VEHICLES PER DAY (SAT) = 49 TOTAL HEAVY VEHICLES PER AVERAGE HOUR = 17 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am) = 23		
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements, associated with Modification 4 only	Nil (Monier operations removed from Preferred Project)	Nil (No finished brick product dispatch, or brick raw material import or export under Modification 4	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
			(200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements – Total, associated with Modification 4 only	TOTAL HEAVY VEHICLES PER DAY (MON - FRI) = 200 TOTAL HEAVY VEHICLES PER DAY (SAT) = 130 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 TOTAL HEAVY VEHICLES PER AVERAGE HOUR = 18 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am) = 18		
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 48 (raw material import trucks)(360,000 tonnes pa/252 days pa/30 tonnes per truck) = 183 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 183 / 12hrs (6am – 6pm) = 15 (round down from 15.25) Total Heavy Vehicles per busiest hour: 21 heavy vehicle loads (42 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 4 raw material trucks arrive totalling 21 heavy vehicle loads (42 movements) in the busiest hour.	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 183 + 200 = 383 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 + 130 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 15 + 18 = 33 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 21 + 18 = 39		
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements, associated with Modification 3 only	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 48 (raw material import trucks)(360,000 tonnes pa/252 days pa/30 tonnes per truck) = 183 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 183 / 12hrs (6am – 6pm) = 15 (round down from 15.25) Total Heavy Vehicles per busiest hour: 21 heavy vehicle loads (42 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 4 raw material trucks arrive totalling 21 heavy vehicle loads (42 movements) in the busiest hour	Nil (No VENM importation under Modification 3)
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements – Total, associated with Modification 3 only	TOTAL HEAVY VEHICLES PER DAY (MON - FRI) = 183 TOTAL HEAVY VEHICLES PER DAY (SAT) = 49 TOTAL HEAVY VEHICLES PER AVERAGE HOUR = 15 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am) = 21		
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements, associated with Modification 4 only	Nil (Monier operations removed from Preferred Project)	Nil (No finished brick product dispatch, or brick raw material import or export under Modification 4	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
			and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements – Total, associated with Modification 4 only	TOTAL HEAVY VEHICLES PER DAY (MON - FRI) = 200 TOTAL HEAVY VEHICLES PER DAY (SAT) = 130 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 TOTAL HEAVY VEHICLES PER AVERAGE HOUR = 18 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am) = 18		
Preferred Project: Phase 4 (approx. year 14 onwards) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 48 (raw material import trucks)(300,000 tonnes pa/252 days pa/30 tonnes per truck) = 183 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 183 / 12hrs (6am – 6pm) = 15 (round down from 15.25) Total Heavy Vehicles per busiest hour: 21 heavy vehicle loads (42 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 4 raw material trucks arrive totalling 21 heavy vehicle loads (42 movements) in the busiest hour.	Nil (Pit 3 backfill complete)

Aspect	Monier roof products manufacturing facility (Modification 3)	PGH brick making facility (Modification 3)	VENM Importation (Modification 4)
Preferred Project: Phase 4 (approx. year 14 onwards) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 175 = 183 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 = 49 TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 15 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 21		
Preferred Project: Phase 4 (approx. year 14 onwards) Heavy Vehicle Movements, associated with Modification 3 only	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 48 (raw material import trucks)(360,000 tonnes pa/252 days pa/30 tonnes per truck) = 183 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 183 / 12hrs (6am – 6pm) = 15 (round down from 15.25) Total Heavy Vehicles per busiest hour: 21 heavy vehicle loads (42 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 4 raw material trucks arrive totalling 21 heavy vehicle loads (42 movements) in the busiest hour	Nil (No VENM importation under Modification 3) and Nil VENM importation under Modification 4 as Pit 3 backfill complete in Phase 3
Preferred Project: Phase 4 (approx. year 14 onwards) Heavy Vehicle Movements – Total, associated with Modification 3 only	TOTAL HEAVY VEHICLES PER DAY (MON - FRI) = 183 TOTAL HEAVY VEHICLES PER DAY (SAT) = 49 TOTAL HEAVY VEHICLES PER AVERAGE HOUR = 15 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am) = 21		
Preferred Project: Phase 4 (approx. year 14 onwards) Heavy Vehicle Movements, associated with Modification 4 only	Nil (Monier operations removed from Preferred Project)	Nil (No finished brick product dispatch, or brick raw material import or export under Modification 4	Nil VENM importation under Modification 4 as Pit 3 backfill complete in Phase 3

2.3 Assessment of preferred project impacts

2.3.1 Overview

As described in Section 2.2.2, the project has changed compared to the project descriptions in the modification 3 and 4 EAs. Therefore, some reassessment of potential impacts has been required.

Technical specialists were engaged to assess potential air quality, noise and surface water impacts from the project as the altered phasing of the project could result in changes to previously assessed impacts to sensitive receivers and the proposed water management system. These assessment reports are in appendices B, C and D, respectively.

The specialists assessed the project to account for cumulative impacts of the modifications combined.

The assessment of other environmental impacts is summarised in Table 2.30.

2.3.2 Air quality impacts

Potential air quality impacts on sensitive receivers from the project were assessed. The air quality assessment report is in Appendix B**,** which is summarised in this section.

Existing environment

Local climate

Long term climatic data from the Bureau of Meteorology weather station at Badgerys Creek Automatic Weather Station (Site No. 067108), which is approximately 1.5 km west of the site, is summarised in Table 2.4. The dispersion modelling used meteorological data from the 2014 calendar year.

Table 2.4 Summary climate data – Badgerys Creek

Parameter	Month	
	Maximum	Minimum
Mean temperature (˚C)	January – 30.1	July – 4.1
Humidity – 9am (%)	March – 83	October – 62
Humidity – 3pm (%)	June – 56	August/September – 44
Rainfall (mm)	February – 98.5	July – 22.6
Windspeed – 9am (km/h)	October – 11.8	March – 8.4
Windspeed – 3pm (km/h)	October – 19.9	June – 13.7

On an annual basis, winds are predominantly from the south-west. During summer there are high percentage of winds from the north-north-east to east-south-east and south-west. In autumn, winter and spring the highest percentage of winds come from the south-west and west-south-west.

Local air quality

Air emission sources around the site are motor vehicle exhaust, domestic wood heaters, agricultural activities and industrial activities.

A high-volume air sampler (HVAS) is operated onsite, which measures ambient 24-hour PM_{10} levels (particulate matter with an aerodynamic diameter of up to 10 microns). The highest reading

between October 2016 and March 2018 was 41 µg/m^3, which is 9 µg/m^3 below the 24-hour average criterion of 50 µg/m^3.

There are also four onsite dust deposition monitors, with their annual average dust deposition results for 2017 summarised in Table 2.5. Dust deposition levels were below the criterion of 4 g/m²/month.

Table 2.5 Summary of site annual dust deposition data

Monitor ID	Annual average insoluble solids (g/m^2/month)
1	0.9
2	1.5
3	1.4
4	1.7

Regional air quality was characterised based on data from the site stations plus OEH monitors at Bringelly, St Marys and Liverpool between 2013 and 2017. Annual average PM_{10} concentrations at Bringelly, St Marys and Liverpool were below the criterion of 25 µg/m³. Maximum 24-hour average PM_{10} concentrations at these stations exceeded the criterion of 50 µg/m³ at times during the review period.

The elevated regional PM_{10} levels typically coincide with regional dust events and bushfires which affect a wide area, as indicated by other air quality monitoring stations in the surrounding region also recording elevated levels on such days. At other times, potential sources such as local agricultural activities, industrial activity and other sources may have contributed to periods of elevated PM_{10} levels.

Annual average $PM_{2.5}$ concentrations at Liverpool were above the criterion of 8 µg/m³ for the period reviewed. The annual average levels of $PM_{2.5}$ concentrations for the Bringelly and St Marys monitors were below the criterion of 8 µg/m³ in 2017. The maximum 24-hour average $PM_{2.5}$ concentrations exceeded the criterion of 25 µg/m³ at times during the review period.

There is a seasonal trend in 24-hour average $PM_{2.5}$ concentrations, with elevated levels in the cooler months. This is opposite to the seasonal trend for PM_{10} concentrations which has elevated levels during the warmer months.

Annual, 24-hour and 1-hour average sulfur dioxide (SO_2) concentrations at the monitoring stations were below the criteria of 60 µg/m³, 228 µg/m³ and 570 µg/m³, respectively. Annual and 1-hour average nitrogen dioxide (NO_2) concentrations at the monitoring stations were below the criteria of 62 µg/m³ and 246 µg/m³, respectively.

PM_{10} and $PM_{2.5}$ have been recorded at three sites around the WSA site since October 2017. 24-hour average PM_{10} and $PM_{2.5}$ concentrations exceeded criteria on occasion for the northern, southern and western monitoring sites during the review period. The eastern monitoring site is closest to the project site and had much lower levels compared to the other monitoring sites.

The 2014 dataset for the Bringelly OEH site was used to represent background air quality levels as it is the nearest monitor to the project site. background levels adopted for the study are summarised in Table 2.6**.**

Total suspended solids (TSP) and deposited dust were not monitored and have been estimated assuming an annual average PM_{10} concentration of 25 µg/m^3 corresponds to a TSP concentration of 90 µg/m^3 and a dust deposition value of 4 g/m^2/month. This results in the TSP concentration and deposition values in the table.

Table 2.6 Adopted background pollutant concentrations

Pollutant	Averaging period	Units	Concentration
TSP	Annual	µg/m³	59.8
PM_{10}	Annual	µg/m³	16.6
	24-hour	µg/m³	42.6
$PM_{2.5}$	Annual	µg/m³	7
	24-hour	µg/m³	24.3
Deposited dust	Annual	g/m²/month	2.7
NO_2	Annual	µg/m³	8.2
	1-hour	µg/m³	51.3
SO_2	Annual	µg/m³	0.7
	24-hour	µg/m³	8.6
	1-hour	µg/m³	25.7

Impact assessment

Total suspended particulates, deposited dust, PM_{10} and $PM_{2.5}$ will be the primary emissions from the extractive activities and brick making facility. Additional to these, stack emissions from the brick making facility will comprise SO_2, NO_2, hydrogen fluoride (HF), chlorine (Cl), sulfuric acid (H_2SO_4) and odour.

Air quality impacts from extraction, earth visual bund construction, brick making and VENM importation/backfilling of pits associated with the phases and operating hours described in Section 2.2.2 were modelled, with equipment at the closest locations to the sensitive receivers.

Dust emissions

Dust emissions were estimated by analysing the types of dust generating activities at the site and using emission factors developed by the United States EPA and in the Australian National Pollutant Inventory (see Section 6.4 of Appendix B). The emission factors assumed implementation of all reasonable and feasible dust mitigation measures.

Dust emissions were predicted for the operation of the project (incremental) and operation of the project with local dust sources and background levels (cumulative) at the sensitive receivers and reported in:

- maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations;
- annual average $PM_{2.5}$ and PM_{10} concentrations;
- annual average TSP concentrations; and
- annual average dust (insoluble solids) deposition rates.

Incremental results

Incremental modelling results for the Phase 1 to Phase 4 operating scenarios are summarised in Table 2.7, Table 2.8, Table 2.9 and Table 2.10. Note there are no incremental criteria for $PM_{2.5}$, PM_{10} or TSP. The dust deposition results are below the incremental criterion of 2 g/m²/month.

Table 2.7 Incremental particulate dispersions results – Phase 1 scenario

Receptor	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air quality impact criteria/VLAMP					
	25	–	50	–	–	2

R5	3.5	0.5	22.7	2.3	6.1	0.2
R9	3.4	0.5	22.8	2.6	7.4	0.3
R11	2.7	0.1	17.5	0.7	1.6	0.1
R12	2.8	0.1	18.5	0.7	1.7	0.1
R12a	3.1	0.1	20.6	0.8	1.8	0.1
R13	2.8	0.1	18.6	0.7	1.7	0.1
R14	2.7	0.1	18.2	0.7	1.7	0.1
R15	2.4	0.1	16.1	0.6	1.5	0.1
R25	3.1	0.4	20.2	2.3	6.3	0.3
R26	3.1	0.4	20.0	2.0	5.3	0.2
R27	2.9	0.4	18.8	1.8	4.5	0.2
R28	3.2	0.4	20.8	1.9	4.9	0.2
R29	2.6	0.3	16.6	1.4	3.6	0.1
R30	2.4	0.3	15.6	1.3	3.2	0.1
R31	3.0	0.3	19.0	1.6	4.1	0.2
R32	2.3	0.3	14.3	1.3	3.3	0.1
R34	2.2	0.2	13.9	1.2	2.8	0.1
R35	2.6	0.3	15.9	1.6	4.0	0.2
R42	3.3	0.4	21.6	2.1	5.4	0.2
R43	2.8	0.3	18.0	1.5	3.7	0.1
R44	2.2	0.2	13.8	1.0	2.4	0.1
R45	2.1	0.2	13.2	1.0	2.5	0.1
R46	2.1	0.2	13.4	1.0	2.5	0.1

Table 2.8 Incremental particulate dispersions results – Phase 2 scenario

Receptor	$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)		TSP (µg/m^3)	DD (g/m^2/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air quality impact criteria/VLAMP					
	25	–	50	–	–	2
R5	3.5	0.3	19.0	1.5	4.3	0.1
R9	4.6	0.4	27.0	2.3	6.8	0.3
R11	3.8	0.1	20.1	0.7	1.9	0.1
R12	4.0	0.2	21.3	0.8	2.0	0.1
R12a	4.6	0.2	24.3	0.9	2.3	0.1
R13	3.7	0.2	20.7	0.8	2.0	0.1
R14	3.5	0.2	19.8	0.8	2.0	0.1
R15	3.0	0.1	17.3	0.7	1.7	0.1
R25	4.1	0.4	23.9	2.0	5.6	0.2
R26	3.4	0.3	18.6	1.4	4.0	0.1
R27	3.1	0.3	16.8	1.2	3.4	0.1
R28	3.1	0.3	16.9	1.3	3.5	0.1
R29	2.7	0.2	14.7	1.0	2.7	0.1
R30	2.4	0.2	13.5	0.9	2.4	0.1
R31	2.8	0.3	15.5	1.1	3.0	0.1
R32	2.5	0.2	14.1	1.0	2.5	0.1

R34	2.2	0.2	12.4	0.8	2.2	0.1
R35	2.9	0.3	16.3	1.3	3.3	0.1
R42	3.3	0.3	18.0	1.4	3.9	0.1
R43	2.6	0.2	14.5	1.0	2.7	0.1
R44	2.0	0.2	10.8	0.7	1.8	0.1
R45	2.0	0.2	11.1	0.7	1.9	0.1
R46	1.9	0.2	10.4	0.7	1.9	0.1

Table 2.9 Incremental particulate dispersions results – Phase 3 scenario

Receptor	$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)		TSP (µg/m^3)	DD (g/m^2/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air quality impact criteria/VLAMP					
	25	–	50	–	–	2
R5	2.6	0.3	13.4	1.3	3.6	0.1
R9	3.6	0.4	21.8	2.0	5.9	0.2
R11	2.7	0.1	14.1	0.7	1.7	0.1
R12	2.8	0.1	15.1	0.7	1.8	0.1
R12a	3.3	0.2	17.1	0.8	2.0	0.1
R13	2.7	0.1	15.0	0.7	1.8	0.1
R14	2.5	0.1	14.6	0.7	1.8	0.1
R15	2.2	0.1	12.8	0.6	1.6	0.1
R25	3.2	0.3	19.2	1.7	4.9	0.2
R26	2.4	0.3	13.2	1.2	3.3	0.1
R27	2.2	0.3	12.3	1.0	2.8	0.1
R28	2.3	0.3	12.3	1.1	2.9	0.1
R29	2.0	0.2	11.0	0.9	2.3	0.1
R30	1.8	0.2	10.2	0.8	2.0	0.1
R31	2.1	0.2	11.5	0.9	2.5	0.1
R32	1.8	0.2	10.3	0.8	2.2	0.1
R34	1.5	0.2	8.8	0.7	1.9	0.1
R35	2.2	0.2	12.8	1.1	2.9	0.1
R42	2.4	0.3	12.9	1.2	3.2	0.1
R43	2.0	0.2	11.0	0.9	2.3	0.1
R44	1.5	0.2	8.7	0.6	1.5	0.0
R45	1.5	0.2	8.7	0.6	1.6	0.0
R46	1.3	0.2	7.5	0.6	1.6	0.1

Table 2.10 Incremental particulate dispersions results – Phase 4 scenario

Receptor	$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)		TSP (µg/m^3)	DD (g/m^2/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air quality impact criteria/VLAMP					
	25	–	50	–	–	2
R5	0.8	0.2	2.7	0.6	1.9	<0.1

R9	0.9	0.2	3.9	0.9	3.0	
R11	0.4	<0.1	1.6	0.1	0.2	<0.1
R12	0.4	<0.1	1.8	0.1	0.3	<0.1
R12a	0.4	<0.1	1.8	0.1	0.3	<0.1
R13	0.5	<0.1	1.8	0.1	0.3	<0.1
R14	0.5	<0.1	1.7	0.1	0.3	<0.1
R15	0.4	<0.1	1.6	0.1	0.3	<0.1
R25	0.7	0.2	3.3	0.7	2.3	0.1
R26	0.9	0.2	2.4	0.5	1.7	<0.1
R27	0.7	0.2	2.0	0.4	1.4	<0.1
R28	0.7	0.2	2.2	0.5	1.5	<0.1
R29	0.6	0.1	1.6	0.3	1.1	<0.1
R30	0.5	0.1	1.4	0.3	0.9	<0.1
R31	0.7	0.1	1.8	0.4	1.2	<0.1
R32	0.8	0.1	1.5	0.3	1.0	<0.1
R34	0.7	0.1	1.4	0.3	0.8	<0.1
R35	0.5	0.1	2.0	0.4	1.3	<0.1
R42	0.7	0.2	2.4	0.5	1.6	<0.1
R43	0.6	0.1	1.6	0.3	1.1	<0.1
R44	0.5	0.1	01.1	0.2	0.7	<0.1
R45	0.5	0.1	1.1	0.2	0.7	<0.1
R46	0.7	0.1	1.3	0.2	0.7	<0.1

Cumulative annual average results

Predicted cumulative annual average $PM_{2.5}$, PM_{10}, TSP and dust deposition levels for the Phase 1 to Phase 4 modelling scenarios are summarised in Table 2.11, Table 2.12, Table 2.13 and Table 2.14. The predicted levels are below the annual average particulate criteria at the receptors for both modelling scenarios.

Table 2.11 Cumulative particulate dispersions results – Phase 1 scenario

Receptor ID	PM2.5 (µg/m³)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.5	18.9	65.9	2.9
R9	7.5	19.2	67.2	3.0
R11	7.1	17.3	61.4	2.8
R12	7.1	17.3	61.5	2.8
R12a	7.1	17.4	61.6	2.8
R13	7.1	17.3	61.5	2.8
R14	7.1	17.3	61.5	2.8
R15	7.1	17.2	61.3	2.8
R25	7.4	18.9	66.1	3.0
R26	7.4	18.6	65.1	2.9
R27	7.4	18.4	64.3	2.9
R28	7.4	18.5	64.7	2.9
R29	7.3	18.0	63.4	2.8

R30	7.3	17.9	63.0	2.8
R31	7.3	18.2	63.9	2.9
R32	7.3	17.9	63.1	2.8
R34	7.2	17.8	62.6	2.8
R35	7.3	18.2	63.8	2.9
R42	7.4	18.7	65.2	2.9
R43	7.3	18.1	63.5	2.8
R44	7.2	17.6	62.2	2.8
R45	7.2	17.6	62.3	2.8
R46	7.2	17.6	62.3	2.8

Table 2.12 Cumulative particulate dispersions results – Phase 2 scenario

Receptor ID	PM2.5 (µg/m³)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.3	18.1	64.1	2.8
R9	7.4	18.9	66.6	3.0
R11	7.1	17.3	61.7	2.8
R12	7.2	17.4	61.8	2.8
R12a	7.2	17.5	62.1	2.8
R13	7.2	17.4	61.8	2.8
R14	7.2	17.4	61.8	2.8
R15	7.1	17.3	61.5	2.8
R25	7.4	18.6	65.4	2.9
R26	7.3	18.0	63.8	2.8
R27	7.3	17.8	63.2	2.8
R28	7.3	17.9	63.3	2.8
R29	7.2	17.6	62.5	2.8
R30	7.2	17.5	62.2	2.8
R31	7.3	17.7	62.8	2.8
R32	7.2	17.6	62.3	2.8
R34	7.2	17.4	62.0	2.8
R35	7.3	17.9	63.1	2.8
R42	7.3	18.0	63.7	2.8
R43	7.2	17.6	62.5	2.8
R44	7.2	17.3	61.6	2.8
R45	7.2	17.3	61.7	2.8
R46	7.2	17.3	61.7	2.8

Table 2.13 Cumulative particulate dispersions results – Phase 3 scenario

Receptor ID	PM2.5 (µg/m³)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.3	17.9	63.4	2.8

R9	7.4	18.6	65.7	2.9
R11	7.1	17.3	61.5	2.8
R12	7.1	17.3	61.6	2.8
R12a	7.2	17.4	61.8	2.8
R13	7.1	17.3	61.6	2.8
R14	7.1	17.3	61.6	2.8
R15	7.1	17.2	61.4	2.8
R25	7.3	18.3	64.7	2.9
R26	7.3	17.8	63.1	2.8
R27	7.3	17.6	62.6	2.8
R28	7.3	17.7	62.7	2.8
R29	7.2	17.5	62.1	2.8
R30	7.2	17.4	61.8	2.8
R31	7.2	17.5	62.3	2.8
R32	7.2	17.4	62.0	2.8
R34	7.2	17.3	61.7	2.8
R35	7.2	17.7	62.7	2.8
R42	7.3	17.8	63.0	2.8
R43	7.2	17.5	62.1	2.8
R44	7.2	17.2	61.3	2.7
R45	7.2	17.2	61.4	2.7
R46	7.2	17.2	61.4	2.8

Table 2.14 Cumulative particulate dispersions results – Phase 4 scenario

Receptor ID	PM2.5 (µg/m³)	PM10 (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.2	17.2	61.7	2.7
R9	7.2	17.5	62.8	2.8
R11	7.0	16.7	60.0	2.7
R12	7.0	16.7	60.1	2.7
R12a	7.0	16.7	60.1	2.7
R13	7.0	16.7	60.1	2.7
R14	7.0	16.7	60.1	2.7
R15	7.0	16.7	60.1	2.7
R25	7.2	17.3	62.1	2.8
R26	7.2	17.1	61.5	2.7
R27	7.2	17.0	61.2	2.7
R28	7.2	17.1	61.3	2.7
R29	7.1	16.9	60.9	2.7
R30	7.1	16.9	60.7	2.7
R31	7.1	17.0	61.0	2.7
R32	7.1	16.9	60.8	2.7
R34	7.1	16.9	60.6	2.7
R35	7.1	17.0	61.1	2.7
R42	7.2	17.1	61.4	2.7

R43	7.1	16.9	60.9	2.7
R44	7.1	16.8	60.5	2.7
R45	7.1	16.8	60.5	2.7
R46	7.1	16.8	60.5	2.7

Cumulative 24-hour analysis

A 'level 2 contemporaneous' assessment was used to predict cumulative 24-hour average $PM_{2.5}$ and PM_{10} concentrations, where the background levels are added to the day's predicted dust level from the site. Assessment results are provided in Section 2.7 of Appendix B, which demonstrated there will be no days when the 24-hour average criteria are exceeded.

Dust impacts on more than 25% of privately-owned land

Dust impacts on more than 25% of privately-owned land were also predicted to determine if CSR will be required to purchase any affected properties. The assessment showed that the project will not impact on more than 25% of any privately-owned land.

Other emissions

Predicted maximum cumulative SO_2, NO_2 and HF concentrations are summarised in Table 2.15. No exceedances of the criteria for these pollutants are predicted at any sensitive receptors or the site boundary due to the project.

Table 2.15 Maximum dispersion results – SO_2, NO_2 and HF

Pollutant	Averaging period	Maximum incremental impact at receptor	Background concentration	Maximum cumulative impact at receptor	Criteria	Units
SO2	1 hour	56.3	25.7	82.0	570	µg/m^3
	24 hour	4.8	8.6	13.4	228	µg/m^3
	Annual	0.7	0.7	1.4	60	µg/m^3
NO2	1 hour	80.7	51.3	132	246	µg/m^3
	Annual	1.2	8.2	9.4	62	µg/m^3
HF	24 hours	2.3	-	-	2.9	µg/m^3
	7 days	0.9	-	-	1.7	µg/m^3
	30 days	0.63	-	-	0.84	µg/m^3
	90 days	0.47	-	-	0.5	µg/m^3

Predicted incremental Cl, H_2SO_4 and odour concentrations are summarised in Table 2.16. No exceedances of the criteria for these pollutants are predicted at any sensitive receptors or the site boundary due to the project.

Table 2.16 Incremental dispersion results – Cl, H_2SO_4 and odour

Pollutant	Averaging period	Percentile	Maximum incremental impact at boundary*	Maximum incremental impact at receptor	Criteria	Units
Cl	1 hour	99.9th	0.00008	0.00009	0.05	mg/m^3
H2SO4	1 hour	99.9th	0.0022	0.0018	0.018	mg/m^3
Odour	1 hour peak to mean corrected	99th	<1	<1	2	OU

Stack emissions

The stacks at the brickmaking facility will generate the emissions in Table 2.17.

Table 2.17 Stack emission rates

Stack	Pollutant	Emission rate (g/s) or (OU/s)
Kiln 1 & Kiln 2	TSP	0.97
	PM10	0.23
	PM2.5	0.23
	SO2	2.0
	NOx	2.85
	HF	0.95
	Cl	0.005
	SO3	0.06
	Odour	29726
Dryers 1- 5	TSP	0.019
	PM10	0.013
	PM2.5	0.013
	SO2	0.0007
	NOx	0.018
	HF	0.0001
	Cl	0.0002
	SO3	0.01
	Odour	683

The NSW Protection of the Environment Operations (Clean Air) Regulation 2010 (POEO Regulations) contains standards for some of the pollutants in Table 2.17, which are compared to the pollutants in Table 2.18. Predicted stack emission will comply with the standards.

Table 2.18 POEO Regulations and stack emissions

Pollutant	Standard of concentration for ceramic works – Group 6	Brick making facility	
		Kiln 1 & 2	Dryer 1 to 5
TSP	50	39	4
NO2	500	114	4
HF	50	38	<1

Consideration of Western Sydney Airport bulk earthworks

Bulk earthworks at the WSA are scheduled from 2019 to 2023, which will overlap with Phase 1 of the preferred project. Total annual average cumulative dust levels for Phase 1 plus WSA at the most impacted receptor are summarised in Table 2.19, which are below criteria.

Table 2.19 Predicted cumulative $PM_{2.5}$ and PM_{10} for Phase 1 and WSA bulk earthworks

Pollutant	Maximum incremental level from the Project (µg/m^3)	Estimated contribution from WSA bulk earthworks (µg/m^3)	Background level (µg/m^3)	Total cumulative level (µg/m^3)	Criteria (µg/m^3)

$PM^{2.5}$	0.5	0.1	7.0	7.6	8
PM^{10}	2.6	<0.5	16.6	<19.7	25

Short term 24-hour average impacts

The receptors between the project and WSA will be the most impacted by the projects and are the most impacted cumulatively by both projects on an annual average basis. However, they cannot be significantly cumulatively impacted on a short-term basis, as one project will always be down wind when the receptor is most impacted by the other project. Therefore, it is not valid to conduct a Level 1 assessment for these receptors (by adding together the maximum short-term impacts from both projects).

Only the receptors further from WSA (to the southeast of the project) can be downwind of both projects at the same time and, therefore, experience short-term cumulative impacts.

A conservative Level 1 assessment can be made by adding the WSA maximum results to the maximum results for the project. It is highly unlikely that maximum activities at both projects would occur simultaneously on the worst-case day at the most impacted receptor. The nature of 24-hour average impacts would vary greatly from day to day for the project and WSA. Therefore, potential cumulative 24-hour average impacts are difficult to estimate accurately. Hence, a large degree of overestimation is inherent in this approach.

The maximum 24-hour dust levels at the most impacted receptor are:

- Project
  - 24-hr average PM_{10} – 22.8 µg/m^3.
  - 24-hr average $PM_{2.5}$ – 3.5 µg/m^3.
- WSA
  - 24-hr average PM_{10} – 1.4 µg/m^3.
  - 24-hr average $PM_{2.5}$ – 0.7 µg/m^3.

The additional WSA 24-hour average PM_{10} and $PM_{2.5}$ contribution is relatively small, i.e. less than 3% of the criteria. This is well within the ±25% measurement tolerance of monitoring instruments per the *Approved Methods for Sampling and Analysis of Air Pollutants in NSW* (NSW, EPA, 2007).

The additional cumulative effect due to the WSA works is unlikely to alter the predicted 24-hr average cumulative assessment in the AQIA. Nevertheless, any potential cumulative 24-hour average impacts will be managed at the project in accordance with the air quality management plan and it is reasonable to expect that appropriate management measures would also be applied by WSA.

Potential impacts on adjacent vacant land

The potential for air quality impacts on adjacent vacant land in the Aerotropolis Core Precinct during phases 2 and 3 has been evaluated using the predicted pollutant dispersion contours.

Contours for $PM_{2.5}$, PM_{10}, TSP and deposited dust were plotted to determine the extent of off-site impacts. This showed that $PM_{2.5}$ would be the pollutant contributing to most of the exceedances of criteria on adjacent land, where the cumulative criterion of 8 µg/m^3 will be exceeded along the southern boundary of the site, in the extreme northern boundary of the Aerotropolis Core Precinct. This area may not initially be suitable for residential development.

During Phase 4, when extraction and backfilling activities of the quarry pits have ceased, and the brick making facility operations are confined to a 30 Ha area in the centre of the site, the dust

impacts would be reduced and the northern boundary of the Aerotropolis Core Precinct would be suitable for residential development.

CASA plume rise assessment

The site is immediately east of the WSA site and the proposed project has potential to affect the protected airspace known as the obstacle limitation surface (OLS) as the existing 41 m brick making facility exhaust stack is being replaced with two 41 m stacks in a similar location as the existing. A plume rise assessment is required where tall structures and exhaust plumes are within the OLS and have the potential to impact aircraft safety.

A form 1247 was submitted to the Civil Aviation Safety Authority (CASA) requesting a plume rise assessment for the project. CASA assessed all exhaust plumes from the project and found that:

> "there is no infringement of the Obstacle Limitation Surfaces at a critical velocity of 4.3m/sec and CASA considers that there will be an Acceptable Level of Safety. No additional mitigations will be required."

Residual impacts and management measures

The assessment demonstrated that, with implementation of existing dust management measures, the preferred project will not impact the air quality at sensitive receivers.

The existing air quality management plan (AQMP) includes a reactive dust management program which requires the use of portable ambient air quality samplers downwind of the extraction activity, between the site and the receivers during the extraction campaigns.

As the air quality assessment demonstrates that the modified project operations will not result in exceedances of relevant air quality criteria at any sensitive receivers, a reactive dust management program is not required. However, the existing HVAS should be moved to as close to the northern boundary of the property and the closest sensitive receiver as possible.

The existing deposited dust gauges should also be relocated to appropriate positions as close to the property boundaries and nearest sensitive receivers as possible. If HVAS and deposited dust air quality monitoring identifies ongoing exceedances of the relevant air quality criteria then the reactive dust management program may need to be reinstated at the site.

The AQMP will be revised to address changes to the approved project operations, relocation of air quality monitoring equipment, and removal of the need to continue to implement a reactive dust management program.

2.3.3 Noise impacts

Potential noise impacts on sensitive receivers associated with the project were assessed. The noise impact assessment report is in Appendix C, which is summarised in this chapter.

Existing environment

Sensitive receivers

The locations of assessed receivers sensitive to project operations are in Table 2.1 and receivers sensitive to road noise are in Table 4.2 of Appendix C.

Noise sources

The site is in a rural area which has low background noise levels. Noise sources in the local area include:

- natural (e.g. birdsong, insects, road noise and livestock);

- domestic and small rural enterprises; and
- commercial and industrial (chicken farming, composting, nurseries, resource recovery).

Meteorology

Noise levels at receivers at distance from a source can be influenced by meteorological conditions, particularly temperature inversions and gradient winds.

Temperature inversions are likely in the area, particularly during winter nights, and have been included in the assessment for night time and the morning shoulder.

Prevailing winds were identified in accordance with *Fact Sheet D* of the NPI based on hourly wind speed and direction observations during 2017 at the Bringelly Air Quality Monitoring Station.

Winds are considered a feature of the area, and noise enhancing, when the proportion of wind above 3 m/s from a particular direction (+/- 45˚) is 30% or more and must be included in the assessment. There are daytime and evening prevailing winds at the site. However, these winds are unlikely to occur at receivers R11-15 and the noise enhanced predictions for these have not been considered.

Ambient noise

Unattended noise monitoring was undertaken at the three residential receivers potentially most affected by noise from the site. The rating background levels (RBL) were derived from the background noise for day, evening, night and morning shoulder (0500-0700hrs) periods in accordance with the EPA's (2017) *Noise Policy for Industry* (NPI), which are summarised in Table 2.20.

Table 2.20 Ambient noise and rating background levels

Monitoring location	Represented receivers	Period	Noise levels (dBA)	
			RBL	L_{Aeq}
L1	R9, R25, R35	Morning shoulder	38	47
		Day	40	50
		Evening	35	43
		Night	34	43
L2	R5, R26-32, R34, R42-46	Morning shoulder	38	45
		Day	37	51
		Evening	36	43
		Night	34	42
L3	R11-15	Morning shoulder	41	47
		Day	38	47
		Evening	38	43
		Night	37	45

Notes: morning shoulder 0500-0700, day 0700-1800, evening 1800-2200, night 2200-0500.

Noise was also monitored at two locations on Martin Road at the same time as traffic counts to establish the noise levels at sensitive receivers (Table 2.21) and existing traffic levels.

Table 2.21 Existing traffic noise levels

Monitoring Location	Façade/Free-Field	Day* ($L_{Aeq, 15\ hour}$)	Night* ($L_{Aeq, 9\ hour}$)
L1	Free-field	53.1	47.9
L2	Free-field	54.1	48.4

*Day 0700–2200; night 2200–0700.

Impact Assessment

Operational noise

Noise levels were predicted for the following scenarios during the morning shoulder, day, evening and night periods using the CadnaA acoustic noise prediction software and the CONCAWE noise prediction algorithm:

Noise impacts from extraction, brick making and VENM importation/backfilling of pits associated with the phases and operating hours described in Section 2.2.2 were modelled, with equipment at the closest locations to the sensitive receivers.

The existing site topography was included in the model and comprises:

- an approximately 4.5 m high noise bund along the site's main entrance driveway; and
- a partially constructed noise bund in the south-eastern corner of the site, along the eastern edge of the approved Pit 3.

A 3 m landscaped visual bund, to the east, south and west of the brick making facility raw material stockpile area, will be constructed by the end of phase 1. This will be an earthen bund and will attenuate noise to the east, south and west of the brick making facility. However, as a conservative measure, this bund has not been included in the noise modelling.

The existing and proposed structures associated with the brick making facility are also included in the noise model.

Modelled activities and worst-case operating scenarios are presented in Section 3.4 of the noise impact assessment (Appendix C).

Noise results were compared to noise trigger levels, which was taken as the lower of the intrusiveness or amenity noise levels.

The intrusiveness noise level is the noise level 5 dBA above the background noise level for each time period (daytime, evening or night time) of interest at a residential receiver.

Amenity noise levels are a limit on continuing increases in noise levels from all industrial noise sources affecting a variety of receiver types; that is, the ambient noise level in an area from all industrial noise sources remains below recommended amenity noise levels.

The noise trigger levels for the site have mostly been derived from the intrusiveness noise levels and are listed in Table 2.22, Table 2.23, Table 2.24 and Table 2.25 for comparison with the predicted noise levels. No exceedances of the trigger levels were predicted.

Table 2.22 Predicted operation noise levels – Phase 1

Receiver	AM Shoulder [a]				Day [a]						Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level				Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b]		NE [c]				Calm [b]	NE [c]			Calm [b]	NE [c]		
					OB [e]	RM [e]	OB [e]	RM [e]										
R5	34	38	42	Yes	36	36	41	41	42	Yes	36	41	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	35	36	39	40	45	Yes	35	39	40	Yes	27	31	38	Yes
R11	22	27	43	Yes	39	35	- d	- d	43	Yes	39	- d	43	Yes	19	25	38	Yes
R12	22	28	43	Yes	41	36	- d	- d	43	Yes	41	- d	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	41	37	- d	- d	43	Yes	41	- d	43	Yes	21	26	38	Yes
R13	22	28	43	Yes	39	36	- d	- d	43	Yes	39	- d	43	Yes	19	24	38	Yes
R14	22	27	43	Yes	39	35	- d	- d	43	Yes	39	- d	43	Yes	18	23	38	Yes
R15	22	27	43	Yes	38	34	- d	- d	43	Yes	38	- d	43	Yes	18	23	38	Yes
R25	31	34	43	Yes	35	35	39	39	45	Yes	35	39	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	34	34	39	39	42	Yes	34	39	41	Yes	30	35	38	Yes
R27	30	34	42	Yes	33	33	38	39	42	Yes	33	38	41	Yes	29	33	38	Yes
R28	30	35	42	Yes	34	34	39	39	42	Yes	34	39	41	Yes	29	34	38	Yes
R29	27	32	42	Yes	32	32	37	37	42	Yes	32	37	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	31	31	36	36	42	Yes	31	36	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	33	33	38	38	42	Yes	33	38	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	31	31	36	36	42	Yes	31	36	41	Yes	25	30	38	Yes
R34	24	29	42	Yes	29	29	34	35	42	Yes	29	34	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	32	33	37	37	45	Yes	32	37	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	34	35	39	40	42	Yes	34	39	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	32	32	37	37	42	Yes	32	37	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	29	29	34	35	42	Yes	29	34	41	Yes	23	28	38	Yes

R45	24	29	42	Yes	29	30	35	35	42	Yes	29	35	41	Yes	23	28	38	Yes
R46	22	27	42	Yes	27	28	33	33	42	Yes	27	33	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.
e. OB = overburden removal; RM = raw material extraction.

Table 2.23 Predicted operation noise levels – Phase 2

Receiver	AM Shoulder a				Day a				Evening a				Night a			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm b	NE c			Calm b	NE c			Calm b	NE c			Calm b	NE c		
R5	34	38	42	Yes	36	40	42	Yes	34	39	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	35	39	45	Yes	31	35	40	Yes	27	31	38	Yes
R11	22	27	43	Yes	35	- d	43	Yes	22	- d	43	Yes	<20	25	38	Yes
R12	22	28	43	Yes	36	- d	43	Yes	22	- d	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	37	- d	43	Yes	23	- d	43	Yes	21	26	38	Yes
R13	22	28	43	Yes	36	- d	43	Yes	23	- d	43	Yes	<20	24	38	Yes
R14	22	27	43	Yes	35	- d	43	Yes	22	- d	43	Yes	<20	23	38	Yes
R15	22	27	43	Yes	34	- d	43	Yes	22	- d	43	Yes	<20	23	38	Yes
R25	31	34	43	Yes	35	39	45	Yes	31	34	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	34	39	42	Yes	32	36	41	Yes	30	35	38	Yes
R27	30	34	42	Yes	33	38	42	Yes	30	35	41	Yes	29	33	38	Yes
R28	30	35	42	Yes	33	38	42	Yes	31	36	41	Yes	29	34	38	Yes
R29	27	32	42	Yes	31	36	42	Yes	28	33	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	30	35	42	Yes	27	32	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	32	37	42	Yes	30	35	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	30	35	42	Yes	27	32	41	Yes	25	30	38	Yes

R34	24	29	42	Yes	28	34	42	Yes	24	29	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	32	37	45	Yes	26	31	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	34	39	42	Yes	32	37	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	31	36	42	Yes	29	34	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	28	33	42	Yes	25	30	41	Yes	23	28	38	Yes
R45	24	29	42	Yes	28	33	42	Yes	25	30	41	Yes	23	28	38	Yes
R46	22	27	42	Yes	27	33	42	Yes	23	28	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

Table 2.24 Predicted operation noise levels – Phase 3

Receiver	AM Shoulder a				Day a				Evening a				Night a			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm b	NE c			Calm b	NE c			Calm b	NE c			Calm b	NE c		
R5	33	38	42	Yes	35	39	42	Yes	34	39	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	34	38	45	Yes	31	35	40	Yes	27	31	38	Yes
R11	22	27	43	Yes	37	- d	43	Yes	22	- d	43	Yes	<20	25	38	Yes
R12	22	27	43	Yes	39	- d	43	Yes	22	- d	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	40	- d	43	Yes	23	- d	43	Yes	21	26	38	Yes
R13	22	27	43	Yes	38	- d	43	Yes	23	- d	43	Yes	<20	24	38	Yes
R14	22	27	43	Yes	37	- d	43	Yes	22	- d	43	Yes	<20	23	38	Yes
R15	21	26	43	Yes	36	- d	43	Yes	22	- d	43	Yes	<20	23	38	Yes
R25	30	34	43	Yes	34	38	45	Yes	31	34	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	32	37	42	Yes	32	36	41	Yes	30	35	38	Yes
R27	29	34	42	Yes	31	36	42	Yes	30	35	41	Yes	29	33	38	Yes
R28	30	35	42	Yes	32	37	42	Yes	31	36	41	Yes	29	34	38	Yes

R29	27	32	42	Yes	29	34	42	Yes	28	33	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	28	33	42	Yes	27	32	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	31	35	42	Yes	30	35	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	28	33	42	Yes	27	32	41	Yes	25	30	38	Yes
R34	23	28	42	Yes	26	31	42	Yes	24	29	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	31	35	45	Yes	26	31	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	33	38	42	Yes	32	37	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	30	34	42	Yes	29	34	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	26	31	42	Yes	25	30	41	Yes	23	28	38	Yes
R45	24	29	42	Yes	26	31	42	Yes	25	30	41	Yes	23	28	38	Yes
R46	22	27	42	Yes	25	30	42	Yes	23	28	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

Table 2.25 Predicted operation noise levels – Phase 4

Receiver	AM Shoulder a				Day a				Evening a				Night a			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm b	NE c			Calm b	NE c			Calm b	NE c			Calm b	NE c		
R5	33	38	42	Yes	34	39	42	Yes	34	39	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	32	35	45	Yes	31	35	40	Yes	27	31	38	Yes
R11	22	27	43	Yes	22	- d	43	Yes	22	- d	43	Yes	<20	25	38	Yes
R12	22	27	43	Yes	23	- d	43	Yes	22	- d	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	24	- d	43	Yes	23	- d	43	Yes	21	26	38	Yes
R13	22	27	43	Yes	23	- d	43	Yes	23	- d	43	Yes	<20	24	38	Yes
R14	22	27	43	Yes	23	- d	43	Yes	22	- d	43	Yes	<20	23	38	Yes
R15	21	26	43	Yes	22	- d	43	Yes	22	- d	43	Yes	<20	23	38	Yes

R25	30	34	43	Yes	31	35	45	Yes	31	34	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	32	37	42	Yes	32	36	41	Yes	30	35	38	Yes
R27	29	34	42	Yes	30	35	42	Yes	30	35	41	Yes	29	33	38	Yes
R28	30	35	42	Yes	31	36	42	Yes	31	36	41	Yes	29	34	38	Yes
R29	27	32	42	Yes	28	33	42	Yes	28	33	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	27	32	42	Yes	27	32	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	30	35	42	Yes	30	35	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	27	32	42	Yes	27	32	41	Yes	25	30	38	Yes
R34	23	28	42	Yes	25	30	42	Yes	24	29	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	27	31	45	Yes	26	31	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	33	37	42	Yes	32	37	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	29	34	42	Yes	29	34	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	25	30	42	Yes	25	30	41	Yes	23	28	38	Yes
R45	24	29	42	Yes	25	30	42	Yes	25	30	41	Yes	23	28	38	Yes
R46	22	27	42	Yes	23	28	42	Yes	23	28	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

Voluntary Land Acquisition and Mitigation Policy

The project is a State significant mining/extractive industry development and, therefore, the VLAMP must be considered.

The predicted noise levels comply with the noise trigger levels at all sensitive receivers. Additionally, the predicted noise levels do not exceed the acceptable noise level plus 5 dB in Table 2.2 of the NPfI on more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Therefore, no voluntary mitigation or land acquisition rights, as prescribed by the VLAMP, will be required.

Predicted L_{Amax} operational noise levels

Pneumatic parking brakes on trucks will be the most likely source of maximum noise levels. Based on Wilkinson Murray's previous measurements, the L_{Amax} sound power level of pneumatic parking brakes is up to 122 dBA.

The predicted L_{Amax} noise levels at sensitive receivers due to the operation of truck parking brakes on the site will comply with the maximum noise trigger level at all receivers and no assessment of sleep disturbance is warranted.

Operational noise impacts on the Western Sydney Aerotropolis

With respect to the LUIIP, operational noise levels from the project will comply with NPfI-derived noise trigger levels for:

- commercial and industrial land uses on all land beyond the site boundary during all phases;
- commercial and industrial land uses to the north and west of the final 30 Ha brick making site from phase 2 onwards;
- commercial and industrial land uses to the south and east of the final 30 Ha brick making site from phase 4 onwards; and,
- residential land uses to the south and east of the final 30 Ha brick making site from phase 4 onwards.

Construction noise

Noise levels at receivers were predicted for the construction activities summarised in Table 2.26 with the CadnaA noise prediction software using the CONCAWE noise prediction algorithms during standard construction hours.

The predicted noise levels at receivers are compared to noise management levels (NML) for residences from EPA's (2009) *Interim Construction Noise Guideline* in Table 2.26 with exceedances in bold.

Table 2.26 Predicted construction noise levels ($L_{Aeq, 15min}$ dB(A))

Receiver	Predicted Level				NML	Exceedance
	New Buildings	Building Alterations	VENM Haul Road	Visual Bund		
R5	**51**	37	37	42	47	**4 dB**
R9	37	27	**52**	33	50	**2 dB**
R11	23	<20	43	29	48	-
R12	23	<20	44	29	48	-

R12a	24	<20	45	30	48	-
R13	24	21	45	29	48	-
R14	26	21	44	29	48	-
R15	27	21	43	29	48	-
R25	37	27	**51**	34	50	1 dB
R26	46	36	39	39	47	-
R27	44	34	38	39	47	-
R28	46	34	36	41	47	-
R29	39	31	37	36	47	-
R30	37	29	36	35	47	-
R31	43	33	36	40	47	-
R32	40	34	40	34	47	-
R34	34	27	39	32	47	-
R35	36	25	49	30	50	-
R42	**48**	35	37	42	47	1 dB
R43	39	32	36	37	47	-
R44	34	28	34	34	47	-
R45	35	28	36	34	47	-
R46	32	25	38	30	47	-

There is the potential for construction noise levels to exceed NMLs at several receivers ranging from 1-4 dB. No exceedances of the 75 dBA highly affected level are predicted.

Martin Road and Elizabeth Drive intersection

Noise levels at receivers RN1 (1970 Elizabeth Drive Badgerys Creek) and RN2 (10 Martin Road Badgerys Creek) were predicted for the construction of the signalised intersection. Construction noise levels could exceed NMLs by 23 dBA at RN1 and by 21 dBA at RN2 (refer to Table 2.27). No exceedances of the 75 dBA highly affected level are predicted.

Table 2.27 Predicted road noise levels at the most affected residential facades

Receiver	NML	Predicted Level			Exceedance
		Bulk Earthworks	Paving/Asphalting	Furniture Installation	
RN1	50	73	71	65	23 dB
RN2	50	71	69	63	21 dB

Road traffic noise

Martin Road

There will be an increase in traffic volumes during operation of the project. Noise associated with this increase at receivers along Martin Road was predicted using the UK Department of Transport's (1988) *Calculation of Road Traffic Noise* program for day and night periods.

Existing (no build) and predicted (build) noise levels are compared to the EPA's (2011) *NSW Road Noise Policy* (RNP) criteria in , with exceedances in bold. The RNP states that any increase in total traffic noise should be limited to 2 dB above the 'no build' option.

All reasonable and feasible mitigation measures should be implemented to reduce noise levels to the impact assessment criteria when the criteria are exceeded and the increase in noise levels due to a proposal are more than 2 dB at a building façade.

Six receivers (RN5, RN9, RN14, RN16, RN21 and RN22) will experience significantly increased noise levels due to the project and therefore qualify for, and may require mitigation.

Elizabeth Drive

Approximately 75% of the traffic to and from the site will travel along the section of Elizabeth Drive east of Martin Road. Therefore, the assessment of potential road noise impacts focused on this section of Elizabeth Drive.

Predicted road noise levels at the most potentially affected receivers along Elizabeth Drive with and without the project are summarised in Table 2.28, which comply with the RNP criteria and the increase in traffic noise levels will be less than 2 dBA.

Table 2.28 Predicted $L_{Aeq,period}$ road noise levels – Elizabeth Drive

Road	No Build		Build		Criteria		Difference	
	Day [a]	Night [a]	Day [a]	Night [a]	Day [a]	Night [a]	Day [a]	Night [a]
Elizabeth Drive – East of Martin Road	57.7	50.4	58.6	50.9	60	55	0.9	0.5

Martin Road and Elizabeth Drive intersection

The configuration of the proposed signalised intersection was assessed and the changes to the horizontal alignment of the through lanes will not be significant compared to the setback of nearby receivers.

Noise of vehicles travelling through the intersection was predicted at the most potentially affected receivers along Elizabeth Drive immediately south of the intersection, with and without the project and signals. The noise levels comply with the RNP impact assessment criteria and the increase in traffic noise levels due to the project and signalised intersection will be less than 2 dBA (Table 2.29).

The CoRTN model does not account for traffic accelerating and decelerating at intersections, so existing levels of road noise should be quantified prior to intersection construction. This will allow any complaints or concerns raised by receivers' post construction to be measured against existing data, quantified and a determination made on whether architectural treatment should be offered to affected receivers.

Table 2.29 Predicted road traffic noise at most affected residential facades

Receiver	Predicted LAeq,period Noise Levels				Criteria		Increase		Exceed Criteria?		Increase > 2dB?		Mitigate?	Treatment Package
	No Build		Build											
ID	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night		
RN1	46	40	51	43	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN2	50	44	55	46	60	55	5.4	2.7	N	N	Y	Y	N	Nil
RN3	47	41	53	44	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN4	48	42	53	45	60	55	5.4	2.7	N	N	Y	Y	N	Nil
RN5	56	50	**61**	53	60	55	5.4	2.8	Y	N	Y	Y	**Y**	**1**
RN6	54	48	60	51	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN7	39	33	45	36	60	55	5.6	2.9	N	N	Y	Y	N	Nil
RN8	43	37	48	39	60	55	5.5	2.9	N	N	Y	Y	N	Nil
RN9	57	51	**62**	53	60	55	5.3	2.7	Y	N	Y	Y	**Y**	**1**
RN10	49	43	55	46	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN11	42	36	48	39	60	55	5.5	2.9	N	N	Y	Y	N	Nil
RN12	51	45	57	48	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN13	52	46	58	49	60	55	5.4	2.8	N	N	Y	Y	N	Nil
RN14	58	52	**63**	55	60	55	5.3	2.8	Y	N	Y	Y	**Y**	**1**
RN15	55	49	60	51	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN16	58	52	**64**	55	60	55	5.2	2.8	Y	N	Y	Y	**Y**	**1**
RN17	53	47	58	50	60	55	5.3	2.7	N	N	Y	Y	N	Nil

Receiver	Predicted LAeq,period Noise Levels				Criteria		Increase		Exceed Criteria?		Increase > 2dB?		Mitigate?	Treatment Package
	No Build		Build											
ID	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night		
RN18	42	36	48	39	60	55	5.5	2.9	N	N	Y	Y	N	Nil
RN19	46	40	51	43	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN20	48	42	53	45	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN21	56	50	**62**	53	60	55	5.4	2.7	Y	N	Y	Y	**Y**	**1**
RN22 (R34)	58	52	**63**	55	60	55	5.3	2.8	Y	N	Y	Y	**Y**	**1**
RN23	55	49	60	51	60	55	5.4	2.7	N	N	Y	Y	N	Nil
RN24 (R32)	45	39	51	42	60	55	5.7	3.1	N	N	Y	Y	N	Nil
RN25 (R35)	40	34	58	47	60	55	17.6	13.6	N	N	Y	Y	N	Nil
RN26 (R25)	36	29	54	44	60	55	18.8	14.6	N	N	Y	Y	N	Nil
RN27 (R9)	31	25	54	44	60	55	22.8	18.7	N	N	Y	Y	N	Nil

Vibration assessment

The safe working distances for building damage and human comfort applying to vibratory roller (the plant item likely to generate the most vibration) are 25 m and 100 m, respectively. During construction of the VENM haul road (the closest construction activity to sensitive receivers), vibratory rollers will not be used within 100 m of a sensitive receptor. Therefore, it is unlikely there will be vibration impacts during construction.

Residual impacts and management measures

Noise generated from operation of the project is not predicted to exceed criteria. However, noise generated during construction of the project will exceed NMLs and vehicles associated with the project will generate noise which will exceed RNP criteria.

Implementation of management measures during construction will likely reduce construction noise levels by the quantities shown in Table 5.7 of Appendix C. A construction noise management plan will be prepared and implemented during project construction.

With respect to the proposed upgrade to the Martin Road-Elizabeth Drive intersection, prior to construction taking place, existing road noise levels will be quantified to determine if architectural treatment should be offered to receivers raising complaints about increased road noise levels.

The assessment determined the residences affected by road noise will require the 'Type 1' treatment package from RMS's (2015) *At-receiver Treatment Guideline*.

The noise management plan (NMP) will be updated to incorporate the preferred project works and noise mitigation and management measures.

2.3.4 Surface water

This section provides a brief summary of the surface water management approach proposed in the modification 3 and 4 EAs and describes proposed changes to the water management associated with the project.

Modification 3 surface water management

The following water management measures were proposed for the brick making facility in the Modification 3 EA and surface water assessment:

- Sediment Basins 5 and 6 were to be constructed in Years 1 to 5 to capture runoff from the expanded brick making facility and piped to Pit 1 to empty them ready for the next storm.
- Sediment Basin 5 was to overtop to Sediment Basins 1 and 2 and then Badgerys Creek.
- Sediment Basin 6 was to overtop to Sediment Basin 3 and then South Creek.
- Sediment Basin 6 was to be decommissioned once Pit 4 extraction commences, with runoff being treated the same as other Pit 4 runoff.
- Sediment Basin 5 was to be decommissioned once Pit 5 extraction commences, with runoff being treated the same as other Pit 5 runoff.

Sediment Basin 4 at Pit 2 was required to be constructed in Years 6 to 7 to manage runoff from the backfilled and rehabilitated Pit 2 void. Sediment Basin 4 would be decommissioned in Years 17 to 18.

Modification 3 included the construction of the Monier roof products manufacturing facility beyond the eastern boundary of the approved project. Stormwater from this plant was to be treated via a new stormwater management basin along the eastern edge of the facility, prior to discharge towards South Creek.

Modification 3 also included quarrying from Pit 4, starting in Years 8 to 10, and from Pit 5, starting in Years 19 to 21. Water management from these pits involved piping to other pits when required. These pits would also accept water piped from other pits if required.

Modification 4 surface water management

Surface water management for Modification 4 would have involved the following:

- Initial dewatering of Pits 2 and 3 into Pit 1. Dewatering of Pit 1 would involve reuse of water onsite for dust suppression and irrigation, potential transfer to WSA or controlled discharge to Badgerys Creek as a last resort. The rate of discharge to Badgerys Creek is not expected to exceed 100,000 L/hr and could be reduced to approximately 80,000 L/hr maximum, accounting for reuse onsite of 20,000 L/hr.
- Ongoing dewatering of pits during progressive extraction and filling via the same methods as for the initial dewatering, albeit at a reduced rate.

Project surface water management

The key differences in the project surface water management approach from that described in the modification 3 and 4 EAs are:

- The Monier roof products manufacturing facility is no longer part of the project and hence no stormwater treatment basin is required for this component.
- Pits 4 and 5 will no longer be quarried and hence water management at these pits including ongoing dewatering is not required.

The proposed changes to the water management approach associated with each phase of the project is outlined in the following sections.

Phase 1 (Years 1 to 6) (refer to Figure 1 in Appendix D)

- Initial dewatering of Pit 1 over a period of 1 to 3 years will be according to the same process as Modification 4, prioritising onsite water reuse, transfer to the WSA site and then discharge to Badgerys Creek as a last resort. The maximum rate of discharge to Badgerys Creek will not exceed that proposed under Modification 4 (100,000 L/hr).
- Irrigation reuse demand during the initial dewatering is expected to increase relative to Modification 4 due to the demand of grassed areas no longer being developed into the Monier roof products manufacturing facility or the solar farm. These areas total about 15 ha, representing a 30% increase in area for initial irrigation. Accordingly, the onsite reuse would be increased by 5,000 L/hr relative to Modification 4, meaning the potential maximum discharge to Badgerys Creek could be reduced to 75,000 L/hr.
- As per Modification 4, during Pit 1 VENM filling, a perched water treatment basin is to be installed at the north-west corner of Pit 1 to take water collected in the pit.
- Sediment basins 5 and 6 are required to treat stormwater from the expanded brick making facility, as per modifications 3 and 4. These basins are to be dewatered into Pit 1 following a storm until Pit 1 is backfilled. During filling of Pit 1 these sediment basins can be piped to the perched basin in Pit 1.
- Following the completion of Pit 1 filling, the perched basin in Pit 1 is to be removed. From this point onwards water in sediment basins 5 and 6 is to be treated and discharged to sediment basins 1 and 3, respectively. This may require flocculation or use of a pump with filter.
- Alternatively, the water in sediment basins 5 and 6 could be treated and discharged to sediment basins 1 and 3 at the commencement of operations or during filling of Pit 1. The treatment to be provided by the basins would be subject to further detailed design. Sediment basins 5 and 6 may need to be upgraded to incorporate additional treatment capacity if not constructed for stand-alone treatment from the beginning.
- Sediment Basin 4 is required to manage stormwater from the Pit 2 area during filling and rehabilitation. Sediment Basin 4 is to be dewatered into Pit 1 following a storm until Pit 1 is

backfilled. Following the completion of Pit 1 filling, stormwater in Sediment Basin 4 is to be treated and discharged to Badgerys Creek. Sediment Basin 4 can be decommissioned following completion of Pit 2 filling and rehabilitation.

- New sediment basin(s) are required on the inside of the landscaped earth bund (once constructed) to treat stormwater from the brick making facility raw material stockpile area. Discharge from these basins during Phase 1 would be to existing drainage paths towards Badgerys Creek or South Creek via sediment basins 5 and 6. An alternative option would be to direct runoff to the new sediment basin at Pit 3 (see following).
- A new sediment basin is required in the south-east corner of the Pit 3 footprint, to treat water from Pit 3 once Pit 1 is backfilled. Water collected in the basin is to be treated prior to discharge to the small drainage channel flowing to South Creek.
- Surface water from the development of adjacent properties and CSR land in accordance with the LUIIP will need to be managed via detention and stormwater treatment, which will form part of future development applications.
- Appropriate erosion and sediment control measures are to be implemented for the revised VENM haul road alignment.

As initial dewatering discharges to Badgerys Creek (if required), it is recommended that sediment properties in Badgerys Creek be investigated to check the potential impact of a continuous discharge on geomorphology. It is also recommended that water quality and biological monitoring programs be continued/ established for Badgerys Creek to assess any impact of the discharges on ecology.

Ongoing dewatering activities (after Year 3) will be limited to stormwater collected in Pit 3 during the latter part of Phase 1 and during phases 2 and 3. This dewatering is considered separate to stormwater collected at proposed sediment/treatment basins. These ongoing discharges from Pit 3 will be to South Creek via the proposed treatment basin at Pit 3.

The Modification 4 Dewatering Strategy report identified that the discharge of initial pit water from Pit 3 to South Creek could lead to an impact on some water quality parameters in South Creek, including pH, total alkalinity as CaCO3, arsenic and copper. Initial dewatering of Pit 3 will be to Pit 1 and not to South Creek.

It is expected that appropriate measures can be implemented to improve or treat the ongoing stormwater dewatered from Pit 3, thus minimising the impact of ongoing discharges to South Creek. The standard of treatment required will be based on further assessment of water quality in South Creek to determine appropriate constituent levels.

The rate of discharge to South Creek is expected to be minor and therefore the impact on geomorphology would be limited. However, it is recommended that the water quality monitoring program be continued for South Creek to assess any impact of the ongoing discharges to water quality.

If it is found that the Pit 3 water cannot meet the water quality standards for South Creek but can meet those for Badgerys Creek, then an alternative option would involve the laying of an underground pipeline within an easement through the developable land to the perched basin in Pit 1 for treatment and discharge of Pit 3 water to Badgerys Creek. In this case the perched basin in Pit 1 would need to be retained until the end of Phase 3, when Pit 3 VENM backfilling is complete.

Phase 2 (Years 7 to 10) (refer Figure 2 in Appendix D):

- Surface water from any new adjacent developments will need to be managed via detention and stormwater treatment, which will form part of future development applications.
- Stormwater from sediment basins 5 and 6 is to be treated and discharged to sediment basins 1 and 3, respectively, or to flow paths created through new adjacent developments once sediment basins 1, 2 and 3 have been removed. This may require flocculation of sediment basin 5 and 6 or the use of a pump with filter.

- Stormwater from the basins inside the landscaped bund is to be treated and discharged to flow paths created through new adjacent developments. An alternative option would be to direct runoff to the new sediment basin at Pit 3.
- Stormwater from Pit 3 is to be treated in the Pit 3 sediment basin prior to discharge.
- Appropriate erosion and sediment control measures are to be implemented for the revised VENM haul road alignment.

Phase 3 (Years 11 to 13)

The proposed surface water management for Phase 3 would be the same as Phase 2 (refer to Figure 3 of Appendix D).

Phase 4 (Year 14 Onwards)

The proposed surface water management for Phase 4 would be the same as for Phase 3, but with Pit 3 measures removed (refer to Figure 4 of Appendix D).

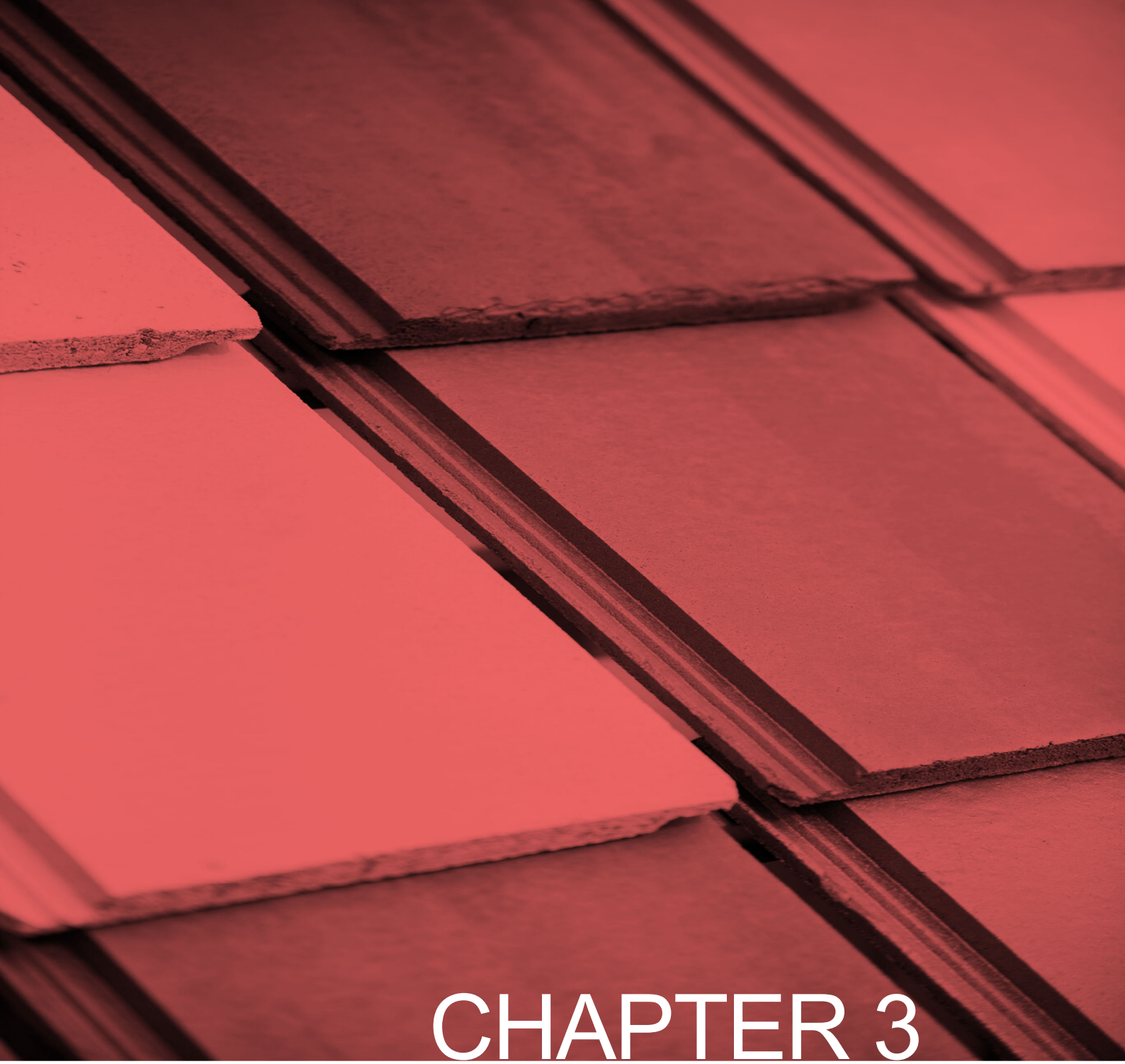
2.3.5 Other environmental impacts

The other environmental impacts assessed in the Modification 3 EA are summarised in Table 2.30, including a summary of how the impacts have changed under the project.

Table 2.30 Summary of environmental issues associated with the preferred project under Modification 3

Environmental issue	Comments	Residual risks
Contamination	The assessment concluded that the potential for widespread contamination on site is low, noting that isolated areas of contamination should not be discounted. Although the potential for significant risk to human health or the environment is low, CSR will prepare an unexpected finds procedure (UFP) and regular inspections of materials, building footprints and stockpiles in addition to existing environmental management measures and practices.	Removing the roof products manufacturing facility, sediment basin, future expansion area and areas surrounding these required for construction access proposed under the project will reduce the risk of encountering contaminated land during construction.
Terrestrial biodiversity	All works proposed in the project, including the Martin Road and Elizabeth drive intersection, will be on biodiversity certified land under State Environmental Planning Policy (Sydney Region Growth Centres) 2006. Therefore, biodiversity impacts do not require consideration by the consent authority.	None
Aboriginal heritage	The EA stated that all of BCBW18 AS 01 and part of BCBW18 AS 02 will be impacted by the roof products manufacturing facility, sediment basin, future expansion area and areas surrounding these required for construction access. However, these components of Modification 3 are no longer proposed under the preferred project. Therefore, no Aboriginal sites will be impacted by the project. Notwithstanding, items removed during the test excavation will be reburied with the hearth and a permanent fenced 10 m exclusion zone will be created around the hearth. The Aboriginal heritage management plan (AHMP) will be updated with the findings of the Modification 3 ACHA.	There is a marginal risk the reburied Aboriginal items and hearth could be impacted by livestock under the grazing lease. Therefore, a permanent fence will be installed to create a 10 m exclusion zone around the hearth.
Visual amenity	The project has low overall visual exposure to its visual catchment. Mitigation measures have been	Impacts of the project on visual amenity will be lower than those from Modification 3 as the roof

	proposed to reduce the impact of new structures on neighbouring receptors. A 3 m high landscaped earth bund will be constructed around the brick making facility raw material stockpile area during Phase 1 of the preferred project. The earth bund will be planted with trees and shrubs to create a minimum of a 5 m high visual screen around the raw material stockpile area. Trees and shrubs will also be planted around the remainder of the brick making facility and around the northern, western and southern sides of Pit 3. This landscaping and screen planting will visually screen the brick making facility and Pit 3 works from commuters travelling along the extended Martin Road and to future development around these operations both on CSR owned and neighbouring land. These additional landscaping and screen plantings will also further reduce the visual impact of the project on existing neighbouring residential receivers. To reduce the potential for impacts to the WSA, landscaping within the site will, as far as possible, avoid plants and trees that attract wildlife.	products manufacturing facility is no longer proposed and landscaping and screen planting is proposed around the brick making facility and Pit 3. Therefore, the landscaping for the roof products manufacturing facility will no longer be required.
Traffic and transport	The project will result in impacts to Martin Road and the intersection with Elizabeth Drive. CSR is finalising the deed of agreement with the LCC that outlines its contributions to the upgrade and maintenance costs for Martin Road. As described in Table 2.1, fewer trucks will enter and leave the site under the project compared to Modification 3. Notwithstanding, CSR will construct a signalised Martin Road-Elizabeth Drive intersection, significantly improving the safety of the intersections as well as the intersection performance to level of service (LOS) A. A construction traffic management plan will be prepared and implemented to manage impacts on the road network, including the intersection, from construction vehicles.	The project will impact traffic less than Modification 3 as fewer trucks will enter and leave the site. Notwithstanding, the Martin Road-Elizabeth Drive intersection will still be signalised as proposed in Modification 3 to improve road safety.
Bushfire	Surrounding vegetation presents a low bushfire risk and the project conforms with the aim and objectives of the Planning for Bushfire Protection 2006 (PBP). There is no bushfire hazard vegetation within 100 m of project components under Modification 3. The water supply and utility requirements for the project will be further investigated and established during the detailed design phase.	None



CHAPTER 3

ANALYSIS OF SUBMISSIONS

3 ANALYSIS OF SUBMISSIONS

Public exhibition of the EA ended on 13 May 2019. Eighteen submissions were lodged with the DPIE during the exhibition period, including organisation, agency responses and the request for an RTS from the DPIE (Table 3.1).

Table 3.1 Summary of EA submissions

No.	Agency	Date submission received
1	Fire and Rescue NSW (F&R)	1 May 2019
2	Rural Fire Service (RFS)	8 May 2019
3	Civil Aviation Safety Authority (CASA)	9 May 2019
4	Roads and Maritime Service (RMS)	13 May 2019
5	Western Sydney Planning Partnership (WSPP) – superseded by submission dated 2 July 2019.	14 May 2019
6	Greater Sydney Commission (GSC)	16 May 2019
7	Western Sydney Aerotropolis Authority (WSAA)	16 May 2019
8	Department of Planning, Industry and Environment (DPIE) – Hazards Team	22 May 2019
9	WaterNSW	22 May 2019
10	Endeavour Energy	22 May 2019
11	Australian Native Landscapes Pty Ltd (ANL)	22 May 2019
12	DPIE - Biodiversity and Conservation	23 May 2019
13	Environmental Protection Authority (EPA)	24 May 2019
14	DPIE – Water, lands and Primary Industries	27 May 2019 11 June 2019
15	Liverpool City Council (LCC)	29 May 2019
16	Western Sydney Airport Company (WSA)	30 May 2019
17	Transport for NSW	14 June 2019
18	Department of Planning, Industry and Environment (DPIE)	18 June 2019
-	WSPP - revised	2 July 2019

3.1 Submission matrix

A detailed matrix of the types of submissions received and submission themes is in Appendix A. The matrix notes which submissions are comments, which are in support and which are objections.

An overview of the submissions received is provided in Table 3.2.

Table 3.2 Summary of stakeholder submissions on the EA

Position	Organisation	Public Authority	Total
Comment	1	17	18
Objection	0	0	0
Support	0	0	0
Total	1	17	18

There were no objections to the project, however the primary concern is whether the modification is consistent with the LUIIP.

3.2 Submission themes

The submissions matrix (Appendix A) provides a detailed list of the matters raised in the submissions. The key themes raised in submissions are summarised in Table 3.3, with many submissions commenting on multiple themes. The themes are grouped as follows in descending order of quantity of comments:

- Air quality – 12 comments relating to the assessment methodology, results and cumulative impacts.
- Traffic – 10 comments relating to heavy vehicle numbers and upgrades to Martin Road and Elizabeth Drive.
- Electricity – nine comments relating to electrical infrastructure.
- Aboriginal heritage – Six comments relating to discrepancies between Modifications 3 and 4.
- Contamination – Four comments relating to screening thresholds and assessment of salinity.
- Surface water – Three comments relating to flooding and water management.
- Noise – Three comments relating to noise bunds and limits.
- Planning frameworks – Three comments relating to compliance with the Liverpool Local Environmental Plan 2008 (LEP) and LUIIP.
- Rehabilitation – Three comments relating to rehabilitation of the site.
- Modification 4 – Three comments referencing Modification 4.
- No comments – Three agencies confirmed no comment on Modification 3.
- Biodiversity – Two comments regarding managing wildlife risk to the airport.
- Visual – Two comments regarding the impact of lighting on the airport.
- Bushfire – Two comments relating to bushfire regulations and fire safety statements.
- Consultation – Two comments recommending further consultation with agencies.
- Safety – Two comments associated with site safety.
- Environment protection license – One comment relating to revisions to the EPL.
- Figures – One comment requesting that the rectangular assessment trigger area, described in Guideline B of the National Airports Safeguarding Framework (NASF), is included on a project figure.
- Sewage attenuation – One comment querying how sewage will be managed on site.
- Building certificates – One comment referencing the need for a building certificate prior to commencing construction.

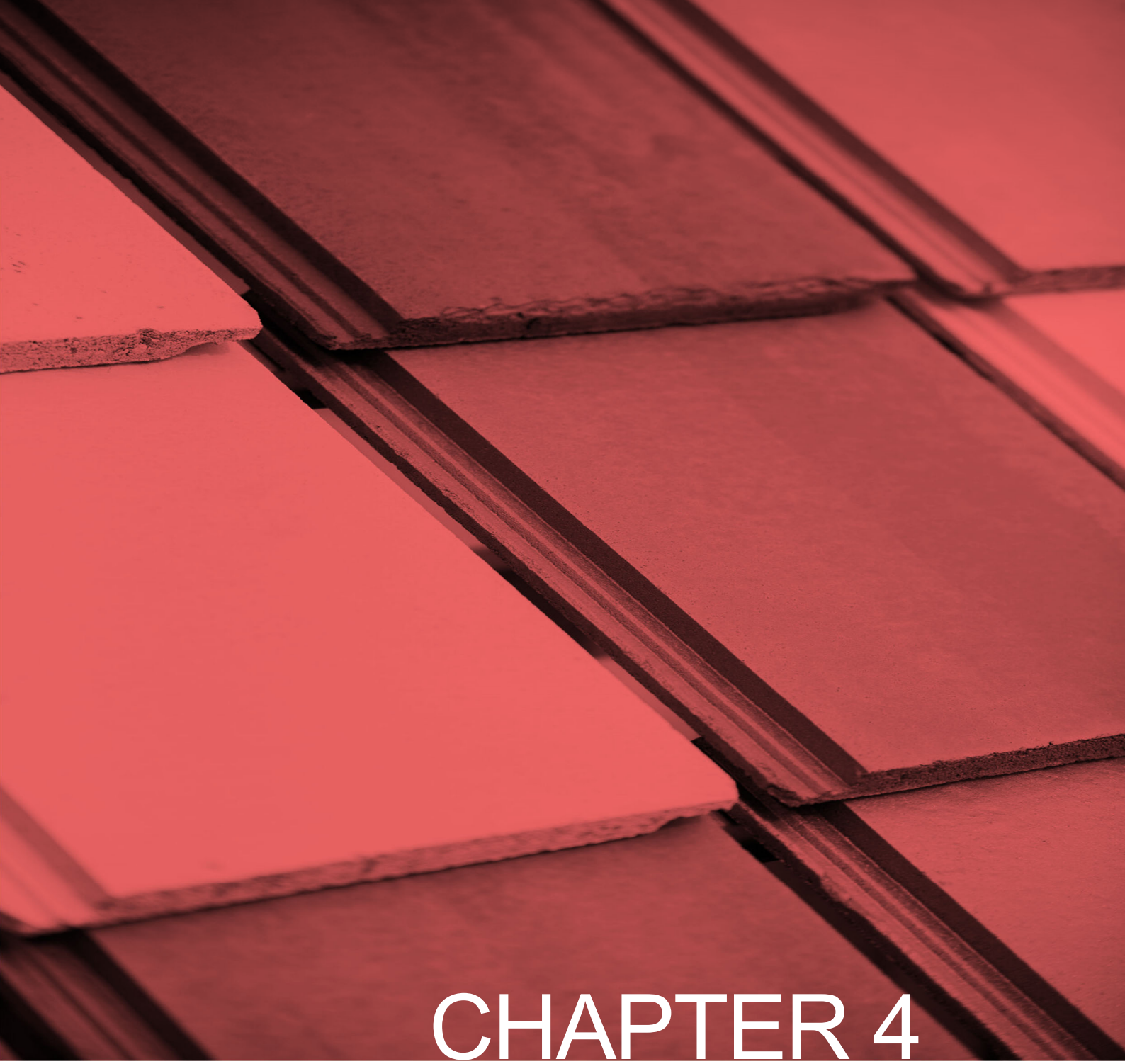
Each individual government agency submission is addressed in Chapter 5.

The single organisation submission, received from ANL, has been addressed in Chapter 6.

Table 3.3 Key submission themes

Key themes	Public authority	Community / organisations	Total
Surface water	3	0	3
Contamination	3	0	3
Terrestrial biodiversity	2	0	2
Aboriginal heritage	6	0	6
Air quality	12	0	12
Noise	3	0	3
Visual	2	0	2
Traffic	7	3	10
Bushfire	2	0	2
Planning frameworks	3	0	3
Consultation	2	0	2
Rehabilitation	3	0	3

Modification 4	3	0	3
Health and safety	2	0	2
Sewage	1	0	1
Building certificate	1	0	1
Electricity supply	10	0	10
Environment protection license	1	0	1
Figures	1	0	1
No comment	3	0	3



CHAPTER 4

POST EA ACTIVITIES

4 POST EA ACTIVITIES

This section summarises community and government agency engagement activities associated with Modification 3 that CSR undertook after submission of the EA.

4.1 Community engagement

The original Modification 3 road traffic noise assessment identified four residences along Martin Road that have the potential to be affected by road traffic noise associated with the modification and that may qualify for Type 1 architectural treatment.

CSR visited the potential road noise affected residences to speak to the residents to establish whether they are interested in CSR carrying out architectural treatment of their houses to mitigate potential road noise impacts. The outcome of this consultation is summarised in Table 4.1.

The revised road noise assessment for the project (refer to Section 2.3.3 and Appendix C) has identified six residences that have the potential to be affected by road traffic noise from the project (modifications 3 and 4) and that may qualify for Type 1 architectural treatment.

The revised road noise assessment determined that where truck movements generated by the preferred project are not greater than those allowed under the current PA, no architectural treatments would be warranted at receivers on Martin Road. Moreover, noise modelling results indicate that the preferred project could generate up to 180 truck movements in the daytime period without requiring architectural treatments to receivers on Martin Road.

CSR will continue to attempt to contact the owners of the potential road noise affected residences (including the additional two residents potentially affected by the project road noise) to determine whether they are interested in Type 1 architectural treatment of their home when truck movements from the site exceed 180 truck movements in the daytime period, if it is determined by further inspection of their properties, that they qualify for this type of architectural treatment.

Table 4.1 Summary of engagement with potential road noise affected receivers

Date	Address	Outcome
2 August 2019	165 Martin Road	The property gates were locked, access was unsuccessful and there was no letterbox to leave notes. Observations from the street established there are two houses on the property, with a double story home located approximately 26m from Martin Road. This structure is made of brick and was seen to contain aluminium windows, two external air-conditioning units and a solid front door
2 August 2019	120 Martin Road	This property contained a two-level brick house with aluminium windows and a visible external air-conditioning unit. A workshop / warehouse is located to the rear. It was unclear if the house was occupied or used as an office. Nobody was present to discuss noise generated by the project, and CSR contact details could not be left at the gate.
2 August 2019	110 Martin Road	This property contained a two-level brick residential homestead with aluminium windows and motorised shutters on all external windows except those on the southern side of the home.

		This structure also contained an external air-conditioning unit. The neighbour confirmed that the owner is currently in Italy and would not be back at the property for another two months. CSR provided contact details for the neighbour to provide to the resident on their return.
2 August 2019	65 Martin Road	This property contains a single level brick home with aluminium windows and a recessed front door covered by an awning. External air-conditioning units were identified at the house. The resident did not speak English well, so her son (Frank Cali) was consulted and confirmed the household would not pursue architectural treatment. Trucks operating at night was the only issue raised.

4.2 Government agency engagement

4.2.1 Department of Planning, Industry and Environment and Western Sydney Planning Partnership

The site and Monier's Rosehill roofing operation was inspected by DPIE on 14 May 2019 to gain an understanding of the receiving environment and how a brick making facility and roof products manufacturing facility operate.

CSR met with DPIE and WSPP on 3 July 2019 to discuss concerns raised in WSPPs submission on the consistency of the modification with the LUIIP. It was agreed in this meeting that the Modification 4 RTS would need to:

- discuss how and when parts of the site could be made available for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP (addressed in Section 5.3); and
- that a 40m wide easement for the future realignment and extension of Martin Road through the site can be accommodated (addressed in Section 5.3).

CSR had an additional meeting with DPIE on 3 September 2019 to present the project and agree on the best process to change the proposed modifications as currently presented in the modification 3 and 4 EAs and response to submissions report.

DPIE requested that CSR amend the existing modification 3 and 4 RTSs to include:

- a description of the preferred project and changes to the modification 3 and 4 project descriptions;
- a description of the changes to the impacts associated with the preferred project. DPIE agreed that the RTSs should be accompanied by revised noise, air quality and surface water technical assessments; and
- a response to all submissions received on the modification 3 and 4 EAs from government agencies and neighbouring landowners that are relevant to the preferred project.

The description of the preferred project in Section 2.2 is based on the outcomes of this meeting. The responses to public and organisation submissions in chapters 5 and 6 reflect the preferred project.

4.2.2 Liverpool City Council

Two meetings were held with the LCC on 8 May 2019 and 4 July 2019.

The first meeting was to present the Modification 3 and 4 applications and afford the LCC an opportunity to fully interrogate the details of the proposed modifications and to raise questions on the content of the EA reports, to gain a thorough understanding of the modifications and inform the preparation of their submissions.

The second meeting was with the traffic section of the LCC to discuss the draft Deed of Agreement (the deed) that outlines CSR's and LCC's responsibilities for the upfront upgrade and ongoing maintenance contributions for Martin Road. It was agreed that the LCC will review the deed and where necessary, revise it to reflect the maximum truck numbers presented in the Modification 4 EA. CSR will continue to engage with LCC to finalise the deed as soon as possible. LCC also requested that CSR provide further discussion in the Modification 3 and 4 RTSs on the ability for the site to accommodate the future realignment and extension of Martin Road through the site, if this was ever to eventuate (addressed in Section 5.3).

4.2.3 Roads and Maritime Services

RMS were contacted by phone on 18 April 2019 to confirm whether RMS would like to meet during the exhibition of the EA, to ask questions on the modification. The relevant RMS representative was unavailable, and a follow up by email was sent. No response was received from RMS.

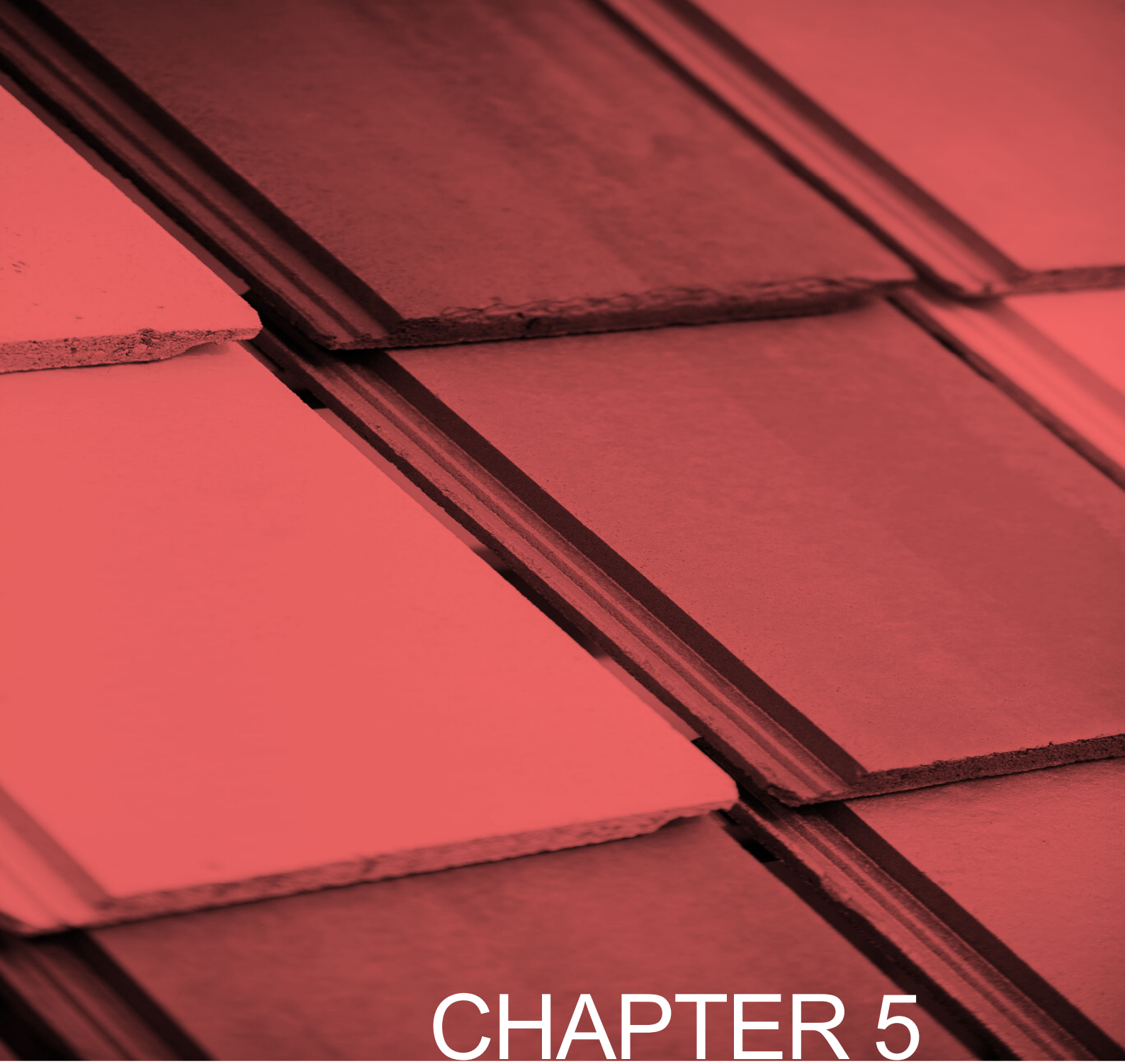
AT&L, CSR's transport engineers contacted RMS on 26 July 2019 to enquire whether they require any further concept civil design plans for the proposed Martin Road-Elizabeth Drive intersection, in addition to those already provided in the EA and Traffic Impact Assessment (Appendix N of the EA). RMS advised that they don't require any further concept civil design plans but do require Concept Traffic Control Signal plans depicting the ultimate and interim design (refer to Section 5.8 and Appendix E).

4.2.4 Other agency consultation

The EPA, DPIE Water and DRG were engaged by telephone on 18 April 2019 to offer a site inspection or meeting to go through the Modification 3 EA, familiarise them with the report content and provide an opportunity to ask questions. Representatives of DPIE and DRG were not available and have not responded to the voicemail requesting them to contact CSR if further consultation was required.

The EPA confirmed that a new representative had been allocated to Modification 3, and that they would contact CSR directly if additional consultation was required.

None of these government agencies required any further meeting or clarification on the content of the EA.



CHAPTER 5

RESPONSE TO PUBLIC AUTHORITIES

5 RESPONSE TO PUBLIC AUTHORITIES

5.1 Introduction

The public authority submissions are addressed in this chapter. Normal text is an exact reproduction of the submissions received. Therefore, original submissions haven't been appended to this RTS except where the submission contained entirely or predominantly observations that do not require a response. **Bold** text in this chapter is CSR's response to submissions.

The responses are specific to the preferred project described in Section 2.2. As the submissions are in response to Modification 3 and were received prior to formulation of the project, submissions relevant to the preferred project have been responded to, and it has been noted when submissions are not relevant to the project.

5.2 NSW Department of Planning, Industry and Environment

The DPIE requested on 18 June 2019 that the RTS provide specific focus on the following matters.

5.2.1 Future intent of the area

A number of submissions have raised concerns regarding the proposed development and how it aligns with the future strategic intent of the area. Please provide further justification to how the development is consistent with the future intent.

Further justification for how the project is consistent with the future strategic intent of the area is provided in Section 5.3.

5.2.2 Traffic

The traffic generation from the proposed development would result in a significant increase in traffic movements along Martin Road, traffic volumes for Heavy Rigid Vehicles would increase by 1,008 trips per day during the week and an increase of 534 trips per day on a Saturday.

Please consider the impacts associated with the increase in traffic generation and provide further justification to how this increase can be managed and be considered appropriate for the area.

The project does not propose an increase of 1,008 heavy vehicle trips (two-way vehicle movements i.e. inbound and outbound) per weekday and an increase of 534 heavy vehicle trips on a Saturday. Proposed truck movements associated with the preferred project are detailed in Table 2.1**, including a comparison with the existing project approval and variance to Modification 3.**

As shown in Table 2.1**, traffic movements will be lower under the project compared to Modification 3. Impacts from the proposed increase in traffic and how these can be managed have been thoroughly considered in the EA from the following perspectives:**

1. **Intersection capacity/performance: The traffic assessment predicted that the level of service (LoS) of the Martin Road-Elizabeth Drive intersection in 2021 with the project, will be E in the AM peak hour and F in the PM peak hour, which indicates the intersection will be at capacity in the AM and oversaturated in the PM. The traffic assessment determined traffic signals will be the most appropriate intersection treatment. A signalised intersection will have LoS A during the AM and PM peak hours in 2021 and**

2026 with low vehicle delays. A concept design of the proposed Martin Road-Elizabeth Drive intersection was included in the EA and was also provided separately to RMS.

In their submission on the EA RMS advised they have no objections to the signalisation of the intersection and have requested traffic control signal plans prior to providing in principle approval of the intersection. Traffic control signal plans have been produced (Appendix E) and are discussed in Section 5.8.

ANL was the only private organisation along Martin Road that lodged a submission to DPIE and raised concern about the ability of the existing Martin Road-Elizabeth Drive intersection to cope with the proposed truck numbers. ANL recommended the intersection is upgraded to include traffic lights and left-hand turns. CSR has committed to the proposed major intersection upgrade described in Section 3.5 and presented in Figure 3.17 of the EA, which includes:

- **Two approach lanes on Martin Road.**
- **Two eastern approach/western departure lanes on Elizabeth Drive with a shared left turn/through traffic lane.**
- **Three western approach/eastern departure lanes on Elizabeth Drive with two through lanes and a right turn bay.**
- **Increase in length of the eastbound departure side kerbside lane to allow sufficient merge length for vehicles that have just turned from Martin Road.**
- **Three phase signal operation including a right turn green light.**
- **Pedestrian crossings on all approaches.**

This signalised intersection design addresses all ANL's concerns, meets RMS's standards and allows for the safe movement of both heavy and light vehicles in and out of Martin Road, with the intersection operating at a good LoS A with low vehicle delays. The right turn movement out of Martin Road onto Elizabeth Drive is currently the most dangerous movement especially for heavy vehicles that have to cross the westbound lane of Elizabeth Drive and merge with the eastbound traffic.

The proposed signalised intersection will improve vehicle delays for trucks turning right out of Martin Road but will also significantly improve the safety of trucks. This improvement to safety and vehicle delays will benefit both CSR vehicles as well as all other vehicles using Martin Road including ANL vehicles, which would not occur without the proposed project.

2. **Condition of Martin Road: As outlined in Section 13.2.4 of the EA, CSR has committed to contributing to the upgrade and ongoing maintenance of Martin Road. As detailed in Section 4.2.2 of this RTS, CSR are in the final stages of signing a Deed of Agreement between CSR and LCC on CSR's contributions to the upgrade and ongoing maintenance of Martin Road. This will ensure both LCC's and ANL's concerns on the state of Martin Road are fully addressed.**
3. **Road traffic noise: A road traffic noise assessment was undertaken in accordance with the EPA's (2011) NSW Road Noise Policy (RNP). Six receivers (RN5, RN9, RN14, RN16, RN21 and RN22) are predicted to experience increased noise levels due to the project and may require mitigation in the form of the 'Type 1' treatment package from RMS's (2015) At-receiver Treatment Guideline. CSR has visited these four potential road noise affected receivers and were only able to engage with one resident (65 Martin Road) who stated that they would not pursue architectural treatment but were concerned about trucks navigating Martin Road at night. The remaining three properties were unoccupied during the site inspection but a brief inspection of the houses from the road confirmed:**

- All structures contain mechanical ventilation, in the form of air-conditioning units; and
- while the internal configuration of the houses could not be assessed, the southern and northern sides of the structures were considered to be habitable (facing Martin Road) and may qualify for architectural treatment.

4. Sight distances to and from the Martin Road intersection along Elizabeth Drive meet Austroads standards. However, trucks in the right turn bay at the waste facility intersection impede the sight of eastbound vehicles in the western approach of Elizabeth Drive, as well as for vehicles turning right out of Martin Road.

   This is one of the key reasons why signalisation of the intersection is required, and even though the reduced traffic generation from the project compared to Modification 3 may partly alleviate the above impacts, it will not remove the sight distance matter and CSR remains committed to upgrading the intersection as described above.

CSR has therefore fully considered all potential traffic impacts associated with the project and have committed to significant intersection and road upgrades, ongoing road maintenance contributions and potential at receiver architectural treatments to mitigate road traffic noise (where further investigations deem noise affected receivers to qualify for architectural treatment). Although the project will increase traffic volumes along Martin Road, without it other users of Martin Road would not benefit from an upgraded and better maintained Martin Road, or from a far safer intersection at Elizabeth Drive.

Whether the increase in traffic associated with the project is considered appropriate for the area, is a matter that should be considered in the context of the current and future plans for the area. When quarrying and brickmaking first started at the site over three decades ago, the area was dominated by rural residential land uses interspersed with predominantly agricultural (including poultry) and some industrial type activities including the Badgerys Creek brick making facility.

Then, heavy vehicle traffic along Martin Road was dominated by trucks movements associated with the quarry and brick making facility. In the early 1980s ANL started operating a composting facility to the north east of the site, which increased the number of heavy vehicles using Martin Road and recently a resource recovery facility at 80 Martin Road was also approved and will introduce additional heavy vehicle movements to the northern end of Martin Road.

These changes are however relatively minor in the context of the strategic plans for the area, to develop a Western Sydney Aerotropolis, including the Western Sydney Airport as well as nine precincts as outlined in the LUIIP. Construction has already commenced on the Western Sydney Airport that borders the site to the west.

The LUIIP shows the site and the land to the north, including properties accessed via Martin Road, to be within the Badgerys Creek precinct. The three precincts that have been identified for initial development include the Aerotropolis Core, The Northern Gateway and South Creek.

The Aerotropolis Core borders the site and the Badgerys Creek precinct to the south, the South Creek precinct boarders the site and the Badgerys Creek precinct to the east and the Northern Gateway is north of Elizabeth Drive and the Western Sydney Airport. Although the site and the rest of the Badgerys Creek Precinct isn't currently within one of the three initial precincts, major construction has already commenced immediately west of it (Western Sydney Airport), while some of the major transport infrastructure projects to service the Western Sydney Aerotropolis as well as development of the initial precincts are likely to commence within the next five years. As outlined in the LUIIP, some of the key

road infrastructure projects proposed to service the Aerotropolis (amongst others) includes:

- the M12 Motorway, providing direct access to the Western Sydney Airport and connection to Sydney's motorway network via the M7 Motorway.
- upgrades to Elizabeth Drive, the key east-west link in the north of the Aerotropolis.
- the M9 Outer Sydney Orbital, a major north–south transport corridor which will include a motorway connection to the M4 Motorway.
- upgrades to Bringelly Road, the key east-west link in the south of the Aerotropolis.
- an upgrade to The Northern Road, the primary north–south connection along the western boundary of the Aerotropolis.

A number of these key road infrastructure projects will need to take place prior to the opening of the WSA and substantial development in the rest of the Western Sydney Aerotropolis. Once constructed and combined with the proposed freight and commuter rail network, land development in the Aerotropolis is likely to accelerate resulting in a significant increase in road traffic throughout the Aerotropolis including within the Badgerys Creek precinct. Therefore, as development of the Aerotropolis progresses, the additional traffic associated with the project will be a minor contributor to the total traffic volumes using the Aerotropolis road network.

As discussed in Chapter 5 of the EA, RMS and LCC advised that the strategic infrastructure plans for the area, which includes the above mentioned key road infrastructure projects, will also require the realignment of Martin Road to remove the 'S' bend in the road and its extension southwards through the site. This potential future extension and likely widening of Martin Road would significantly change the use of Martin Road from a dead end road used primarily by a few rural residential properties, ANL and CSR to a through road linking Elizabeth Drive to other major roads to the south through the centre of the Badgerys Creek and Aerotropolis Core precincts.

Therefore, the owners of properties accessed via Martin Road are aware that they are located in the centre of the Western Sydney Aerotropolis, they have the Western Sydney Airport currently being built immediately to their west and there is major transport infrastructure and intense land development to take place adjacent to and within the Badgerys Creek precinct.

CSR did not receive any submissions from residents for Modification 3 and only one from a resident along Lawson Road for Modification 4, even after the thorough community engagement process outlined in Chapter 5 of the EA. This supports the inference that the residents in the area, including those using Martin Road to access their properties, are not concerned about the proposed increase in trucks associated with the project, as they have acknowledged that the changes already occurring and proposed within the Western Sydney Aerotropolis will significantly change the area and result in a significant increase in noise and traffic (associated with the airport, aerotropolis and associated transport infrastructure).

The proposed increase in traffic associated with the project:

- is not considered inappropriate for the area in the context of the immediate and future plans for the area along with CSR's commitment to:
    - the significant intersection and road upgrades;
    - ongoing road maintenance contributions; and
    - potential at receiver architectural treatments to mitigate road traffic noise (where deemed necessary).

- **is unlikely to negatively impact future transport and infrastructure planning across the Aerotropolis as:**
  - **as development of the Aerotropolis progresses, key road infrastructure projects that service the Aerotropolis will have been completed and the additional traffic associated with the project will be a minor contributor to the total traffic volumes using the Aerotropolis road network;**
  - **the project will facilitate an important future north-south road transport link through the Badgerys Creek and Aerotropolis Core precincts by preserving a corridor through the centre of the site to allow the realignment, widening and southwards extension of Martin Road.**

5.2.3 Noise

a. Provide detail on the design of the noise bunds proposed, including height and location, as well as the timing of bund construction, the Department seeks certainty that bunds will be constructed to ensure adequate noise attenuation.

   Refer to Section 5.16.3.

b. Provide evidence of consultation undertaken with the four (4) receivers requiring "treatment package type" mitigation. Chapter 5, table 5.2 of the Environmental Assessment does not provide enough evidence to demonstrate that the receivers have been consulted with, particularly as architectural treatments will be required to mitigate road noise.

   Refer to Section 4.1.

5.2.4 Extension of project life

Please clarify that the request for extension to project life is being made solely through Modification 4.

Schedule 2, condition 8 of PA 10_0014 states:

> **The Proponent may carry out quarrying operations and brick making on the site until 27 September 2031.**

Therefore, if this condition was not modified on approval of Modification 3 and assuming DPIE grants consent for the project in 2019, CSR would only likely have approval to manufacture bricks for 10 years as the brick making facility is likely to only be operational in the latter half of 2021 or even into 2022.

A 10-year consent for an investment of approximately $155 million for the brick making facility is insufficient for such a substantial investment. Therefore, the extension of project life of manufacturing cannot be made solely through Modification 4.

Therefore, CSR requests that schedule 2, condition 8 be modified as part of Modification 3 in one of two ways:

1. **Remove all limits to the duration of manufacturing on the site; or**
2. **Limit brick manufacturing to 30 years from the date of approval.**

5.2.5 Conditional changes

Please provide a list of all conditions sought to be amended within both the Project Approval and Concept Plan Approval. Provide justification for all conditional changes.

Refer to Appendix F for a list of all conditions of approval (COA), proposed amendments and justification for the project approval. CSR does not propose to amend the concept approval.

5.2.6 Mitigation measures

Please provide a consolidated list of mitigation measures.

Refer to Chapter 7 for a summary of mitigation measures.

5.2.7 Statement of commitments

Please provide a revised statement of commitments.

Refer to Chapter 8 for a revised statement of commitments.

5.2.8 Stakeholder engagement

Please provide detailed evidence of the consultation CSR undertook with agencies including meeting dates, attendees and key outcomes, if possible. Information is particularly requested regarding consultation with Western Sydney Airport and Civil Aviation Safety Authority.

Chapter 5 of the EA provides a detailed discussion of consultation during the EA process. To provide further clarification, four meetings were held during this process and included:

- **a meeting with the LCC on 3 December 2018 to discuss the required upgrades and maintenance costs for Martin Road, as well as the Martin Road and Elizabeth Drive intersection;**
- **Two meetings were held with TFNSW on 5 December 2018 and 2 April 2019 to discuss requirements for the Martin Road and Elizabeth drive intersection; and**
- **CSR met with WSA on 6 February 2019 and facilitated a site inspection on 12 February 2019 to brief this agency on Modification 3. WSA were also provided with the plume rise assessment at this time.**

Chapter 4 includes a summary of stakeholder engagement undertaken post the submission of the EA.

5.2.9 Agency and public submissions

Please consider and respond to all agency and public submissions received, including instances where submissions for MP 10_0014 Modification 4 also relate to Modification 3.

Responses to submissions on Modification 3 and those on Modification 4 that relate to modification 3 are included in the sections that follow.

5.3 Western Sydney Planning Partnership

5.3.1 Stage 1 LUIIP – Badgerys Creek precinct and South Creek precinct

The site is located within the Stage 1 LUIIP boundary. The site is located within the Badgerys Creek Precinct and a minor portion appears to extend into the South Creek Precinct. Badgerys Creek Precinct is not identified as an initial precinct and there is no indicative timeframe for the precinct planning or rezoning of that precinct. South Creek is identified as an initial precinct.

The Stage 1 LUIIP outlines planning principles and indicative land uses for each precinct in the creation of the aerotropolis. Badgerys Creek Precinct is identified for flexible employment and South Creek is identified for non-urban land.

As South Creek is an initial precinct, desirable land uses have been identified. These include open space, recreation facilities, pedestrian and cycle connectivity, community facilities and restaurants or cafes. Only limited residential development is allowed in this precinct.

The proposed eastern stormwater detention basin and part of the roof manufacturing facility may extend into the South Creek Precinct. If required, this would need to be verified by requesting an overlay of how the development compares to the Stage 1 LUIIP precinct boundaries.

Consistency with the LUIIP

The LUIIP presents a Western Sydney Aerotropolis, including the Western Sydney Airport as well as nine precincts. Construction has already commenced on the Western Sydney Airport that borders the site to the west. The LUIIP shows the site and the land to the north, crossing Elizabeth Drive and extending north to the confluence of South Creek and Badgerys Creek to be within the Badgerys Creek precinct. The three precincts that have been identified for initial development include the Aerotropolis Core, The Northern Gateway and South Creek. The Aerotropolis Core borders the site and the Badgerys Creek precinct to the south, the South Creek precinct boarders the site and the Badgerys Creek precinct to the east and the Northern Gateway is north of Elizabeth Drive and the Western Sydney Airport.

As described in Section 2.2, modifications 3 and 4 have been refined into a preferred project in response to DPIE and WSPP submissions on the EAs.

The project is consistent with the LUIIP as it will:

- **Not compromise the integrated land use and transport planning that has focused the initial development areas on the Northern Gateway or Aerotropolis Core. The proposed project does not lie within the alignment of any proposed transport corridors.**

  Although the realignment and southward extension of Martin Road (as proposed by RMS) is not proposed in the LUIIP, the preferred project has allowed for this by not locating any project components in the Martin Road extension corridor, as shown on Figure 2.2 **to** Figure 2.5**.**

  A future extension of Martin Road through the site will allow better access to the Aerotropolis Core from Elizabeth Drive. CSR has reassessed the proposed alignment of the southward extension of Martin Road through the site as presented in Figure 3.10 of the EA and Figure 2.2 **to** Figure 2.5 **of this report and has proposed a slight change to a potential road corridor through the site that avoids Pit 3 allowing the Martin Road extension to be constructed a lot earlier.**

  The transitional use of the site for quarrying and brick making will not compromise the desirable land uses of the Aerotropolis Core precinct to the south (the Northern Gateway precinct is a number of kilometres to the north) as:

  - **the new brick making facility will be a modern, state of the art, advanced manufacturing facility with limited noise and dust emissions;**
  - **the project includes an innovation centre which combines research and development in building products in a practical approach;**
  - **the extraction of clay and burden and then the backfilling of voids with burden and VENM, which is responsible for the majority of the noise and dust emissions from**

the site, will be completed in the southern areas of the site (closest to the Aerotropolis Core precinct) within 13 years of recommencing quarrying;
- A 3 m high landscaped earth bund will be constructed around the brick making facility raw material stockpile area during Phase 1 of the project. The earth bund will be planted with trees and shrubs to create a minimum of a 5 m high visual screen around the raw material stockpile area.
  Trees and shrubs will also be planted around the remainder of the brick making facility and around the northern, western and southern sides of Pit 3.
  This landscaping and screen planting will visually screen the brick making facility and Pit 3 works from commuters travelling along the extended Martin Road and to future development around these operations both on CSR owned and neighbouring land; and
- having a key building product manufacturing facility so close to the initial precincts will facilitate development of these precincts at lower cost.

- Be at no cost to government and represent orderly development. The preferred project will not cost government, is permissible development, will comply with all conditions of approval including substantial environmental controls and management measures and will allow for the upgrade and ongoing maintenance of Martin Road and the construction of a far safer signalised intersection at Elizabeth Drive for the benefit of all property owners in Martin Road.
- Be fully supported by enabling infrastructure. As outlined in Chapter 3 of the EA and above, the site is serviced by all necessary utilities, some of which may require upgrade and will be accessed by an upgrade Martin Road and a new signalised intersection at Elizabeth Drive.
- Not preclude future urban development identified in the LUIIP by virtue of:

  - the proposed subdivision of land and subsequent lot size, subdivision pattern or tenure arrangement. The project does not propose the subdivision of land and the entire site is to remain under the ownership of CSR.
  - the proposed investment in, and the operational and/or economic life of, the proposed development. As outlined in Section 5.2.4, CSR is proposing a significant investment at the site of approximately $155 million and would therefore require at least a 30 year operational life to justify the cost. The proposed investment and operational life will not preclude development of the initial precincts. The timing of when and where land on the site can be made available for development in a logical manner and therefore not preclude redevelopment of the site consistent with the LUIIP's proposed Badgerys Creek precinct, is discussed in sections 2.2 and 5.3.2.

In addition to the above, the LUIIP identifies the key features of the Badgerys Creek precinct to:

- support airport operations and the new urban centre;
- support land use that is not sensitive to aircraft noise;
- meet demand for a range of employment generating uses that do not require or benefit from direct access to public transport but which would benefit from proximity to airport operations and the new urban centre; and
- avoid residential development.

The proposed project is a transitional land use that is:

- not sensitive to aircraft noise;
- will generate 70 jobs;
- will not require direct access to public transport; and
- does not include residential development.

As described in Section 2.2.2, there will be approximately 65 ha available for development in accordance with the LUIIP at the start of the project as the preferred project will not include the approved pit 4 and 5 areas, Monier roof products manufacturing facility and solar farm.

By the end of year 6 (end of 2025), the Pit 1 and 2 areas as well as some land between the site's southern boundary and the raw material stockpile area (38.49 ha), is also available for progressing development applications for activities aligned with the LUIIP. A total of 104.21 ha is available for development from the end of 2025 onwards.

Approximately 117 ha will be available for development in accordance with the LUIIP from approximately year 14 (end of 2032) onwards.

Potential overlap of project and South Creek Precinct

The maps in the LUIIP are course and of a low resolution so it is difficult to ascertain exactly where the South Creek precinct overlaps the site. By comparing the shape of the western boundary of the South Creek precinct to the probable maximum flood (PMF) line in Liverpool City Council's flood mapping, they appear very similar, although it is unknown whether the PMF extent has been used as the western boundary of the South Creek precinct, where it traverses the site.

No development is proposed within the PMF and the roof products manufacturing facility, the only component of Modification 3 near the South Creek precinct, has been removed from the project.

CSR is able to overlay the Stage 1 LUIIP precinct boundaries onto the project site development plan if WSPP provide the drawing (.dxf or .dwg) or shape (.shp) files of the precinct boundaries.

5.3.2 Submission during exhibition of the LUIIP

On 9 September 2018, during the exhibition of the Stage 1 LUIIP, Department staff met with Allison Basford and Andrew Mackenzie of CSR. Advice was provided to CSR that a Stage 1 LUIIP submission should address permissibility, options for accelerated quarrying, how the interface would be managed and the timing and the rehabilitation of the site.

Following the meeting, CSR lodged a submission dated 2 November 2018, suggesting that if Badgerys Creek Precinct becomes an initial planning precinct, it will bring forward plans to develop an advanced manufacturing hub and minimise the extraction of clay at the site.

CSR is also strongly opposed the use of the Probable Maximum Flood (PMF) line in the South Creek Precinct as they state it is contrary to the NSW Floodplain Development Manual and Local Environment Plan 1:100 mapping. CSR advise the site will assist the construction and development of the remainder of the precinct through the provision of construction material and will provide a catalyst for aerotropolis growth.

WSPP's summary of previous consultation with CSR is noted.

As outlined in Section 4.2.1, CSR met with DPIE and WSPP on 3 July 2019 to discuss concerns raised in WSPPs submission on the consistency of the project with the LUIIP. It was agreed in this meeting that the RTS would need to:

- **discuss how and when parts of the site could be made available for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and**
- **that a 40m wide easement for the future realignment and extension of Martin Road through the site can be accommodated.**

As described in Section 2.2.1, components of modifications 3 and 4 have been changed in response to WSPP's submission. As described in Section 2.2.2, there will be approximately 66 ha available for development in accordance with the LUIIP at the start of the project as the project will not include the approved pit 4 and 5 areas, Monier roof products manufacturing facility and solar farm.

- **By the end of year 6 (end of 2025), the Pit 1 and 2 areas as well as some land between the site's southern boundary and the raw material stockpile area (approximately 38 ha), will also be available for progressing development applications for activities aligned with the LUIIP. Approximately 104 ha will be available for development from the end of 2025 onwards (once backfilling of Pit 3 is complete) and approximately 117 ha will be available for development from the end of 2032 onwards.**

The proposed revised 40 m wide Martin Road extension corridor through the site (Figure 2.2 **to** Figure 2.5**) has been realigned from that presented on Figure 3.10 of the Modification 3 EA, to allow it to be constructed whenever it is required and to provide better access to the entire site and land in the Aerotropolis Core precinct to the south.**

The EA showed a possible future extension of Martin Road through the centre of Pits 3 and 4. However, construction of the Martin Road extension would then be constrained by when pits 3 and 4 would be backfilled. As the backfilling of Pit 4 (as presented in the Modification 4 EA) would have only been complete by approximately year 22, the extension of Martin Road through the site would have been prevented for the next 22 years.

The proposed revised Martin Road extension corridor is aligned between the brick making facility and Pit 3.

The proposed revised 40 m wide Martin Road extension corridor curves south-west through the site and continues in a south-west direction as it enters the Aerotropolis Core to the south.

As Badgerys Creek and South Creek (the two main topographical, environmental and planning constraints) both flow in a north easterly direction in this area, the proposed alignment and location of the Martin Road extension, orientates this road parallel to and half way between Badgerys and South Creeks.

This provides a logical road transport and access spine through the centre of the Badgerys Creek and Aerotropolis Core precincts, linking Elizabeth Drive to the north with other key access roads to the south and facilitating development within the centre of the Western Sydney Aerotropolis.

The revised Martin Road extension corridor would allow the construction of Martin Road through the site whenever it is required. The only operational constraint that this creates for the site is that trucks and other extraction machinery would need access between Pit 3 and the raw material stockpile area, which would require crossing of the extended Martin Road. The location of a possible temporary underpass has been shown on Figure 2.3 **to** Figure 2.5 **which will provide this necessary access. This underpass can also be used to facilitate the movement of VENM importation trucks between the eastern and western parts of the site.**

The project is therefore considered to:

- **present an appropriate transitional use of the site whereby CSR can:**
  - **make use of the sites natural resources (clay) for manufacturing bricks on and off site;**

- **secure a medium-term site within the Sydney basin for manufacturing bricks, as a number of their other brick manufacturing sites are under shorter term pressure to relocate due to surrounding urban development;**
- **supply building products for the development of the Western Sydney Airport and the initial precincts within the Western Sydney Aerotropolis; and**
- **backfill the quarry voids on the site with VENM available from a number of the major construction projects in Sydney, to facilitate future development of the site, consistent with the Badgerys Creek precinct.**

- **present a logical staged approach to making large areas of the site available for future development, while allowing for the establishment of an extension of Martin Road southwards through the site to facilitate development of the site within the Badgerys Creek precinct and the Aerotropolis Core precinct to the south.**

5.3.3 Airport ring road

TfNSW should be contacted for comment on the location of a future airport ring road. The road may provide an important arterial link for traffic from the Northern Gateway to Aerotropolis Core. Future Transport 2056 identifies that Western Sydney Airport – Badgerys Creek Aerotropolis Inner and Outer Ring Roads are initiatives for investigation (20+ years) timeframe.

In their submission on the Stage 1 LUIIP, CSR advised they are willing to work with the NSW Government to facilitate and coordinate a corridor through its land to enable the sub-arterial road link to be established early in the Aerotropolis timeframe.

TfNSW provided comment on the modification application (Section 5.9), confirming that investigations into the corridor preservation program for an airport ring road are still underway, and that no further comment could be provided on this matter at this stage.

CSR's willingness to accommodate an extension of Martin Road southwards through the centre of the site, early in the Aerotropolis timeframe is discussed in Section 5.3.2.

5.3.4 Discharge into South Creek

The modification proposes to discharge excess runoff into South Creek. The proponent states that the eastern edge of the storm water basin encroaches slightly into the PMF. INSW are leading the South Creek Sector Review which will look at flood modelling and water flows in the creek system. This work is yet to be completed.

The PMF extent for South Creek was determined by the flood engineers using flood maps and data provided by the LCC. The potential impact of the roof products manufacturing facility storm water basin encroaching into the PMF zone was assessed in section 6.2 and Appendix G of the EA and expected to have a negligible impact on the existing flood characteristics of South Creek.

As the preferred project does not include the roof products manufacturing facility and associated storm water basin, the project will not encroach on the South Creek PMF zone.

5.3.5 National Airports Safeguarding Framework Guidelines

Due to the proximity of the site to the Western Sydney Airport, the National Airports Safeguarding Framework (NASF) should be considered in the assessment.

Guideline A: Measures for managing impacts of aircraft noise

Not applicable as NSW applies ANEF/ANEC contours. Regardless, the proposed land uses are not considered to be noise sensitive.

WSPP comments are noted.

Guideline B: Managing building-generated windshear and turbulence

The site plans provided do not show the distance from the second airport runway to the expansion of the brick making facility, proposed roof manufacturing facility or NATA laboratory. A site context plan to scale should be provided showing the distance of the southern airport runway to the proposed buildings to confirm whether they are located within the rectangular assessment trigger area as per page 6 of the guideline.

Guideline B of the NASF explains that buildings and structures generate windshear and turbulence, posing a threat to aircraft if located in the airport runway rectangular

assessment trigger area (Figure 5.1). The rectangular assessment trigger area starts 500m from each end of the runway (grey line), extends 900m past the runway end and 1200m to each side of it. Building induced wind effects within this area can potentially impact approaching and departing aircraft below 200 feet (61 m) above the runway.

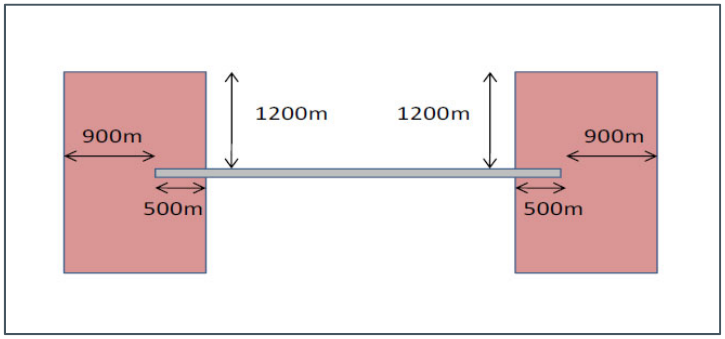


Figure 5.1 Rectangular runway trigger area

For structures in the rectangular assessment trigger area, building height should not encroach into the 1:35 surface extending perpendicular from the runway centreline. Therefore, the distance from the closest part of the building to a runway end should be more than 35 times its height. Where buildings penetrate the 1:35 surface, consideration needs to be given to compliance with:

- **along-wind and across-wind windshear criteria; and**
- **a turbulence criterion.**

A geographic information systems (GIS) was used to determine if any built structures associated with the project are in the rectangular assessment trigger area, of the northern end of the WSA second runway, which is the end of the two proposed runways closest to the site (Figure 5.1). It was determined that the only building that is/will be within the rectangular assessment trigger area is approximately 3,000 m^2 of the existing brick factory and approximately 4,600 m^2 of the proposed extension to the factory. The proposed NATA laboratory and extension to the administration offices are outside the rectangular assessment trigger area being 25 m and 60 m respectively from the trigger area.

With a maximum roof height of approximately 13 m, the brick factory would need to be a minimum of 455 m away from the runway centreline (when applying the 1:35 ratio) to avoid the requirement for further mitigation measures. The brick factory is a minimum of 1,382 m from the trigger area.

No further assessment or mitigation is required in accordance with Guideline B of the NASF.

Figure 5.2
Western Sydney Airport runway rectangular assessment trigger area

CSR ADVANCED MANUFACTURING HUB
Response to Submissions Report



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Guideline C: Managing wildlife strike risk

- The proposed uses are not listed as land uses with a wildlife attraction risk in Attachment 1 of Guideline C. However, any waste produced, or waste managed on the site will need to avoid wildlife attraction.

  Waste management on the site will be in accordance with the existing waste management plan, which will be updated to provide measures to avoid wildlife attraction.

- Chapter 6 and Appendix G of the Environmental Assessment (EA) discusses surface water. The application indicates that water will travel into South Creek, pits, sediment basins and detention basins. The assessment will need to consider how wildlife attraction will be managed.

  The approved quarrying approach and final landform is to extract clay from pits 3, 4 and 5, backfill Pit 2 with burden from these quarry pits, use Pit 1 as the primary water storage and leave pits 1, 3, 4 and 5 as open voids at the end of the project life which will slowly fill with water.

  The project will include the dewatering of Pit 1, the existing major water body on the site, and the backfilling of Pit 1 and the rest of the pits to facilitate future development, reducing the open water bodies on site to a few existing farm dams (referred to in the EAs as sediment basins 1, 2 and 3 and dams 1 and 2).

  This will significantly reduce the habitat on site for birds, reducing wildlife attraction and therefore risk of bird strikes at the airport.

  The proposed new sediment basins will be designed in accordance with *Managing Urban Stormwater: Soils & Construction (Landcom, 2004)*. Storage capacity will be restored following rainfall, so the sediment basins won't be kept full of water, further reducing habitat for birds and therefore wildlife attraction.

- Any landscaping species selected should not attract wildlife or grow to a size which will penetrate the Obstacle Limitation Surface.

  The rehabilitation plan will be revised following approval of the project to exclude plant species that are known to attract wildlife and grow to a size which will penetrate the obstacle limitation surface (OLS).

Guideline D: Managing the risk of wind turbine farms as physical obstacles to air navigation

Not applicable.

WSPP comments are noted.

Guideline E: Managing the risk of distractions to pilots from lighting in the vicinity of airports

Two kilns exhaust stacks are proposed. The guideline discusses refinery flare plumes as a potential distraction to pilots. The Environmental Assessment (EA) notes a Form 1247 was submitted to the Civil Aviation Safety Authority (CASA) requesting a plume rise assessment. It is not clear from the information submitted in support of the application whether CASA assessed the impact of lighting from the proposed development. NASF Guideline E generally requires lighting within 6km of an aerodrome to comply with the provisions of regulation 94 of Civil Aviation Regulations 1988.

It is also mentioned in the EA that all external lighting associated with the project complies with Australian Standard AS4282 (INT) 1995 - Control of Obtrusive Effects of Outdoor Lighting. NASF Guideline E makes no reference to this Australian Standard.

CASA provided a submission on the modifications which is presented and discussed in Section 5.7. CASA did not assess the impact of lighting from the proposed development.

The visual impact assessment (VIA) (Table 3-1 in Appendix M of the EA) considered aviation safety and lighting, with specific focus on NASF Guideline E. The Guideline nominates four zones within a 6 km radius of an airstrip where ground light can cause interference as a pilot approaches to land. The intensity of light emissions within each light control zone is specified in the Guideline. Although within 6 km of the WSA, the site is not within the four light control zones as outlined in Attachment 1 of the Guideline and therefore Guideline E does not apply to operations at the site. However, proposed lighting at the site will still comply with Australian Standard AS4282 (INT) 1995 - Control of Obtrusive Effects of Outdoor Lighting.

Guideline F: Managing protected airspace intrusion

The EA suggest that outputs from the Obstacle Limitation Surface (OLS) tool confirmed that structures could be erected on the site between 58.9 m and 79.2 m above existing ground level. The EA states that the highest proposed structures are the two 41 m kiln stacks and the proposed modification will not impact on the Western Sydney Airport OLS. Consideration should be given to CASA's assessment of the impact any plume will have on the OLS.

WSPP comments are noted. CASA's comments are assessed in Section 5.7.

Guideline G: Protecting aviation facilities — communications, navigation and surveillance (CNS)

Not applicable as no CNS facilities have been identified at this time.

WSPP comments are noted.

Guideline H: Protecting strategically important helicopter landing sites (SHLS)

Not applicable, as no SHLS facilities have been identified at this time.

WSPP comments are noted.

Actions

That Industry Assessments:

a. Note Stage 1 LUIIP didn't envisage uses of this nature. However, in response to submissions received during consultation, a review will be undertaken to determine whether these uses should be accommodated within the Aerotropolis.

   A discussion on the consistency of the project with the LUIIP and how large areas of the site will be made available for future development in a staged manner is included in sections 2.2.2, 5.3.1 and 5.3.2.

b. Note the information contained in this memo.

   A response has been provided above to all WSPP comments contained in their memo dated 2 July 2019.

c. Provide Western Sydney Planning Partnership a copy of the determination letter.

DPIE will provide WSPP with a copy of the project assessment and modified project approval on determination.

d. Note that this supercedes previous advice dated 14 May 2019.

WSPP comment is noted.

5.4 Western Sydney Airport

5.4.1 Correspondence of 22 May 2019

I have not finished reviewing the documents, but so far have not been able to confirm within WSA who CSR met with, so if they could provide more details of meeting date, attendees, notes etc that would be good.

CSR emailed WSA (Mr K Osborne) on 12 June 2019 confirming that the contacts within WSA were Mr C Osborne and Mrs S. Reynolds. CSR directed WSA to these representatives for briefing dates and notes.

In terms of lighting it is unclear exactly what lighting is proposed on the site. Given the immediate proximity of the site to the airport, any lighting must not cause confusion or distraction to pilots. Additional information is required in relation to this (CSR should refer to the National Airports Safeguarding Framework – Guideline E which can be found at this link - https://www.infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/nasf_principles_guidelines.aspx

CSR will install outdoor lighting typical of 24-hour manufacturing operations to facilitate safe night time operations at the site. Outdoor lighting will comply with Australian Standard AS4282 (INT) 1995 - Control of Obtrusive Effects of Outdoor Lighting. A discussion on the relevance of the NASF Guideline E is included in Section 5.3.5.

5.4.2 Correspondence 30 May 2019

WSA notes that a plume rise assessment was prepared and submitted to CASA for review. CASA has advised that their plume rise velocities were acceptable and would not require management measures or design changes. WSA has no additional comment in relation to plume rise and turbulence.

The WSA comments are noted.

WSA notes that a Water Management Plan was prepared and approved as part of the original project approval. The WMP should be amended as required to reflect the proposed changes to the approved project to ensure appropriate water quality standards.

The water management plan will be revised to reflect the project.

Air quality management measures should be amended to reflect the proposed modified project. This should include a dust management/mitigation program to manage potential off-site impacts from dust and particulate matter arising from the proposed operation.

Air quality management measures that reflect the project are included in Chapter 7 and 8 and include measures to mitigate against dust. These mitigation measures will be included in the revised air quality management plan.

5.5 NSW Fire and Rescue

The following notes and comments are provided:

- It is understood that a State Environmental Planning Policy No. 33 (Hazardous and Offensive Development) (SEPP 33) assessment has been undertaken and the development has not been deemed to be either hazardous or offensive.

  NSW Fire and Rescue (FRNSW) comments are noted.

- It is noted that a 'future battery store' is proposed as part of the modifications to the existing brick manufacturing facility. FRNSW have identified a number of hazards and risks associated with battery storage that would require consideration prior to development.

  CSR is no longer proposing a battery store as part of the project.

- No BCA [Building Certificate Australia] assessment was included with the Report.

  CSR emailed FRNSW on 27 June 2019 requesting a meeting to discuss the proposed design concept for constructing the roof products manufacturing facility and redeveloping the brick making (two class 8 buildings) as semi-automated manufacturing facilities. On 27 June 2019 CSR also submitted the following documentation to FRNSW which are included in Appendix G:

  - **BCA statements;**
  - **The fire engineering brief questionnaire (FEBQ);**
  - **Computational fluid dynamics (CFD) model output;**
  - **Trial concept design;**
  - **Site plans;**
  - **Floor plans; and**
  - **Elevations.**

CSR notes the preferred project does not include the roof products manufacturing facility and will provide revised versions of the above documents to FRNSW.

The following recommendations are provided:

- Consultation with FRNSW be undertaken by way of the Fire Engineering Brief Questionnaire (FEBQ) process prior to the issue of the relevant construction certificate.

  CSR completed and submitted the FEBQ questionnaire to FRNSW on 27 June 2019 (Appendix G).

  CSR notes the preferred project does not include the roof products manufacturing facility and will provide a revised FEBQ to FRNSW.

- Further information be provided to FRNSW regarding the proposed battery storage.

  As described in Section 2.2.2, CSR no longer proposed to construct and operate a solar farm. Notwithstanding, the proposed solar farm never included a battery store.

- While there is currently no requirement for a FSS [Fire Safety Statement], FRNSW may request one be undertaken at a later stage should information be provided such that it is deemed that the development poses unique challenges to the response to and management of an incident.

  FRNSW comments are noted.

5.6 Rural Fire Service

5.6.1 Water and utilities

The intent of measures is to provide adequate services of water for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building. To achieve this, the following conditions shall apply:

- The provision of water, electricity and gas shall comply with section 4.1.3 of Planning for Bush Fire Protection 2006.

  Where relevant the upgrade of water, electricity and gas services to the site will comply with RFS (2006) Planning for Bushfire Protection.

  As outlined in Section 4.2.4 of the EA:

  - **The project will require fire hydrants to be installed to comply with *Australian Standard 2419.1-2005 Fire Hydrant Installations – System Design, Installation and Commissioning* so that all sides of a building envelope are within 70 m of a hydrant by lay of the hose (or 90 m with a tanker parked in-line maximum 20 m from the hydrant).**
  - **Where overhead electrical transmission lines are installed, the vegetation clearance distances are to comply with *ISSC 3 Guideline for Managing Vegetation Near Power Lines*.**
  - **Any gas services are to be installed and maintained in accordance with *Australian New Zealand Standard 1596-2008 The storage and handling of LP gas*.**

5.7 Civil Aviation Safety Authority

CASA has reviewed the modifications and I am advised that no modifications to the stacks and their emissions were identified. Therefore, CASA's previous advice with regard to the Obstacle Limitation Surface (OLS) remains valid. There is no infringement of the OLS at a critical velocity of 4.3m/sec and CASA considers that there will be an acceptable level of safety. No additional mitigations would be required.

CASA's response regarding the OLS is noted.

Although CASA's comments are summarised in the CSR Advanced Manufacturing Hub Mod 4 EA Main Text (March 2019, page 72), the proponent's response to CASA's comments could not be identified in the referenced Chapter 12 or Appendix K. With regard to the establishment of the grid connected 4.4 megawatt solar farm, CASA is not aware of any glare reflectivity analysis report being prepared and submitted for review and/or discussion.

The CASA plume rise assessment is summarised in Section 10.2.4 of the EA and presented in full in the air quality impact assessment report in Appendix K of the EA. The CASA plume rise assessment is not included in the Modification 4 EA as the assessment of plume rise is associated with the two 41 m brick making facility kiln stacks, proposed under Modification 3.

As described in Section 2.2.2, the solar farm is no longer proposed under the preferred project and, therefore, there will be no glare impacts associated with the project.

5.8 Roads and Maritime Service

Roads and Maritime has no objections to the signalisation of this intersection, however to provide in principle approval the following documents are required to be sent to Roads and Maritime (these comments should be addressed prior to the determination of the application):

1. Separate concept civil design plans depicting the ultimate and interim design are to be provided.

   AT&L, CSR's transport engineers contacted RMS on 26 July 2019 to enquire whether they require any further concept civil design plans for the proposed Martin Road-Elizabeth Drive intersection, in addition to those already provided in the EA and Traffic Impact Assessment (Appendix N of the EA). RMS advised that they don't require any further concept civil design plans but do require Concept Traffic Control Signal plans depicting the ultimate and interim design (refer below).

2. Concept Traffic Control Signal (TCS) plans depicting the ultimate and interim design are to be provided. The proposed Traffic Control Signal (TCS) at the intersection of Elizabeth Drive and Martin Road is to be designed to meet Roads and Maritime requirements. The concept TCS plan is to be drawn by a suitably qualified person and endorsed by a suitably qualified practitioner be in accordance with Austroads Guide to Road Design in association with relevant Roads and Maritime supplements (available on www.rms.nsw.ciov.au).

   Interim and ultimate concept traffic control signal plans have been prepared and are included in Appendix E.

5.9 Transport for NSW

The Corridor Preservation program is currently preparing to undertake investigations on preserving land for a future airport ring road for the new airport. At this stage, no comment can be provided.

It would be appreciated that DP&E provides TfNSW with a notice of determination on this proposal.

TfNSW comments are noted.

CSR's willingness to accommodate an extension of Martin Road southwards through the centre of the site, early in the Aerotropolis timeframe is discussed in Section 5.3.2.

5.10 Greater Sydney Commission

The Greater Sydney Commission stated that they do not have any comments on the proposed modification and noted that the Western City Aerotropolis Authority (WCAA) are the master planners for the Aerotropolis and can be contacted for any advice or comments.

The GSC comments are noted. Refer to Section 5.11 for responses to WCAA comments.

5.11 Western City Aerotropolis Authority

With CSR's requested extended project life of 30 years from approval, the Proposed Modifications represent an extended and intensified industrial use of land adjacent to the intended land use of Aerotropolis Core.

Together with the introduction of new uses to the existing development, in particular, the roof tile facility and the solar farm, the additions and intensifications require a substantial quantitative increase in truck movements from 120 to 544 per day on weekdays, and from 40 to 158 per day on Saturdays. These increases represent a fundamental increase to existing traffic and traffic-related impacts in the local area, and in areas around the Site, and in the absence of further road development will be of detriment to the precinct.

WCAA understands that CSR has lodged the Proposed Modifications under repealed section 75W of the Environmental Planning and Assessment Act 1979 pursuant to savings and transitional regulations. WCAA understands that relevant provisions require the Minister to be satisfied that the proposed concept plan modifications which enable modification of CSR's project approval meet a 'minimal environmental impact', or 'substantially the same' threshold. If the Minister is satisfied that one of these thresholds applies, such that the Proposed Modifications to CSR's concept plan and project approval can potentially be approved, WCAA considers the Department should assess the following in the context of the Western Sydney Aerotropolis Stage 1 Land Use and Infrastructure Implementation Plan and other key policy documentation:

- whether the Proposed Modifications are consistent with the proposed land uses and vision for the Aerotropolis;
  This matter has been addressed in Section 5.3.
- the consistency of the intensified industrial use at the Site in the context of proposed high and advanced technology land uses in the Aerotropolis Core and in future precincts within the Aerotropolis;
  This matter has been addressed in Section 5.3.
- the impact of the significant increase in truck movements not only on current sensitive receivers, but also on future transport and infrastructure planning across the Aerotropolis; and
  This matter has been addressed in Section 5.2.2.
- the future viability of the transport and haulage routes required to support the intensified operations the subject of the Proposed Modifications for the proposed 30-year period, given the priorities set out for the development of the Aerotropolis.
  This matter has been addressed in sections 5.2.2 and 5.3.

WCAA considers that the points above are critical in ensuring that any decision in relation to the Proposed Modification demonstrates the promotion of the orderly and economic use and development of land in the Aerotropolis.

5.12 Endeavour Energy

Endeavour Energy provided a consolidated submission on both Modification 3 and 4 on 22 May 2019 (Appendix I). The submission states that:

- Endeavour Energy has no objection to the proposed modifications;
- there are no easements over the site benefitting Endeavour Energy; and
- Endeavour Energy's network should be able to accommodate the connection of both the proposed manufacturing activities (brick making and roof products manufacturing) under Modification 3 and the proposed solar farm under Modification 4, with potential upgrades required to the existing 11 kilovolt (kV) high voltage power lines.

Endeavour's submission includes substantive general information that applies to developments of the type proposed including information on:

- protected assets;
- easements;
- network capacity/connection;
- urban network design;
- location of electricity easements/prudent avoidance;

- earthing;
- easement management/network access;
- vegetation management;
- Dial Before You Dig;
- demolition;
- public safety; and
- emergency contact.

CSR and Beca Consulting Engineers (appointed power and electrical consultants) have reviewed all the information contained in Endeavour Energy's submission and accepts that further planning, design, construction and management of the site's power and electrical supply needs to be in accordance with this information and recommendations.

Endeavour Energy's submission included requirements for planning of trees in the vicinity of electrical infrastructure. Endeavour Energy comments relating to vegetation management are noted and accepted. Endeavour Energy's restrictions on vegetation planting and management in proximity to electrical infrastructure will be incorporated into the revised rehabilitation plan for the site.

CSR and Beca will continue to engage with Endeavour Energy through the next phases of power and electrical supply investigations, design and implementation including:

- **confirming the connected, typical operating and maximum demand electrical loads for all proposed equipment; and**
- **appointment of a Level 3 Accredited Service Provider (L3ASP) to undertake design and interface with Endeavour Energy on:**
  - **the detailed design and costs associated with the installation of a new 11 kV feeder including the extension and reconfiguration of the existing network; and**
  - **the planning approvals pathway for the 11 kV feeder works.**

As described in Section 2.2.2, the preferred project does not include the roof products manufacturing facility or solar farm and these previous project components will not be included in the future investigations and designs described above.

5.13 WaterNSW

In WaterNSW's submission of 22 May 2019 they advised that the site is not located near any WaterNSW land, assets or infrastructure, and therefore they have no comments or particular requirements.

WaterNSW comments are noted.

5.14 NSW Department of Planning Industry and Environment – Hazards Team

The Applicant preliminary risk screening in EIS Section 15.6 is in accordance with the Department's *Applying SEPP 33* guideline. From this screening, it is noted that the dangerous goods quantities associated with the project as modified is below the relevant screening threshold quantities. As such, the project as modified is not potentially hazardous under SEPP 33, and a PHA is not required to be included with the application.

Notwithstanding, it is recommended that the following conditions be included in the modification consent to ensure continual safety of the project as modified:

1. The Applicant must ensure that the quantities of dangerous goods on-site and transported to and from the site remains below the screening threshold quantities listed in the Department's *Applying SEPP 33* guideline at all times.

CSR accepts this condition.

2. The Applicant must store all chemicals, fuels and oils used on-site in accordance with:

   a. the requirements of all relevant Australian Standards; and
   b. the NSW EPA's 'Storing and Handling of Liquids: Environmental Protection – Participants Handbook' if the chemicals are liquids.

In the event of an inconsistency between the requirements listed from (a) to (b) above, the most stringent requirement shall prevail to the extent of the inconsistency.

CSR accepts this condition.

5.15 Department of Planning, Industry and Environment - Biodiversity and Conservation (previously OEH)

5.15.1 Biodiversity

OEH notes the proposed reconstruction and extension of the brick making facility will be undertaken on existing hardstand /disturbed areas and within the approved project boundary. The proposed roof products manufacturing facility is to be on land not previously assessed in the original EA but it is located within biodiversity certified land in accordance with the Order to confer biodiversity certification on the State Environmental Planning Policy (Sydney Region Growth Centres) 2006 and therefore impacts on biodiversity associated with Modification 3 do not require assessment by the consent authority (see Section 4.3.6, page 76 and Section 8 page 113).

DPIE – Biodiversity and Conservation comments are noted.

5.15.2 Badgerys Creek, Badgerys Creek tributary and South Creek

The EA for MOD 3 refers to the rehabilitation of the riparian corridors along Badgerys Creek and its tributary which extend into the lower eastern portion of the site as part of MP10-0014 and it indicates this includes planting and weed control (see Section 2.4.7, page 21). The EA for MP10-0014 indicates:

- the project includes a rehabilitation program consisting of fencing, planting and weed control along approximately 900m of the eastern side of Badgerys Creek and along both sides of Badgerys Creek Tributary (for a length of approximately 280 m) with a fenced area of 50m from the top bank (see Section 4.3.4)
- the riparian areas would be rehabilitated to emulate the local community at a density that would naturally occur (see Section 4.3.4)
- the eastern side of South Creek would also be fenced to prevent stock access (see Section 4.3.4)
- a 50 m buffer around Badgerys Creek and South Creek would be maintained and rehabilitated as part of the proposal (see Section 17.3.1).

OEH notes the Rehabilitation Plan attached to the EA for MP10-0014 (EA Appendix D) implies the rehabilitation works would commence in 2010/2011 (see Section 8). It indicates for South Creek this includes fencing the riparian corridor to allow natural regeneration and undertaking weed control. The project approval for MP10-0014 requires:

- a minimum setback width of 60 metres (measured from top of bank) between extraction areas and both Badgerys Creek and Badgerys Creek tributary (see Condition 18)
- the rehabilitation of the site, including planting and weed control along Badgerys Creek and Badgerys Creek (Condition 34).
- the progressive rehabilitation of the site as soon as reasonably practicable following disturbance (Condition 35).

OEH notes the final landform plan (rehabilitation plan - Year 30) in the EA for MOD 3 does not show a rehabilitated corridor along Badgerys Creek, Badgerys Creek tributary or along South Creek (see Figure 3.9, page 36).

The Department should seek clarification as to whether any rehabilitation of the riparian corridors along Badgerys Creek, Badgerys Creek tributary and South Creek has commenced as Nearmap appears to show it has not commenced since project approval of MP10-0014 on 27 September 2011. It is also noted that Bushfire Assessment for MOD 3 states "CSR intend to continue the grazing lease within the paddocks eastward down to South Creek" (page 8) which implies the South Creek riparian corridor has not yet been fenced to prevent stock access to allow natural regeneration. If rehabilitation of the riparian corridors has not commenced, the Department should require the proponent to clarify when the riparian corridors are to be rehabilitated. The Staging Plans in the EA should be amended to reflect the intent of rehabilitating the riparian corridors.

As outlined in section 2.2 of the EA, project approval was issued on 27 September 2011 under Section 75J of the EP&A Act for the ongoing production of bricks and the expansion of the existing quarrying operations. Due to uncertain economic conditions and a downturn in residential housing activity, Boral reviewed its bricks production capacity in NSW and decided to 'mothball' its operations at Badgerys Creek effective from 30 March 2012. As a consequence of the shutdown, Boral was unable to comply with the conditions of approval and submitted a modification application under Section 75W of the EP&A Act (10_0014 Mod 1 or Modification 1) within a month of project approval. Modification application (10_0014 Mod 1) requested that post-March 2012 activities be limited to:

- **minor maintenance and inspection (e.g. water management, equipment testing);**
- **operation of the retail display facility; and**
- **irregular and occasional dispatch of bricks from the inventory remaining on-site.**

Therefore, Boral did not commence implementation of the Rehabilitation Management Plan, the preparation of which was required as a condition of the original project approval (PA10_0014).

In 2015, Boral and CSR formed a joint venture brick business called Boral CSR Bricks Pty Ltd. The assets held by the respective companies were transferred into the joint venture. At the end of October 2016, CSR acquired Boral's share of the brick business and with it, the Badgerys Creek Brick Making Facility. CSR then commenced the planning process for what is now the preferred project proposed in the modification 3 and 4 applications. In the interim CSR lodged a modification application under Section 75W of the EP&A Act (Modification 2) to remove the mothballed status of the site so that quarrying could recommence and also applied to export clay from the site and temporarily store finished building products imported from off-site. CSR was granted approval for Modification 2 from DPIE on 5 May 2018.

Between May 2018 and present, CSR has been ensuring all relevant conditions of approval that need to be complied with prior to the commencement of quarrying have been met and that the mining lease (ML 1771) (granted for the site on 8 May 2018) and the Mine Operations Plan (MOP) (approved on 23 October 2018) were obtained.

As described in Section 2.2.2, pits 4 and 5 are not proposed to be developed under the preferred project and, therefore, will not require rehabilitation. Further, clay extraction will

cease by the end of year 10, which will be approximately two years prior to the currently approved limit. The pits are proposed to be filled with VENM by the end of 2032.

The Rehabilitation Management Plan will be updated to reflect the project once approved. Once CSR recommences operations on the site, it will commence the implementation of all management and mitigation measures within the environmental management plans including the Rehabilitation Management Plan.

5.15.3 Flooding

The proposed development site is located between South Creek and Badgerys Creek. The modelling results shows that the proposed facilities of the site would not be impacted by the PMF flood level, except a small portion of the roof products manufacturing plant located adjacent to South Creek on the eastern side of the development site.

The modelling results indicate that the development site is likely to be isolated for about six hours during PMF event since Elizabeth Drive, the evacuation route from the site, will be disconnected at its intersections with South Creek and Badgerys Creek under 20% AEP Event. The essential services (such as water, power and sewerage) are likely to be interrupted during major flooding and PMF events when around 150 people (workers and customers) will be on site based on the statistics of the manufacturing and sales activities.

The interruption of essential services during major flooding and PMF events may restrict the options for a shelter-in-place strategy proposed by the proponent due to potential health risks of the people trapped at the site. The shelter-in-place option may be possible through localised provision of essential services at the development site when the services from utilities will be interrupted during major flooding events. The proponent will need to check with utility managers about the continuity of the essential services during major and PMF flood events prior to exploring the options for localised provision of services.

The proponent will need to discuss the above details (i.e. opportunities and limitations) for localised shelter-in-place option(s) and the development of an alternative route for evacuation from the site with SES. The SES resources would likely be stretched to undertake emergency management operations during major flooding events without an appropriate evacuation plan at the development site.

CSR will ensure that the following provisions are always in place at the brick making facility in the unlikely event that the local road network is cut-off by flooding (for approximately 6 hours) and essential services are interrupted:

- **backup generators; and**
- **bottled water sufficient to sustain the maximum number of people likely to be on site at any one time for a period of eight hours.**

The site is/will be serviced by on site wastewater treatment systems and therefore sewerage services won't be interrupted if the local road network is cut-off by flooding.

CSR will ensure that prior to recommencing project operations on site, they will discuss/develop an appropriate evacuation plan for the site in consultation with the SES, which will be appropriately documented, displayed on site and communicated to all site personnel in inductions and ongoing training.

5.15.4 Aboriginal cultural heritage

The CSR Advanced Manufacturing Hub is located between Badgerys Creek and South Creek. This landscape is very important for Aboriginal cultural heritage.

It would have been preferable if one Aboriginal Cultural Heritage Assessment Report (ACHAR) had been prepared which covered both MOD 3 and MOD 4 proposals rather than providing two separate ACHARs for the two modifications given that the survey assessment assessed the whole site. One ACHAR would make the assessment of significance easier to understand by considering the landform between Badgerys Creek and South Creek. The totality of the Ring tree (BCBW 18 Tree), Clay heat retainer hearth (BCBW18 AS 02), High Density Subsurface Artefact Scatter (BCBW18 AS 03) and Isolated Surface Artefact (BCBW18 IF 01) etc. should have been assessed in one ACHAR for consistency rather than splitting between MOD 3 and MOD 4.

Modification 3 and Modification 4 are two separate modification applications that involve different activities on the same CSR owned site. DPIE agreed to CSR lodging two separate modification applications. The EA for each modification application needs to assess the impacts associated with that modification (and any cumulative impacts associated with the other application) as it is not certain that both modifications would be approved.

As both modification applications are being undertaken concurrently, the most appropriate approach was to undertake site survey and test excavation for the entire study area (encompassing ground disturbance associated with both Modification 3 and 4), present the results of these Aboriginal cultural heritage investigations in a single archaeological technical report (ATR) and then assess the potential impacts of the ground disturbance activities for each modification in a separate ACHAR. This enables DPIE to understand the impacts associated with each modification as they will be assessed and determined separately.

All Aboriginal cultural heritage sites that will not be impacted by Modification 3 or 4 will be protected and managed in accordance with a single Aboriginal Heritage Management Plan (AHMP). The existing AHMP will be updated with the findings of the Modification 3 and 4 ACHARs.

As described in Section 2.2.2, a preferred project has been proposed, which reduces the project components described in the modification 3 and 4 EAs. This will result in reduced surface disturbance and, as described below, no identified heritage sites will be impacted.

OEH notes there are discrepancies and inaccuracies between the Aboriginal heritage information which is provided in the EAs for MOD 3 and MOD 4 and the ACHAR for MOD 3 and 4 proposals. Insufficient information is provided to assess the potential impacts on the Aboriginal cultural heritage values, for example in relation to the Clay heat retainer hearth:

- The EAs for MOD 3 and 4 note a subsurface site (BCBW18 AS 02) containing a heat retaining hearth was discovered within the MOD 3 and 4 study area. It is noted that only a portion of BCBW18 AS 02 is located within the study area for MOD 3 (ACHAR, page 29).
- The EAs for MOD 3 and 4 note there will be partial impact and loss of value (see pages 121 and 133 of EAs). Further details are required on what "partial loss" means including a detailed scaled map which shows the extent of loss as:
    - the Archaeological Technical Report (ATR) included in the ACHAR for MOD 3 states "CSR has indicated a preference towards conserving portions of BCBW18 AS 02 (AHIMS ID 45-5-5164) for artefact reburial" (section 10.2, page 82) and Section 10.2.1 of the ACHAR notes CSR has indicated a preference towards conserving the hearth feature within BCBW18 AS 02 (AHIMS ID 45-5-5164) within a 1Om exclusion zone (page 39) Section 10.2.1 of the ACHAR notes a portion of BCBW18 AS 02 will be impacted by the proposed works but as the portion of the site which will be impacted is of very low artefact density, it is unlikely that significant archaeological material remains within the impact area (page 39).
    - Section 11.1 of ACHAR notes the majority of BCBW18 AS 02 will not be impacted by the proposed works. The most significant portion of BCBW18 AS 02 is the hearth feature, which

will not be impacted by the proposed work and will be protected by a 1Om buffer under the MOD4 works (page 42).

- The ATR notes the site features a clay heat retainer hearth, which is extremely rare within the regional context. The intact nature of the deposit presents an opportunity to use the obtained carbon dates to contribute towards a regional sequence of artefact assemblages. Due to the high research potential and rarity of the site, BCBW18 AS 02 (AHIMS ID 45-5-5164) is of high scientific significance but the remainder of the site is of low significance and potential (section 9.2.2, page 80).

After further interrogation of the Modification 3 and 4 ACHARs by CSR, Element and Artefact (Aboriginal heritage consultants) it can be confirmed that there are no inaccuracies or discrepancies between the two ACHARs. It appears that DPIE – Biodiversity and Conservation's confusion is with the description of the impacts on BCBW18 AS 02 and the different level of significance attributed to different parts of this site.

BCBW18 AS 02 is a low-density subsurface artefact scatter located on an intact landform. Low density artefacts scatters are common on the Cumberland Plain, however this site also features a clay heat retainer hearth, which is extremely rare within the regional context. Therefore, BCBW18 AS 02 has been assessed as being of high significance due to the rarity of the hearth feature within the local context. The remainder of BCBW18 AS 02 (AHIMS ID 45-5-5164) is a low density artefact scatter, with low archaeological potential and is of low significance.

A small portion of BCBW18 AS 02 characterised as a low-density artefact scatter, fell within the potential future expansion area of the roof products manufacturing facility. Figure 9.1 of the Modification 3 EA and Figure 10.1 of the Modification 3 ACHAR show the extent of BCBW18 AS 02, the location of the hearth and the project disturbance footprint which represents the "partial loss" referred to in the EA and ACHAR. The hearth is located a substantial distance (approximately 90m) to the south-east of the previously proposed Modification 3 disturbance footprint presented in the EA and is located within the part of the BCBW18 AS 02 site that is outside of the previously proposed Modification 3 disturbance footprint. That is why the Modification 3 ACHAR concludes that there will only be "partial loss" of BCBW18 AS 02 and that "The impact assessment found that impacts to BCBW18 AS 02 will be very minor and will not impact major features of the site".

A larger portion of BCBW18 AS 02 characterised as a low density artefact scatter, fell within the solar farm footprint previously proposed under Modification 4. Figure 11.1 of the Modification 4 EA and Figure 10.1 of the Modification 4 ACHAR show the extent of BCBW18 AS 02, the location of the hearth and the previous Modification 4 disturbance footprint which represents the "partial loss" referred to in the EA and ACHAR. The hearth is located on the north-eastern edge, but outside of the Modification 4 disturbance footprint. That is why the Modification 4 ACHAR states that "The most significant portion of BCBW18 AS 02, is the hearth feature, which will not be impacted by the proposed work and will be protected by a 10 m buffer.

BCBW18 AS 02 will not be impacted as the solar farm and roof products manufacturing facility are not part of the preferred project. Notwithstanding, the artefact scatters have been salvaged and will be buried with the hearth as recommended by the ACHA.

- Further details need to be provided on the clay heat retainer hearth (BCBW18 AS 02) which the EA notes is extremely rare in the region (section 9.2.4, page 121). A Plan drawing of the hearth feature has been provided (see Figure 8.12 in the Archaeological Technical Report,

page 70). This figure is not adequate for OEH to be able to determine the significance of the hearth.

Cross section and plan drawings of the hearth are in figures 8.11 and 8.12 of the ATR, photographs of the hearth are in Figure 7.1 and 7.3 of the Modification 4 ACHAR and the results of the radiocarbon dating are in Section 8.2.3.6 of the ATR.

Artefact Heritage advises that the only remaining method that has not already been used, that could provide further information on the hearth, is residue analysis, which is a destructive process and could do irreparable damage to the hearth. Therefore, Artefact has recommended conservation of the hearth, including the reburial of collected artefacts. CSR can facilitate a site inspection with DPIE – Biodiversity and Conservation to view the hearth if required.

- The MOD 3 EA notes the hearth will be protected from impact (page 122) but it also states, "the hearth will be reburied after it has been investigated and a 1Om exclusion area will be placed around the site with fencing or similar" (section 9.3 page 122). The proponent needs to demonstrate to the Department that impacts on the hearth will be avoided. Based on this it would appear the hearth is to be permanently protected by the fenced buffer. OEH does not consider a 1Om buffer is suitable to protect the hearth given that the hearth is of high scientific significance (section 9.2.4, page 120). Further details need to be provided on how the hearth is proposed to be conserved, protected and managed in the short term and in perpetuity and whether all the relevant registered Aboriginal parties have been consulted on this.

  The ATR and ACHAR illustrate that most of the hearth was identified during the fieldwork and is only approximately 1 m x 1 m in size. Only parts of the hearth (clay heat retainers) were removed for further assessment (carbon dating) and will be returned to the excavation, reburied and conserved with the hearth.

  No development is proposed near the hearth under the preferred project. A 10 m exclusion area will be placed around the hearth (with fencing or similar) to protect it from animals associated with the grazing lease that applies to the area.

  In the short term, the excavation around the hearth has been backfilled with sand, including a small mound to protect the feature from trampling. The hearth has also been fenced with star pickets and orange barrier mesh.

  Registered Aboriginal parties (RAPs) have been actively involved in the Aboriginal cultural heritage assessment process by reviewing the test excavation methodology, assisting with fieldwork and reviewing the ACHAR prior to exhibition of the EA. They did not raise concerns about the proposed 10 m exclusion zone and management of the hearth. Additionally, the RAPs will be present on site when all artefacts recovered during test excavations are reburied with the hearth after which permanent fencing or similar will be erected.

5.15.5 Aboriginal Cultural heritage management plan

OEH is very concerned about how the significant cultural heritage values will be protected and managed. The EAs for MOD 3 and MOD 4 note the Aboriginal Cultural Heritage Management Plan (ACHMP) will be updated with the findings of the MOD 3 and MOD 4 ACHAR (see Sections 9.3, page 123 of MOD 3 EA and Section 11.3, page 134 of MOD 4 EA). The ACHMP needs to address how the clay heat retainer hearth will be conserved, protected and managed in the short term and in perpetuity.

DPIE – Biodiversity and Conservation comments are noted. Refer to Section 5.15.4 for discussion on current and proposed management of the heat retainer hearth.

5.16 Environment Protection Authority

The EPA notes that Boral CSR Bricks Pty Limited currently holds an Environment Protection Licence (EPL No. 684) under section 48 of the Protection of the Environment Operations Act 1997 (POEO Act) authorising Ceramic Works, Extractive Activities and Mining for Minerals at 235 Martin Road, Badgerys Creek (the Premises). In reviewing the application and information provided, the EPA is of the view that if the modification is approved the current licence must be varied. The holder of the licence will need to make a separate application to the EPA to have the licence varied.

Under section 6 of the POEO Act the EPA would be the Appropriate Regulatory Authority (ARA) during the construction and operation of the modified development (if approved).

The EA has generally provided the information required by the Secretary's Environmental Assessment Requirements (SEARs), however, the EPA seeks further information/clarification on some items as outlined below. Additional comments and recommendations from the EPA are also provided:

The EPL will be amended in consultation with EPA after the project is approved.

5.16.1 Environment protection licence

The EPA requests clarification of proposed variation(s) to EPL 684 in terms of the scheduled activities concrete works and crushing, grinding or separating.

The EPA requests that the proponent considers and confirms whether the modification, specifically the operation of a roof products manufacturing facility, would trigger 'Concrete Works' as a scheduled activity. Alternatively, the proponent should confirm whether it would seek to apply for a new licence for the roof manufacturing facility.

Further, the EPA requests that the proponent considers and confirms whether the brick manufacturing process, where the as-mined clay material is crushed from <500mm to <2mm through a crushing process triggers the scheduled activity of 'Crushing, grinding and separating'.

Under Section 48 of the Protection of the Environment Operations Act 1997 (POEO Act), an Environment Protection Licence (EPL) is required for premises-based activities listed in Schedule 1 of the Act.

The premises current EPL No. 684 provides for the following scheduled activities:

- Ceramics production: 0 – 15,000 T produced;
- Land-based extractive activity: 0 – 30,000 T extracted, processed or stored;
- Mining for minerals: 0 – 30,000 T produced.

The Environmental Assessment (EA) states that "The modification will not trigger additional scheduled activities under the POEO Act. However, variation/s to the EPL may be required as a result of the modification.

The requirement to vary the EPL will be confirmed by CSR via liaison with the EPA following the receipt of the notice of Project Approval".

The EPA notes that the modification proposal includes the construction and operation of a roof products manufacturing facility, replacing a facility that currently operates at 10 Grand Avenue, Rosehill NSW. The EA states that the new facility will produce up to 132,000 tonnes of roof products per calendar year, which equates to approximately 24 million tiles. The EA also provides details of the roof tile manufacturing process including "The tile body is a mixture of fine and

coarse body sand, cement, flyash and water. The raw materials are batched up by weight, fed into a mixture to create a tile concrete mix….."

The existing CSR Building Products Limited premises at Rosehill holds EPL No. 2007 for Concrete Works: > 25,000.00-50,000.00 m^3 annual production capacity.

The premises current EPL No. 684 provides for the following scheduled activities:

- **Ceramics production: 0 – 15,000 T produced;**
- **Land-based extractive activity: 0 – 30,000 T extracted, processed or stored;**
- **Mining for minerals: 0 – 30,000 T produced.**

The as-mined clay material meets the definition of 'crushing, grinding and separating'. The EPL will need to be varied to include this additional scheduled activity and increase the scale of the activities.

5.16.2 Noise

The EPA is satisfied that the Noise Impact Assessment (NIA) has generally assessed the potential impacts from the existing operations as well as the MOD 3 proposal. However, the EPA requires the proponent provide further clarification on the noise bunds and proposed noise limits for consent, as outlined below.

As the appropriate regulatory authority (ARA) during the construction and operation phases of the proposed modification, the EPA will regulate noise through the licence and associated limit conditions.

The EPA comments are noted. Clarification on the noise bunds and proposed noise limits is provided in Section 5.16.3.

5.16.3 Noise bunds

1. The EPA recommends that the height and location of noise bunds be confirmed before project approval is granted.

The EPA does not support flexibility to modify noise bund design after consent and therefore recommends the proponent commit to the construction of bunds as outlined in Section 5.3.3 of the Noise Impact Assessment (NIA).

Any reconfiguration of the noise bunds would require additional review of the noise impact assessment to confirm that the Project Noise Trigger Level can be achieved.

As outlined in section 11.3 of the EA, the following noise bunds were proposed:

- **a 5.5-6 m high noise barrier will be erected in the north-eastern corner of the site prior to the commencement of operations at the roof products manufacturing facility or quarrying in Pit 4 (Figure 1.2 and figures 3.1 to 3.9 of the EA);**
- **a 2 m high barrier will be erected along the top of a section of the existing noise bund that runs along the entrance driveway prior to the commencement of quarrying in Pit 4 (Figure 1.2 and figures 3.3 to 3.9 of the EA); and**
- **construction of the 8 m high Pit 5 noise bund at the start of overburden removal in Pit 4 (Figure 1.2 and figures 3.4 to 3.9 of the EA).**

The predicted operational exceedances (tables 11.3 and 11.4 of the EA) would have resulted from the following:

- **operation of the front-end loader at the roof products manufacturing facility (exceedances at R9 and R25);**

- **quarrying in Pit 4 (exceedance at R9, R25 and R26); and**
- **removal of overburden from Pit 4 (exceedance at R5).**

However, as described in Section 2.2.2, a preferred project is proposed in this report which does not include quarrying of pits 4 and 5 or construction of the roof products manufacturing facility.

As described in Section 2.3.3 of this report, noise impacts of the preferred project were assessed, and operational noise is no longer predicted to exceed noise trigger levels at any sensitive receiver. Therefore, the noise bunds described in the Modification 3 EA are no longer required and are not proposed under the preferred project.

2. The EPA requests that the staging of the construction of bunds be clarified.

Refer to response in point 3 below.

3. The EPA requests the proponent confirm if the material for construction of the noise bunds is to be imported to the site, is overburden or material already on site.

The proponent should confirm the staging/timing of noise bunds, including the 8m bund (formerly proposed 10m) and the two additional bunds/barriers (5.5m high and 2m high) recommended as mitigation measures to ensure bunds are in place to mitigate against noise at closest sensitive receivers prior to commencement of other activities.

The NIA assumes that noise bunds are in place however, the EA does not stipulate the staging of the activities and whether the noise bunds will be constructed from material won on site from prestripping for pit development. The later would then mean that noise from some pit excavations are not mitigated by the completed noise bunds

The EPA is unclear whether all proposed bunds would be constructed from overburden and whether the noise impact from the construction of the bunds, given that the detailed design has not been completed, have been fully assessed.

As described above and in Section 2.2.2, construction of the roof products manufacturing facility and quarry of pits 4 and 5 are no longer proposed under the preferred project. The assessment of noise impacts from the preferred project predicted operational noise trigger levels will not be exceeded at any sensitive receivers. Therefore, provision of new noise bunds is no longer justified and are not a component of the project phases described in Section 2.2.2.

5.16.4 Noise limits

4. The proponent should confirm whether it seeks to modify the Construction Noise criteria in the current consent, and if so, propose new criteria for consideration.

The current construction noise criteria on the existing consent (Table 2 – Construction Noise Criteria dB(A)) relate only to construction of Bunds 3C, 4A and 4B. These limits do not reflect other construction activities associated with the proposed project. The construction noise limits on the consent require amending to reflect the activities proposed in the modification, including construction of the proposed new and modified bunds.

CSR proposes that construction noise criteria do not form part of the consent, but that construction noise impacts are managed under a construction noise and vibration management plan (CNVMP) where all reasonable and feasible measures are implemented to manage noise levels from construction activities down towards the noise management

levels (NML) identified in the EA. This approach is consistent with EPA's (2009) *Interim Construction Noise Guideline*.

The consent should clearly outline those activities that the CNVMP applies to.

5. The EPA recommends that the project approval, if granted, includes a condition to limit construction to standard hours only.

CSR accepts this condition.

6. The EPA seeks clarification of the proponent's intention to amend operational noise limits.

The current operational noise criteria on the existing consent (Table 3 – Operational Noise Criteria dB(A)) are not significantly different from the Project Noise Trigger Levels in the Table 5-4 of the NIA. The NIA operational noise assessment assumes that the proposed 8m noise bund is constructed. The project noise level has been assessed for all sensitive receivers for Day, Evening Night and Shoulder. These values do not correspond to the operational noise criteria in the consent. The EPA therefore requests the proponent confirms whether it seeks to amend the consent's operational noise limits.

The EPA supports the Project Noise Trigger Levels in the Table 5-4 of the NIA as modified operational noise criteria for the proposed modification, if approved.

CSR seeks to amend the operational noise limits in the existing consent to reflect the project noise trigger levels in Table 2.22 **to** Table 2.25 **of this report as modified operational noise criteria for the project.**

7. The EPA recommends project approval conditions require implementation of the mitigation measures for road traffic noise (described in Section 6.3.6 in the NIA) along Martin Road.

CSR accepts this condition and notes revised mitigation measures are provided in 2.3.3 of this report

5.16.5 Air

The EPA recommends that the Air Quality Impact Assessment (AQIA) be reassessed to include cumulative impacts from WSA, likely future receptors and a further assessment of the brick and tile making facilities/processes.

Todoroski Air Sciences, specialist air quality consultants who prepared the air quality impact assessments for Modification 3 and 4, have thoroughly considered all EPA air quality comments, undertaken further assessment where required, and provided the responses in this section.

The reassessed AQIA must address the following matters:

1. a cumulative assessment with consideration of any other significant bulk earth work activities associated with the Western Sydney Airport.

   The assessment has not considered potential cumulative impacts with other bulk earthwork activities associated with other developments in the area (Western Sydney Airport).

Results of the assessment of cumulative impacts of the project and bulk earth works at WSA are described in Section 7.63 of Appendix B and Section 2.3.2 of this report. Dust impacts of the project and WSA will not exceed cumulative $PM_{2.5}$ and PM_{10} criteria and the additional cumulative effect due to the WSA works is unlikely to alter the predicted 24-hr average cumulative assessment.

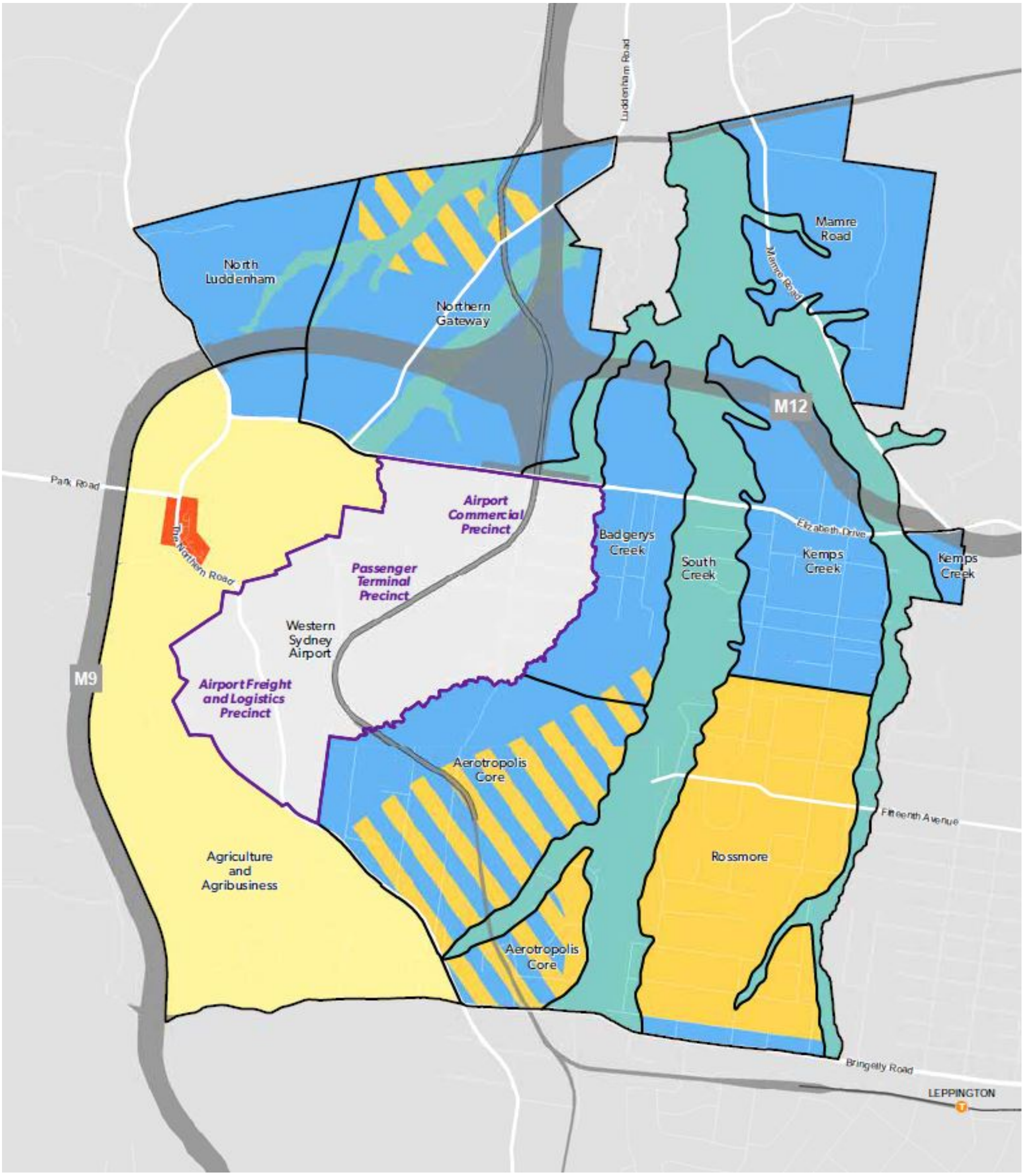
2. include an assessment at any likely future receptors.

The assessment does not advise on future sensitive receptors, noting that the location is likely to be subject to significant development in the future.

Refer to 2.3.2 for a summary of the assessment of impacts on adjacent vacant land. The cumulative $PM_{2.5}$ criterion of 8 µg/m^3 will be exceeded during phases 2 and 3 along the southern boundary of the site, in the extreme northern boundary of the Aerotropolis Core Precinct. This area may not initially be suitable for residential development, however, it will no longer be impacted by $PM_{2.5}$ during and after Phase 4.

Figure 5.3
Western Sydney Aerotropolis Stage 1 Structure Plan

CSR Advanced Manufacturing Hub
RESPONSE TO SUBMISSIONS REPORT



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Source: NSW Department of Planning, Industry and Environment (2018). Western Sydney Aerotropolis. Land Use Infrastructure Plan. Stage 1: Initial Precincts.

3. consider a reasonable worst-case scenario accounting for emissions based on proposed peak daily importation rates.

   The assessment has potentially underpredicted peak daily emissions associated with the proposed increase in importation of raw material and hence potentially underpredicted peak short-term (24 hour) ground level concentrations.

There is no need to revise the assessment, emissions during operating hours for the proposed importation of raw material are relatively even, but variable hourly emission levels are modelled to account for potential short-term fluctuations arising from environmental factors.

4. Additional information on emission performance of the Brick making facilities. This includes:

   - Benchmark the proposed plant and equipment against reasonable and feasible best practice emission controls;
   - Demonstration that point source emissions will comply with Group 6 prescribed concentrations contained in the Regulation, as advised in Section 3.5 of the Approved Methods for Modelling and Assessment of Air Pollutants in NSW;
   - Provision of supporting test data, and or manufactures specifications that describes the proposed emission performance of plant and equipment.

   Existing EPL conditions associated with brick making facilities will need to be amended should project approval be granted. Given the proponent is proposing to replace existing manufacturing equipment then point source discharges (i.e. kilns) will need to comply with (as minimum) Group 6 limits prescribed in the Protection of the Environment Operations (Clean Air) Regulation 2010. The AQIA has not adequately demonstrated that the point source emissions associated with the brick making facilities will comply with (as minimum) Group 6 limits. As such the EPA is not in a position to recommend amendments to EPL conditions at this stage. Additionally, the assessment does not benchmark proposed plant and equipment against reasonable and feasible best practice controls, specifically noting that other kilns have installed or are in the process of installing scrubbers for mitigating fluoride emissions.

   The in-stack concentrations for the plant were inadvertently not set out in the AQIA. The new AQIA (Appendix B) describes the assessment of potential brickmaking facility stack emissions, which is summarised in 2.3.2 of this report. Predicted stack emission will comply with the standards in NSW Protection of the Environment Operations (Clean Air) Regulation 2010.

5. The AQIA lacks detailed robust information on the assessment of emissions from the roof product manufacturing facility. As such the EPA is not in a position to adequately interpret assessed emissions and hence recommend appropriate EPL conditions for the new facility.

   The AQIA must include:

   - Detailed process description describing the roof product manufacturing facility, and associated emission discharge points (including any pollution controls associated with the manufacturing facility);
   - A more robust justification for the assessed emissions and pollutants for the roof product manufacturing facility and how emission estimates are representative of the proposed plant and equipment (noting that monitoring data for the existing operations should be readily available);
   - Demonstrate compliance with the Regulation for point source discharges, as per the recommendation for the brick manufacturing discharge points;
   - A revised assessment of air quality impacts should emission estimates need to be revised given the above considerations.

As described in Section 2.2.2, the roof products manufacturing facility is no longer proposed under the preferred project. Air quality impacts of the preferred project are described in Appendix B and summarised in Section 2.3.2. Air quality impacts from the preferred project will be below criteria at all sensitive receivers.

6. The AQIA has not assessed against all relevant impact assessment criteria for hydrogen fluoride (HF) contained in the Approved Methods for Modelling and Assessment of Air Pollutants in NSW.

   The AQIA must include assessment against all impact assessment criteria for hydrogen fluoride (HF).

Hydrogen fluoride emissions have been assessed in the new AQIA (Appendix B) and summarised in Section 2.3.2. No exceedances of the HF criteria are predicted at any sensitive receptors or the site boundary due to the project.

5.16.6 Water management and discharge points

9. The EPA recommends that the project approval, if granted, retains the condition that the proponent must ensure that all surface water discharges from the site comply with the limits (both volume and quantity) set in any EPL applicable to the site.

The current EPL does not permit the discharge of water off-site and contains the following condition:

- Except as may be expressly provided in any other condition of this licence, the licensee must comply with section 120 of the Protection of the Environment Operations Act 1997.

The proponent has indicated it will apply to the EPA to incorporate discharge points and discharges from nominated sediment basins. The EPA will consider any application and supporting information before varying the EPL.

The water balance in the surface water assessment for Modification 3 demonstrated there will not be any controlled discharges from site. However, there could be two to four overflows from the new sediment basins per year during the 90th percentile rainfall event (48.8 mm in five days). CSR will apply to EPA to amend the EPL to include sampling of overflows for sediment concentrations.

5.16.7 Waste

10. The EPA recommends no change in conditions relating to waste on the current approval.

MP10-0014 conditions 38 and 39 state:

The Proponent must:

a. manage on-site sewage treatment and disposal in accordance with the requirements of its EPL, and to the satisfaction of the EPA and Council;
b. minimise the waste generated by the project;
c. ensure that the waste generated by the project is appropriately stored, handled, and disposed of; and
d. report on waste management and minimisation in the Annual Review, to the satisfaction of the Secretary.

Except as expressly permitted in an EPL and/or the conditions of this approval, the Proponent must not receive waste on the site for storage, treatment, processing, reprocessing or disposal.

CSR accepts the existing waste conditions to remain the same.

5.16.8 Contamination

11. The EPA recommends that project approval conditions require the proponent to develop an Unexpected Finds Protocol (UFP) that provides guidance in the event of encountering contaminated materials during excavation activities.

CSR accepts this condition.

5.17 Department of Planning, Industry and Environment (Water, Lands and Primary Industry)

Groundwater monitoring bores be maintained and groundwater monitoring continued. Parameters and frequencies are to be proposed in a revised water management plan.

The water management plan will be updated to include the updated groundwater monitoring network including sampling frequencies and parameters.

5.18 Liverpool City Council

5.18.1 Planning considerations

Liverpool Local Environmental Plan 2008

The site is zoned RU1 – Primary Production under the Liverpool Local Environmental Plan 2008 (LLEP). An objective of the RU1 – Primary Production zone is: To ensure that development does not hinder the development or operation of an airport on Commonwealth land in Badgery's Creek. The proposed development of manufacturing facilities as part of Modification 3 is not permitted under the LLEP. Council requests that the Department determine whether the manufacturing facilities are permissible under an Environmental Planning Instrument. Consideration should also be made with the NASF in the assessment of this proposal to ensure the proposed land uses do not have adverse impacts on the Western Sydney Airport.

The project is permissible as detailed in Section 4.6.2 of the EA.

The project will not hinder the development or operation of the WSA. All potential impacts to the airport have been considered in the EA and in this RTS. The assessment of the project against the NASF guidelines is in Section 5.3.5.

The consistency of the land uses associated with the preferred project proposed in modification 3 and 4 with the LUIIP is demonstrated in Section 5.3.

Land-Use and Infrastructure Implementation Plan – Western Sydney Aerotropolis

The site is identified in the Badgerys Creek precinct of the Western Sydney Aerotropolis Land Use and Infrastructure Implementation Plan, with development subject to Modification 3 proposed in the Badgerys Creek precinct alone. Council notes that precinct planning has not yet been completed for this precinct and therefore the potential impacts on the future land uses within the Aerotropolis cannot be quantified at this stage.

As this site is not in an Initial Precinct, a timeframe for the Badgerys Creek precinct planning and rezoning has not yet been established.

LCC comments are noted. The consistency of the land uses associated with the preferred project proposed in modification 3 and 4 with the LUIIP is demonstrated in Section 5.3.

5.18.2 Traffic

Intersection of Elizabeth Drive/Martin Road

Modification 3 will result in an additional 544 truck movements per day Monday to Friday. This additional traffic will have significant impacts on the performance of the existing Elizabeth Drive/Martin Road intersection. Intersection performance analysis carried out by the applicant indicates that the intersection would be expected to operate with an unacceptable Level of Services E/F during AM and PM peak hours respectively.

As identified in the applicant's traffic report, these intersection performances will result in unsafe right turn vehicle movements and will require an intersection upgrade to traffic signals.

RMS "In principle" approval to the proposed traffic signals is required prior to the determination of MOD 3. The traffic signals should be fully operational prior to the operation.

Clarification on the 'additional' number of truck movements associated with the project is in Table 2.1**, including a comparison with the existing project approval and variance to Modification 3.**

As outlined in Section 13.2.4 of the EA, CSR has committed to contributing to the upgrade and ongoing maintenance of Martin Road. As detailed in Section 4.2.2 of this RTS, CSR is in the final stages of signing a deed of agreement between CSR and LCC on CSR's contributions to the upgrade and ongoing maintenance of Martin Road. This will ensure LCC's concerns on the condition of Martin Road are fully addressed.

As outlined in Section 3.5 of the EA and Section 5.2.2 of this RTS CSR has committed to constructing a signalised Martin Road-Elizabeth Drive intersection.

The realigned Martin Road and its extension

It is noted that MOD 3 has been submitted to address RMS requirements to remove the "S" bend in the road and its extension southwards through the development site. The submitted information has not addressed this requirement. To avoid conflicts in future the applicant should provide a strategic geometric layout of the proposed Martin Road realignment from Elizabeth Drive through the development site, providing a copy to Council for assessment prior to the determination of this application.

It is premature to prepare a strategic geometric layout of the proposed Martin Road realignment from Elizabeth Drive through the development site.

Section 5.3.2 of this RTS details how CSR had initially allowed for a 20 m corridor through the centre of Pit 3 and the previously proposed Pit 4 (once backfilled). However, after consultation with WSPP and LCC and through further interrogation of the site development plan, CSR has identified an alternative alignment and a wider 40 m (as requested by WSPP and LCC) future road corridor, between the brick making facility and Pit 3. This width will accommodate a 30 m wide road comprising a 3 m wide median, three 3 m wide lanes either side of the median and 3.5 m wide shared bike/pedestrian paths and verge either side of the road.

A possible underpass has been identified on the section of Martin Road that traverses the site (green dot on Figure 2.3 **to** Figure 2.5**) to allow the extension of Martin Road south through the site to occur prior to the completion of quarrying and backfilling of Pit 3, providing CSR access between the pit and the raw material stockpile area and brick making facility, without quarry trucks and machinery crossing Martin Road.**

A construction traffic management plan

A Construction Traffic Management Plan (CTMP) detailing construction vehicle routes, number of trucks, hours of operation, access arrangements and traffic control should be submitted to Council's Traffic and Transport Section for approval prior to the issue of a Construction Certificate.

The LCC comment is noted. A CTMP will be submitted for review and approval prior to the construction certificate being issued.

Transport infrastructure funding

The previous conditions imposed on the approved developments require the proponent to

a. repair Martin Road to the satisfaction of Council; and
b. prior to the determination, enter into a formal agreement with Council for the:

- upgrade and widening of Martin Road from the site entrance to the entrance of Australian Native Landscape; and
- annual road maintenance contributions to be paid to Council, based on the weight of brick products and associated materials transported from and to the site for the life of the project.

A draft agreement shall be finalised with Council prior to determination.

As outlined in Section 13.2.4 of the EA, CSR has committed to contributing to the upgrade and ongoing maintenance of Martin Road. As detailed in Section 4.2.2 and 5.18.2 of this RTS, CSR are in the final stages of signing a Deed of Agreement between CSR and LCC on CSR's contributions to the upgrade and ongoing maintenance of Martin Road. This will ensure LCC's concerns on the condition of Martin Road are fully addressed.

5.18.3 Flooding

The development site is above the 1% AEP flood level and only the stormwater basin for the roof product area is partially inundated in a PMF event. Council does not object to this solution with regards to flood safety and stormwater management.

The following condition of consent is recommended:

A detailed stormwater drainage design, prepared by a qualified practicing civil engineer must be submitted to council prior to issue of a construction certificate. The solution shall be designed in accordance with the Monier Concrete Tile Factory – Badgerys Creek Stormwater DA Report dated February 2019 prepared by at&l, and CSR Advanced Manufacturing Hub Modification 3 Surface Water Assessment dated February 2019 prepared by Advision, and shall include all engineering details relevant to collection and disposal of stormwater, pipe sizes and grades, details of on-site detention (OSD) systems, and water quality treatment trains. The OSD system shall provide adequate flow attenuation to ensure that the peak post-development discharges from the development do not exceed peak pre-development discharges for the 20%, 5% and 1% Annual Recurrence Interval (ARI) storm events. On-site water quality control measures shall ensure that stormwater runoffs leaving the site comply with Council's water quality standards. Water quality treatment works shall be designed using MUSIC modelling software and the water quality treatment system performance shall be verified using Council's MUSIC link.

As the roof products manufacturing facility is no longer part of the preferred project, the condition of consent proposed by LCC is no longer relevant or required.

5.18.4 Environmental health

It is uncertain whether the proposed alterations and additions will result in any changes to the existing sewage management systems at the site. Therefore, separate approval may be required under Section 68 of the Local Government Act 1993 for the on-site sewage management system. To mitigate environment and public health impacts, the Applicant is required to demonstrate that the systems' design and capacity is adequate for its intended purpose taking into consideration maximum load requirements, unforeseen incidents and shutdown contingencies.

Beca (consulting engineers) were appointed by CSR to:

- **investigate and confirm the type and condition of the existing sewage management systems servicing the brick making facility;**
- **estimate sewage volumes to be produced by the brick making facility;**
- **confirm the capacity of the existing sewage management systems and identify required upgrades;**
- **define the scope of any further investigations required for detailed design of upgrades, replacements and new sewage management systems;**
- **estimate subsurface conditions near the existing and proposed sewage management systems using geotechnical information;**
- **provide recommendations on the upgrades/replacement of existing sewage management systems and the type of new sewage management systems; and**
- **define the scope of a wastewater management report that will be developed for the brick making facility, to inform detailed design regarding treatment requirements and ability to discharge and to document further investigations required to inform the detailed design including further targeted geotechnical testing.**

As described in Section 2.2.2, the preferred project does not include the roof products manufacturing facility. The Badgerys Creek Development Project Utilities – Sewage Management (Beca, 2019) report, which documents the above and has been revised assuming the roof products manufacturing facility will not be built is in Appendix H.

Based on the available information, Zoic Environmental Pty Ltd concluded that the potential for widespread contamination at the site was low. The consultant recommended that an Unexpected Finds Protocol (UFP) is prepared and that stored materials within the proposed building footprints are inspected and recycled or disposed of at facilities permitted to receive such materials. Soils may be encountered with moderate salinity potential and the contaminated land consultant warned that the geotechnical investigation must inform the detailed design of MOD3 and recommend any measures necessary to protect structures and / or the environment. These recommendations are brought to the attention of the NSW Department of Planning & Environment for their consideration.

LCC comments are noted.

Council previously requested for the Modification Application to be supported by a geotechnical or site assessment report (wastewater management report) prepared by a suitably qualified and experienced wastewater engineer or environmental consultant. As the Application is still devoid of this necessary information, it is requested that the proponent addresses this deficiency prior to further consideration of the Application.

Refer to the response to the first comment of this section and to Section 4.3 of the Badgerys Creek Development Project Utilities – Sewage Management (Beca, 2019) report (Appendix H).

Based upon the findings of the Preliminary Site Investigation, it is believed that the land is not contaminated and is suitable for the proposed modification subject to the implementation of the

consultant's recommendations. Council's Environmental Health Section is satisfied that the land is suitable for the proposed use without the need for remediation.

LCC comments are noted.

Todoroski Air Sciences recommended, to minimise dust generation during construction, that the mitigation measures within Table 7-1 of their report. The consultant indicated that the Reactive Dust Management Program as per the Badgerys Creek Quarry and Brick Making Facility – Air Quality and Greenhouse Gas Management Plan (APP, 2013) was no longer necessary. Furthermore, the consultant recommended for the existing high volume air sampler to be relocated to a position more representative of the surrounding receptor locations, such as to the northern boundary of the site.

LCC comments are noted.

A Construction Noise Management Plan was recommended to ensure that appropriate mitigation measures are implemented to manage construction noise. Traffic noise levels during operation were predicted to exceed the assessment criteria by more than 2 dB. Architectural treatments to reduce road noise levels were recommended for receivers qualifying for mitigation. The NSW Road Noise Policy stipulates that for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB.

LCC comments are noted. Road noise associated with the project was reassessed and described in the new NIA (Appendix C). The predicted $L_{Aeq,period}$ road noise levels at the façade of the most potentially affected receivers along Elizabeth Drive will comply with the RNP impact assessment criteria and the increase in traffic noise levels due to the project will be less than 2 dBA. The predicted road noise levels at the façade of six of the most potentially affected receivers along Martin Road will exceed the RNP impact assessment criteria and the increase in traffic noise levels due to the project will be greater than 2 dBA. These residences may qualify for architectural treatment (refer to Section 2.3.3).

Pursuant to Section 4.47(2) of the Environmental Planning and Assessment Act 1979 and Regulations, the modification application shall be referred to the NSW Environment Protection Authority for comment. It is requested that the NSW Environment Protection Authority reviews the proposed Modification Application to determine that the facility can be operated in an environmentally satisfactory manner consistent with the Environment Protection Licence (EPL).

The EPA submission on the modification application is responded to in Section 5.16.

5.18.5 Heritage

Council has no objections to the Aboriginal Heritage Assessment for Modification 3.

Council recommends that an Unexpected Finds Procedure be prepared, with all staff inducted accordingly prior to any earth works commencing.

The LCC comments are noted. The AHMP will be updated to include an UFP.

5.18.6 Environment

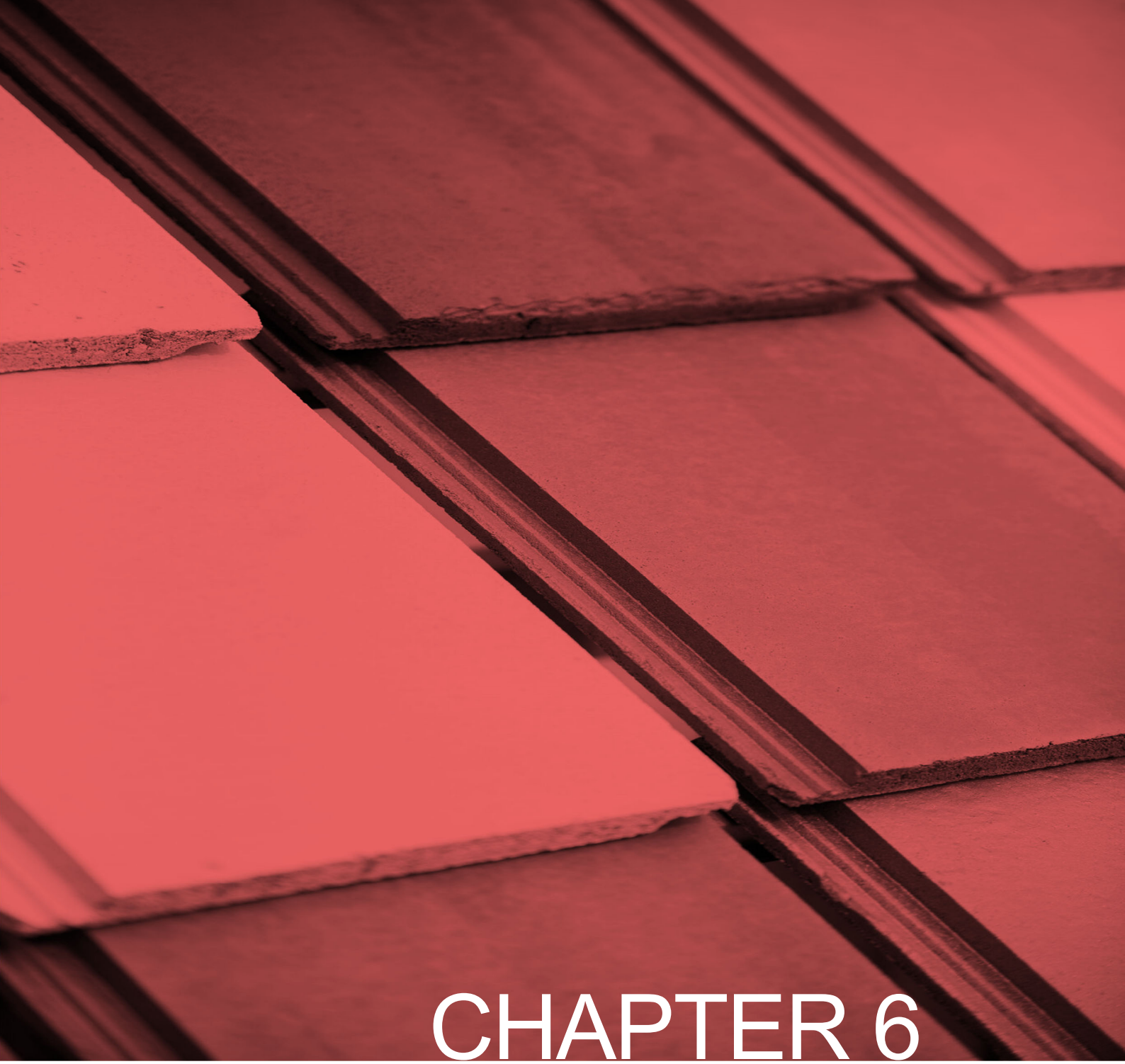
According to Council's records and the Flora and Fauna Report submitted for the Modification (Ecoplanning, 4/12/2018), the land to be impacted upon by Modification 3 is entirely biocertified. The need for threatened species assessment is therefore switched off. Therefore, further consideration of ecological matters would not be considered warranted for this Modification.

The LCC comments are noted.

5.18.7 Cumulative impacts

It is noted that the site is currently subject to a number of modifications. It is pertinent that any activities carried out in tandem are identified with their cumulative impacts concurrently assessed. Impacts associated with truck movements, air quality, runoff, and noise are most likely to be ongoing issues.

All cumulative impacts of the approved project, other approved developments in the area and the proposed Modification 3 are assessed in the Modification 3 EA and this RTS. All cumulative impacts of the approved project, other approved developments in the area, the proposed Modification 3 and the proposed Modification 4 are assessed in the Modification 4 EA and RTS.



CHAPTER 6

RESPONSE TO ORGANISATION SUBMISSION

6 RESPONSE TO ORGANISATION SUBMISSION

Only one submission was received from a private organisation on Modification 3, Australian Native Landscapes, which operates a composting facility on Martin Road, north of the site.

6.1 Australian Native Landscapes (ANL)

ANL has major concerns regarding the additional huge numbers of trucks that will be needed to transport inwards and outwards from the proposed site.

Martin Road currently is in a major state of disrepair and will need a complete rebuild and possible widening. The existing intersection on Martin Road and Elizabeth Drive will not cope with the proposed truck numbers. The letter we received lists dispatch of 275,000 tonnes p.a and 252,000 tonnes of bricks pa as well as the input of 20,000 tonnes plus staff and service vehicles. Martin Road can't cope with these truck numbers, 400 trucks movements a day would create major intersection delays at Elizabeth Drive. This intersection will require lights, left hand turns and major upgrades to cope.

ANL and the other land owners in Martin Road have major concerns. We seek a commitment from your department to communicate all aspects of this proposal to ANL regarding our legitimate concerns regarding truck traffic.

As outlined in Section 13.2.4 of the EA, CSR has committed to contributing to the upgrade and ongoing maintenance of Martin Road. As detailed in Section 4.2.2 of this RTS, CSR are in the final stages of signing a Deed of Agreement between CSR and LCC on CSR's contributions to the upgrade and ongoing maintenance of Martin Road. This will ensure LCC's and ANL's concerns on the condition of Martin Road are fully addressed.

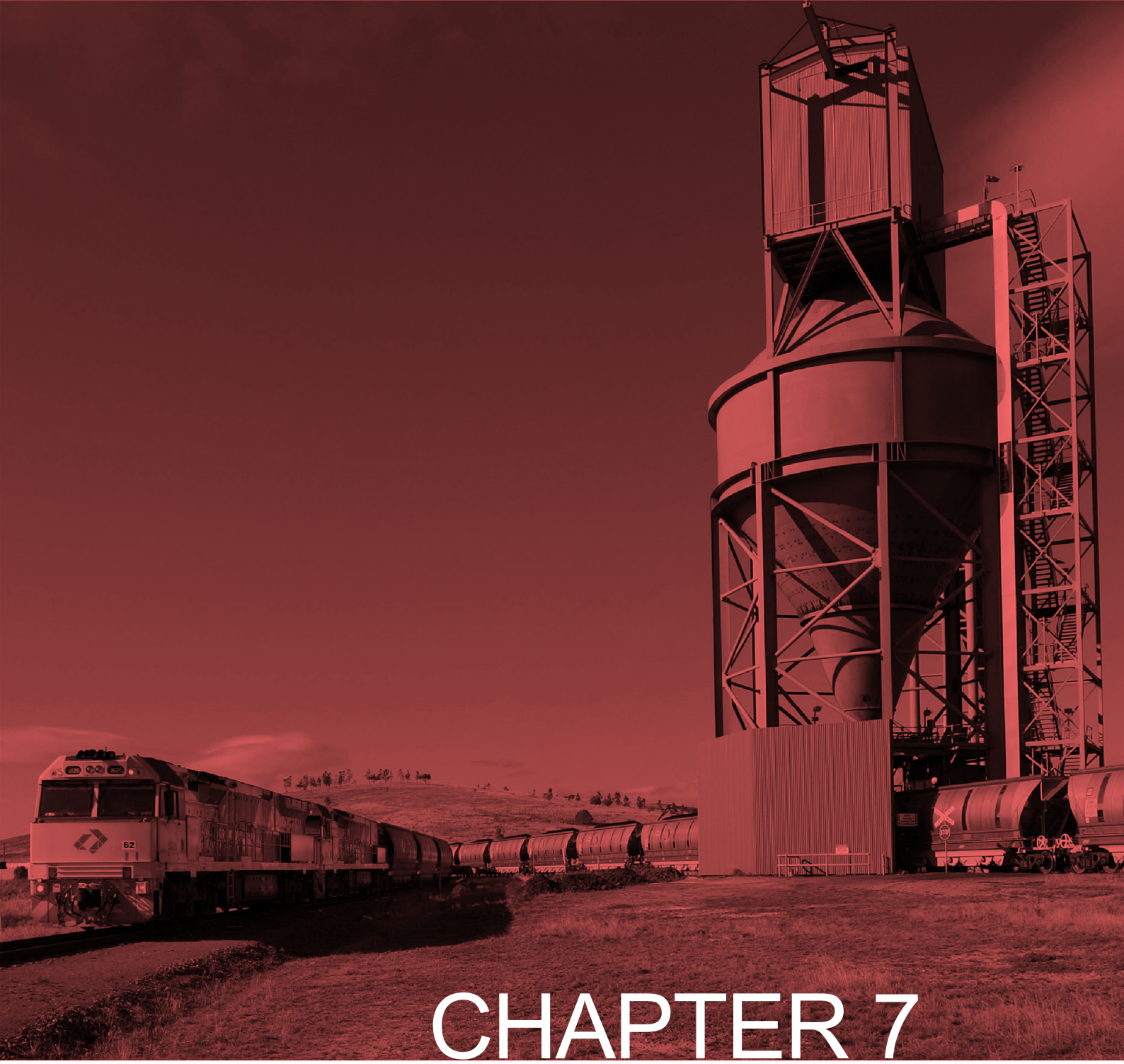
As outlined in Section 3.5 of the EA and Section 5.2.2 of this RTS CSR has committed to constructing a signalised Martin Road-Elizabeth Drive intersection. A concept design of the proposed Martin Road-Elizabeth Drive intersection was included in the EA.

This signalised intersection design addresses ANL's concerns, meets RMS's standards and allows for the safe movement of both heavy and light vehicles in and out of Martin Road, with the intersection operating at a good LoS A with low vehicle delays.

The right turn movement out of Martin Road onto Elizabeth Drive is currently the most dangerous movement especially for heavy vehicles that must cross the westbound lane of Elizabeth Drive and merge with the eastbound traffic.

The proposed signalised intersection will improve vehicle delays for trucks turning right out of Martin Road but will also significantly improve the safety of trucks. This improvement to safety and vehicle delays will benefit both CSR vehicles as well as all other vehicles using Martin Road including ANL vehicles, which would not occur without the project.

Note, no submissions were received from other landowners in Martin Road, even though they were thoroughly consulted on the project.



CHAPTER 7

SUMMARY OF MITIGATION MEASURES

7 SUMMARY OF MITIGATION MEASURES

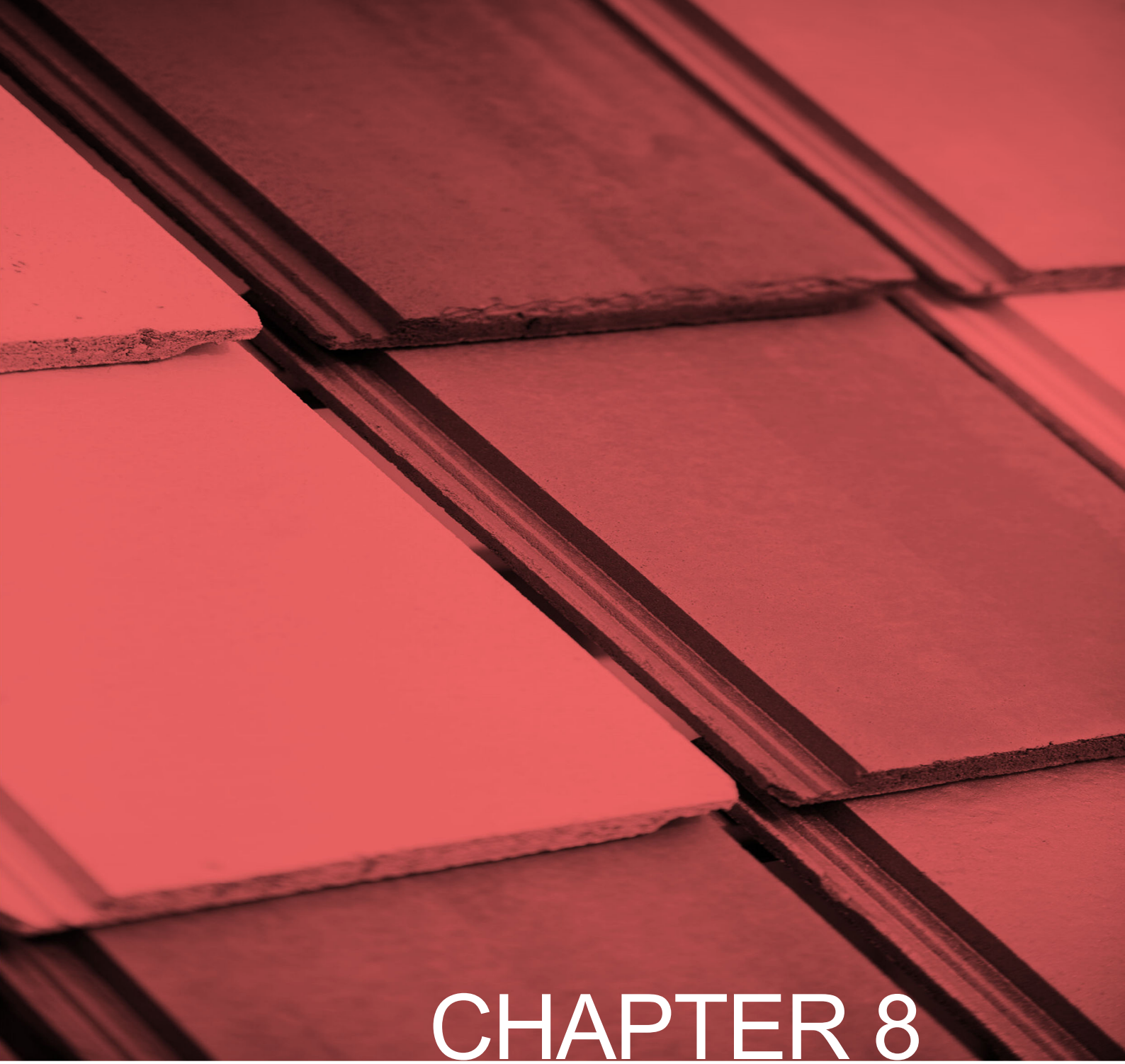
The consolidated list of the mitigation measures identified in the Modification 3 EA that are relevant to the preferred project and any additional mitigation measures identified in planning and assessing the preferred project, have been included in Table 7.1.

Table 7.1 Summary of mitigation measures

Environmental issue	Mitigation measure
Surface water	**Management and monitoring** ▪ The site WMP will be revised prior to construction of the project to include: - Management of the new sediment basins in accordance with Landcom's (2004) Managing Urban Stormwater: Soils & Construction. - Rainfall and evaporation monitoring at the sites weather station. - Monitoring of downstream surface and ground water quality. - Monitoring of discharges from site. - Monitoring of the water balance. ▪ The WMP will have trigger action response plans (TARP) for internal transfer of water (eg from sediment dams to pits after a storm) and/or treatment and release of water off site and sediment dam maintenance. ▪ Monthly surface water quality monitoring will continue at the monitoring points in Badgerys and South creeks. ▪ The WMP will be amended with the TARPs described in Appendix G of the EA to investigate if declines in water quality are due to site operations. Some of the TARPs for Badgerys Creek will be based on monitoring data from WSA for an initial 24 months while more extensive data is collected from CSR's monitoring network. ▪ ANZECC's (2000) microbiological trigger values for recreational users – secondary contact, will be used for Badgerys and South creeks and the trigger values for lowland rivers and freshwater (95% species protection) will be used for physical/chemical stressors and toxicants in South Creek. ▪ CSR will apply to EPA to amend the EPL to include sampling of overflows from sediment basins for sediment concentrations. ▪ The water balance model will be periodically reviewed to ensure it reflects onsite water storages and flows. The model will be reviewed based on data from: - Continuous weather monitoring. - Monitoring of pit water levels. - Monitoring of flows to and from Pit 1 using total flow meters. - Monitoring of water use for dust suppression. **Licensing and approvals** ▪ As described above, CSR will apply to the EPA to amend the EPL to incorporate discharges during heavy rain. Any overflows from sediment basins at other times are to be monitored. The proposed discharge points are: - Badgerys Creek downstream of Pit 1 perched sediment basin. - Badgerys Creek downstream of Sediment Basin 4. - Badgerys Creek downstream of Sediment Basin 2. - South Creek downstream of Sediment Basin 3. - South Creek downstream of the Pit 3 sediment basin. ▪ If CSR intends to use water from holding structures in the future in manufacturing processes, it will apply for a license at that time.
Contamination	▪ An unexpected finds protocol (UFP) will be prepared, providing guidance in the event that future below ground excavations identify contaminated materials (e.g. asbestos, staining, odours). The UFP will outline procedures for handling, assessing and managing any contamination that may be identified as part of the project works. If previously unidentified contaminated materials are encountered during construction and operation of the project, relevant statutory requirements, including potential soil testing and waste classification, will need to be complied with, and the material managed and disposed of appropriately. ▪ Inspect stored materials within the proposed building footprints and recycle or dispose of them to facilities which can legally receive such materials.

	▪ Assess stockpiles of soil materials within the vicinity of the project works in accordance with NSW EPA (2014) Waste Classification Guidelines and either re-use them on site where suitable or dispose of them offsite to a landfill which can legally receive such materials. ▪ Conduct a hazardous material survey on existing site structures prior to demolition/alteration activities.
Aboriginal heritage	▪ A 10 m exclusion zone comprising a fence or similar will be installed and maintained around the heat retaining hearth. ▪ Items retrieved from the test excavation will be reburied onsite within the exclusion area of the heat retaining hearth after they have been analysed. ▪ All items will be reburied in consultation with the RAPs. ▪ The AHMP will be updated with the findings of the Modification 3 ACHA.
Air quality	▪ The reactive dust management program will cease operation. ▪ The existing HVAS will be moved to as close to the northern boundary of the property and the closest sensitive receiver as possible. ▪ The existing deposited dust gauges will be relocated to appropriate positions as close to the property boundaries and nearest sensitive receivers as possible. ▪ If HVAS and deposited dust air quality monitoring identifies ongoing exceedances of the relevant air quality criteria then the reactive dust management program may need to be reinstated at the site. ▪ The AQMP will be revised to address changes to the approved project operations, relocation of air quality monitoring equipment, and removal of the need to continue to implement a reactive dust management program.
Noise	▪ Further investigations of the six residences potentially affected by road noise will be undertaken prior to increasing heavy vehicle movements along Martin Road above the approved heavy vehicle numbers and no greater than 180 truck movements in the daytime period. The investigation will determine whether the residences require the 'Type 1' treatment package from RMS's (2015) *At-receiver Treatment Guideline*. ▪ Prior to construction of the Martin Road-Elizabeth Drive intersection, existing road noise levels would be qualified to determine if architectural treatment should be offered to receivers along Elizabeth Drive raising complaints about increased road noise levels. ▪ A construction noise and vibration management plan (CNVMP) will be prepared and implemented during construction of the project to manage noise exceedances. ▪ Vibration during construction will be managed through the CNVMP to ensure that vibration impacts comply with the limits prescribed in British Standard BS 7385 for structural damage and in *Assessing Vibration: a technical guide* (DECCW, 2006) for human response. ▪ The NMP will be updated to incorporate the project and noise mitigation and management measures. ▪ The NMP will include the implementation of a noise monitoring programme which would involve quarterly attended noise monitoring at a number of nearby identified receiver locations for 12 months after all Modification 3 and 4 activities are in full operation. If there are no exceedances of the project noise trigger levels during quarterly noise monitoring during the first year of monitoring then noise monitoring will cease. Additional noise monitoring would be undertaken in response to any noise complaints.
Visual	▪ A 3 m high visual earth bund will be constructed along the western, southern and eastern perimeter of the raw material stockpile area within the first six years of the project. ▪ Screening vegetation will be planted along the northern and eastern perimeter of the brick making facility and along the northern, western and southern perimeter of Pit 3 within the first six years of the project. ▪ A variety of tall and medium shrubs and trees will be planted on the outside of the visual earth bund and around the brick making facility and Pit 3 within the first six years of the project. ▪ Proposed lighting at the site will still comply with Australian Standard AS4282 (INT) 1995 - Control of Obtrusive Effects of Outdoor Lighting.
Traffic and transport	▪ A construction traffic management plan will be prepared and implemented to manage impacts on the road network, including the intersection, from construction vehicles.

	▪ Traffic signals and road upgrades will be constructed at the Martin Road-Elizabeth Drive intersection prior to increasing heavy vehicle movements from the project above the approved heavy vehicle numbers. ▪ CSR will contribute to the upgrade and ongoing maintenance of Martin Road in accordance with the deed of agreement with LCC.
Bushfire	▪ Defendable space will be maintained around the brick making facility to enable firefighting operations. ▪ The defendable space will remain cleared of vegetation.
Rehabilitation	▪ The site will be progressively rehabilitated in accordance with the approved rehabilitation strategy and rehabilitation management plan. ▪ The rehabilitation strategy and rehabilitation management plan will be revised to incorporate the project, and any additional management strategies to ensure temporary stabilisation of exposed surfaces, permanent stabilisation strategies and progressive rehabilitation with groundcover vegetation.
Waste	▪ All waste generated on site will be managed in accordance with the site's waste management plan that will follow the waste hierarchy of avoid, reduce, re-use, recycle and will be updated to include project works.



CHAPTER 8

REVISED STATEMENT OF COMMITMENTS

8 REVISED STATEMENT OF COMMITMENTS

The statement of commitments issued by DPIE for Modification 2 has been revised in Table 8.1 to reflect Modification 3.

Table 8.1 Revised statement of commitments

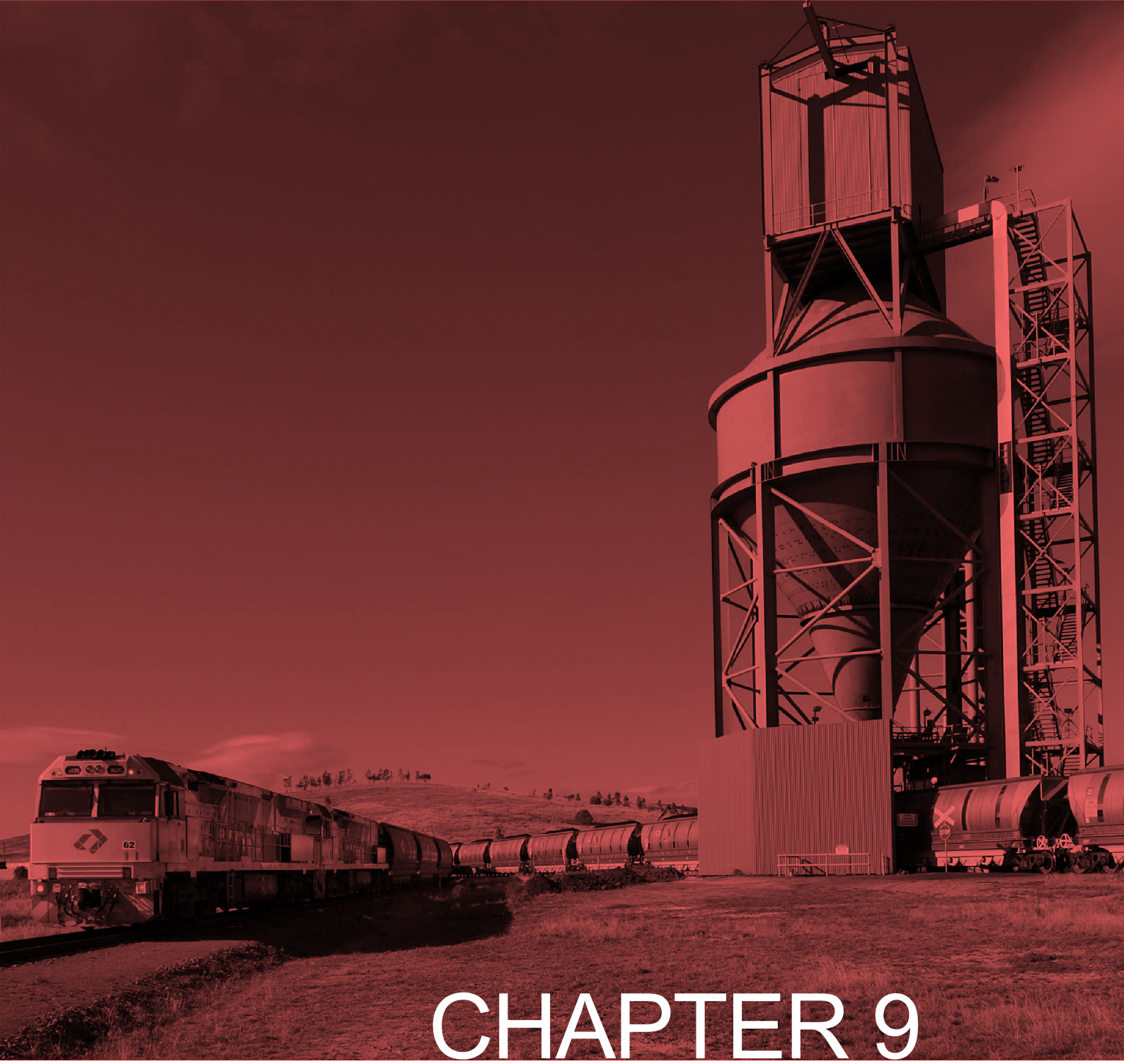
Issue	Modification 3 commitment
General	1. The Proponent will implement all practicable measures to prevent or minimise harm to the environment that may result from the construction, operation or rehabilitation of the Project. 2. CSR will apply to amend EPL 684 to reflect the project. 3. The environmental management strategy and sub plans will be amended to reflect the project.
Air Quality	4. The Proponent will prepare an Air Quality and Green House Gas Management Plan (AQGHGMP) for the project to the satisfaction of the Secretary. The AQGHGMP will outline the purpose, method and expected outcomes of the dust monitoring, and will include the following content: ▪ Dust fraction to be measured, ie TSP, PM_{10}, $PM_{2.5}$ etc. ▪ Equipment to be used to measure selected dust fraction. ▪ Frequency of the monitoring, ie sample collection schedule. ▪ Duration of the monitoring program. ▪ Location of the monitoring station/s. ▪ Standards/guidelines that are to be followed for location/construction of the monitoring station, equipment calibration, collection of samples and analysis of samples. ▪ Calibration method and schedule. ▪ Reporting procedure. ▪ Regulatory guidelines and compliance criteria. ▪ Action levels and contingency measures if pollutant concentrations approach or are likely to exceed the relevant compliance criteria. ▪ A consultation program that involves nearby agricultural producers and residents, in order to determine if the dust mitigation measures are being affective. 5. The AQGHGMP will detail measures to control dust and emissions from the Project Site including the following measures: ▪ Haul roads should be watered using water carts such that the road surface has sufficient moisture to minimise visible on-road dust generation but not so much as to cause pooling and mud/dirt track out to occur ~~▪ Haul roads to be watered at a rate equal to or greater than 2 L/m^2/hr.~~ ▪ Unloading of trucks containing raw or unusable extracted material to be controlled using water sprays/dust suppression when generating excessive visible dust. ▪ Dust from the raw material stockpile to be controlled using water sprays/dust suppression when generating excessive visible dust. ~~▪ Dust from existing stockpiles of unusable material and open pits to be controlled using water sprays with chemical additives (surfactants);~~ ▪ Completed pits to be revegetated as soon as practicable after completion of quarrying activities. ▪ Disturbed soil surfaces to be revegetated in accordance with the RMP for the Project Site. ▪ Operational practices to be reviewed to ensure 'best practice' techniques are being employed and that operational equipment is working efficiently. ~~6. A reactive dust management program will be implemented during quarrying activities. The program will form part of the AQGHGMP. The dust monitors will be located on the boundary of the site between the dust emitting activities and the most affected receptors, and alert the operators when dust levels approach or exceed criteria levels. If the dust levels reach a pre-determined warning or critical concentration and the winds are shown to be blowing from the Site towards the monitor (i.e. the site is likely to be contributing to the elevated dust levels and potentially affecting receptors), prearranged actions will be taken to minimise the Site's dust emissions. Once the dust concentrations return below the warning level, the additional mitigation measures can cease and quarrying operations return to normal. The warning or critical concentration levels will be chosen in consultation with DPIE (biodiversity and conservation) and represent levels that~~

	~~provide the Site enough time to implement mitigation measures and/or inform personnel to cease works.~~
Noise	7. The Proponent will implement all practicable measures to undertake the development in a way that minimises the noise generated. The Proponent has made the following commitments in relation to operation noise management: 8. The Proponent will conduct quarrying activities at the Project Site only between the following hours: ▪ 7.00 am to 6.00 pm Monday to Saturday. 9. The Proponent will remove overburden only between the following hours: ▪ 7.00 am to 6.00 pm Monday to Friday. ▪ 8.00 am to 1.00 pm Saturday. 10. The Proponent will operate the Brick making facility and storage yard at the Project Site 24 hours a day, Monday to Sunday. ~~11. The Proponent will conduct activities within the storage yard (including deliveries and dispatch) only between the following hours:~~ ~~▪ 6.00 am to 10.00 pm Monday to Friday.~~ ~~▪ 6.00 am to 6.00pm Saturday.~~ 12. The Proponent will receive and dispatch finished building products only between the following hours: ▪ 5.00 am to 10.00 pm Monday to Friday. ▪ 6.00 am to 6.00pm Saturday. 13. The Proponent will receive and dispatch raw material only between the following hours: ▪ 6.00 am to 10.00 pm Monday to Friday. ▪ 6.00 am to 6.00pm Saturday. 14. The Proponent will conduct sales selection/cash sales only between the following hours: ▪ 6.00 am to 6.00 pm Monday to Saturday. 15. The Proponent will operate the customer display centre only between the following hours: ▪ 8.00 am to 5.00 pm Monday to Sunday. ~~16. The Proponent will apply 5 dB(A) of noise reduction treatment to all dozers and excavators used in the quarrying operations.~~ ~~17. The Proponent will apply 5 dB(A) of attenuation treatment to the front-end loader operating as part of the brick works.~~ ~~18. The Proponent will construct an earth bund of a minimum height of 10 m along the northern and part of the western Project site boundaries, and 7m along the eastern Project Site boundary and part of the southern Project Site boundaries as shown in Figure 6 and Appendix B of the Noise Assessment Addendum Report. The earth mound will be constructed in stages as specified in Figure 6 of the Noise Assessment Addendum Report.~~ ~~19. The Proponent will remove overburden material using excavators only in pits where the use of a dozer exceeds the noise criteria.~~ ~~20. The Proponent will use smaller dozers during raw material removal stages where the predicted noise levels from larger dozers exceed the noise criteria.~~ 21. Construction works shall be limited to 7am to 6pm Monday to Friday and 8am to 1pm on Saturdays. ~~22. The Proponent will construct an earth bund of a minimum height of 10 m along the northern and part of the western Project site boundaries, and 7m along the eastern Project Site boundary and part of the southern Project Site boundaries as shown in Figure 6 and Appendix B of the Noise Assessment Addendum Report. The earth mound will be constructed in stages as specified in Figure 6 of the Noise Assessment Addendum Report.~~ ~~23. The Proponent will adopt best practicable means of controlling noise during the construction of the noise berm and will include noise mitigation measures in a construction noise and vibration management plan which will form part of the construction management plan to minimise the noise impact at sensitive receivers. This may include the work practices described below as detailed in Chapter 11 of the EA:~~ ~~24. The Proponent will apply 5 dB(A) of attenuation treatment to dozers operating as part of the noise berm construction activities.~~ ~~25. All construction activities associated with the construction of the noise berm will be subject to the standard noise and vibration mitigation measures described in Section 8.2 of the Noise Assessment Addendum Report.~~

	~~26. All construction activities associated with the construction of the noise berm will be subject to the standard noise mitigation measures described in Chapter 11 of the EA.~~ ~~27. Unforeseen noisy activities will be subject to additional mitigation measures depending on the extent of predicted or measured impacts.~~ ~~28. In the case that high impact noise activities, such as those likely to generate noise levels above LAeq 75 dB(A) or activities likely to generate noise with intermittent, impulsive, tonal or low frequency characteristics are required during the construction of the noise berm, adjacent sensitive receivers will be appropriately notified prior to works commencing and respite periods shall be implemented.~~ ~~29. The mitigation measures described in Section 8.5 of the Noise Assessment Addendum Report will be implemented in order to minimise the impact of noise exceedances from heavy vehicles (i.e. trucks and dump trucks) moving around the site.~~ 30. A construction noise management plan will be prepared and implemented during project construction. 31. The construction noise mitigation measures described in Chapter 5.5 of the preferred project noise impact assessment report (appended to the RTS) shall be implemented. ~~32. The Proponent and/or its appointed contractors will select and maintain bulk earthwork machinery as specified in Section 8.6 of the Noise Assessment Addendum Report.~~ 33. The Proponent and/or its appointed contractors will select and maintain bulk earthwork machinery as specified in the preferred project noise impact assessment report (appended to the RTS). 34. Broadband reversing alarms or other non-tonal vehicle movement and warning alarms shall be fitted to all machinery on site. The potential noise impact associated with reversing alarms shall be managed and minimised via a combination of proactive driver/operator training and operational procedures ~~as detailed in Section 8.6 of the Noise Assessment Addendum Report~~. 35. The Proponent shall implement a noise monitoring programme which would involve quarterly attended noise monitoring at a number of nearby identified receiver locations for 12 months after all Modification 3 and 4 activities are in full operation. If there are no exceedances of the project noise trigger levels during quarterly noise monitoring during the first year of monitoring then noise monitoring will cease. Additional noise monitoring would be undertaken in response to any noise complaints. ~~36. The Proponent will undertake consultation with identified nearby residential receivers (as detailed in Section 8.9 of the Noise Assessment Addendum Report) that are predicted to exceed the recommended noise criteria to inform them of the timing and duration of the work.~~ 37. The Proponent shall undertake consultation with identified Martin Road residential receivers predicted to exceed the RNP criteria and conduct further investigation of their residences (as detailed in Section 2.3.3 and 4.1 of the RTS) to determine whether they qualify for and require the 'Type 1' treatment package from RMS's (2015) *At-receiver Treatment Guideline*. 38. The Proponent will maintain a noise complaint register.
Surface Water	~~39. The Proponent will manage surface water on the Project Site in accordance with the SWMP prepared for the Project Site (ERM, 2002), including Addendum dated April 2010 (AECOM, 2010) and included as Appendix C to the EA.~~ 40. The Proponent shall manage surface water on the Project Site in accordance with the WMP prepared for the Project Site and revised for the project, including surface water management measures include in the Modification 3 EA and the RTS. 41. If during the operational phase of the quarry or on completion of the quarry operations, the proponent wishes to make use of the water from the pits/dams in the brick making process or for reuse at other premises offsite etc, a licence will be obtained from DPIE. 42. Sediment basins 4, 5 and 6 and the new basins at the raw material stockpile area and Pit 3 will be sized and operated in accordance with Landcom's (2004) *Managing Urban Stormwater: Soils & Construction.* If any of these basins are to be modified to perform additional stormwater treatment function in the future (other than sediment capture), then appropriate monitoring and design of the basins will be required at that time. In this case monitoring of discharges from the basin at Pit 3 to South Creek will be required. 43. The site WMP will be revised prior to construction of the project.

Groundwater	44. The Proponent shall prepare and implement a Groundwater Monitoring Program for the Project Site generally in accordance with the methodology provided in Chapter 11 of the 2011 EA, subject to consultation with the DPIE (water, lands and primary industry) and the satisfaction of the Director-General of the DP&I. ~~45. The Groundwater Monitoring Program shall commence at least two years prior to the commencement of extraction in proposed Pit 4.~~ 46. The Proponent shall report the results of the Groundwater Monitoring Program to the Secretary of the DPIE on an annual basis. 47. The Proponent shall implement appropriate management measures in relation to groundwater as indicated by the Monitoring Program and agreed with the Secretary. 48. A licence to authorise any groundwater monitoring installation, required as part of this project, shall be obtained from the DPIE Water prior to any drilling commencing. 49. The proponent shall implement an alluvial aquifer mapping and assessment program to inform: ▪ The definition of the boundaries of the alluvial system. ▪ Adjustment to the extent of proposed pits to avoid impacts to the alluvial aquifer. ▪ The establishment of further mitigation measures (if required) to minimise potential impacts upon the alluvial aquifer. ▪ This program will commence within 12 months of recommencing quarrying operations and the results will be reported to the Secretary of the DPIE.
Rehabilitation	~~50. The Proponent will carry out rehabilitation works at the Project Site in accordance with the RP prepared for the Project Site and included as Appendix D to the EA.~~ 51. The Proponent shall carry out rehabilitation works at the Project Site in accordance with the RMP prepared for the Project Site. 52. The Proponent will prepare a Final Landform Rehabilitation Plan in consultation with the DPIE two years prior to the completion of all approved quarrying activities.
Traffic and Transport	53. The Proponent shall manage traffic movements to and from the Project Site generally in accordance with the following: ▪ Personnel operating trucks and vehicles to and from the Project Site would be required to undertake a site-specific health and safety induction, specifying operating hours and vehicle speed limits on Martin Road. ▪ A heavy vehicle protocol would be developed for the Project Site and distributed to relevant staff and contractors during induction procedures. The protocol would deal with such issues as timing of vehicle movements, idling of vehicles, speed limits and parking. ▪ Unnecessary vehicle movements would be minimised where possible. - Deliveries would be scheduled on larger capacity 'Truck and Trailer' vehicles rather than 'Truck Only' vehicles where possible to minimise truck movements. ▪ A construction traffic management plan will be prepared and implemented to manage impacts on the road network, including the intersection, from construction vehicles. ▪ Traffic signals and road upgrades will be constructed at the Martin Road-Elizabeth Drive intersection prior to increasing heavy vehicle movements from the project above the approved heavy vehicle numbers. ▪ CSR will contribute to the upgrade and ongoing maintenance of Martin Road in accordance with the deed of agreement with LCC.
Cultural Heritage	54. The Proponent shall adopt the following measures in relation to the management of cultural heritage on the Project Site: ~~▪ Isolated find BC-01-09 would be collected prior to works commencing in Pit 5.~~ ~~▪ The location of quarry pit 5 and the noise attenuation berm would be modified so as to not encroach within 60m of Badgerys Creek.~~ ▪ The heat retainer hearth will continue to be protected by a fenced 10m exclusion zone. ▪ All Aboriginal heritage items collected during survey and test excavations will be reburied with the hearth in consultation with the RAPs. ~~▪ The location of quarry pit 5 and the noise attenuation berm would be modified so as to not encroach within 60m of Badgerys Creek.~~ ▪ Should relics be uncovered during the course of the approved works, works shall cease. In cases where historical items have been uncovered, the DPIE Heritage Branch shall be advised or should indigenous items be uncovered the National Parks and Wildlife Service shall be advised.

	▪ Workers/contractors shall be informed of their obligations under the NPW Act 1974, namely that it is illegal to disturb, damage or destroy a relic without the prior approval of the Director General of the DPIE (biodiversity and conservation). ▪ Should human remains be found in, on, or under the land during construction, the responsible party shall: - Contact the local police. - Not disturb or excavate the remains. - Immediately cease all work at the particular location. - Notify the DPIE (biodiversity and conservation) office as soon as practicable and provide any available details of the remains and their location. - Not recommence any work at the particular location until authorised in writing by the DPIE (biodiversity and conservation).
Ecology	55. The Proponent shall adopt the following measures in relation to the removal of any trees on the Project Site: ▪ The canopy of the trees to be visually inspected prior to clearing to assess for the presence of fauna. Where bird species are detected the tree is to be nudged prior to felling to encourage the fauna to vacate the tree prior to felling. Trees to be left in situ until the birds leave the canopy. ▪ Felled trees are to be left in-situ for at least 24 hours to allow fauna species to relocate. Qualified personnel are to be on hand to check for wildlife and relocate them. ▪ Felled wood is to be relocated to the remnant woodland (and not placed in piles) or chipped and used in rehabilitation areas. ▪ Should any wildlife be inadvertently injured during the proposed works, WIRES or an accredited veterinarian shall be contacted. ▪ A 60 m buffer area shall be provided along Badgerys Creek and the Badgerys Creek tributary, except where Pit 2 extends into these buffers. Rehabilitation works are to be undertaken in this area in accordance with the RMP. ▪ Five native trees shall be planted for each mature native tree that is removed. The plantings shall be located adjacent to the riparian vegetation along South Creek, Badgerys Creek and its tributary.
Waste	~~56. The Proponent will manage waste in relation to the Project in accordance with the existing WMP for the Project Site, included as Appendix M to the EA.~~ 57. The Proponent shall manage waste in relation to the Project in accordance with the existing WMP for the Project Site.
Mineral Resources	58. The proponent will provide annual production data to the water, lands and primary industries division of the Department of Planning, Industry and Environment, as and when requested.
Environmental Management	59. The Proponent shall prepare an EMS for the Project Site to provide environmental management practices and procedures to be followed during the operation of the Project. The EMS shall include, but not necessarily be limited to: ▪ Identification of statutory and other obligations that the Proponent is required to fulfil in relation to operation of the Project. ▪ A description of the roles and responsibilities for all key personnel involved in environmental management of the Project. ▪ The environmental policies and principles to be applied to the operation of the Project. ▪ Describe in general terms how the environmental performance of the Project would be monitored and managed.



CHAPTER 9

PROJECT EVALUATION AND CONCLUSION

9 PROJECT EVALUATION AND CONCLUSION

CSR is seeking to modify the Badgerys Creek Brick Making Facility's PA 10_0014 and CP 10_0033 under Section 75W of the EP&A Act to provide for:

- Refurbishment of the existing brick making facility and replacement of most of the brick making equipment, including upgrades to access and car parks; construction of a laboratory, innovation centre and weighbridge; and increase in brick production and transportation.
- General modifications such as re-commencing site operations, minor amendments in accordance with the Mining Act, increase in vehicle movements and upgrade of the Martin Road-Elizabeth Drive intersection.

The project is necessary as there are capacity and land use constraints at CSR's other Sydney brick making facilities.

Key environmental issues associated with the project identified through SEARs, government agency and community consultation were assessed by CSR, Element and technical specialists and reported on in the EA. The preparation of this RTS, has addressed all submissions on the EA with key issues focused on the consistency of the project with the strategic planning for the area (LUIIP), impacts on the Western Sydney Airport and traffic impacts.

All potential amenity impacts from the project on sensitive receivers, comprising noise, air quality and visual impacts, will be below relevant criteria or have low residual impacts. The project will not have significant impacts on biophysical aspects such as surface and ground water, biodiversity or Aboriginal heritage.

The increased traffic associated with the project will be mitigated through the upgrade of Martin Road and the signalisation of the Martin Road-Elizabeth Drive intersection. The safety of the existing intersection and the condition of Martin Road is already poor and will be improved as a result of the project.

The project is therefore considered to be in the public interest and is recommended for approval.



APPENDIX A

SUBMISSIONS MATRIX

| Stakeholder | Location | Stakeholder Type | View | Form/Letter | Environmental Community Aspect | | |



APPENDIX B

AIR QUALITY IMPACT ASSESSMENT CSR ADVANCED MANUFACTURING HUB PREFERRED PROJECT

AIR QUALITY IMPACT ASSESSMENT

CSR ADVANCED MANUFACTURING HUB

PREFERRED PROJECT

Element Environment

2 October 2019

Job Number 17030670B

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Air Quality Impact Assessment

CSR Advanced Manufacturing Hub

Preferred Project

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This report has been prepared in accordance with the scope of works between Todoroski Air Sciences Pty Ltd (TAS) and the client. TAS relies on and presumes accurate the information (or lack thereof) made available to it to conduct the work. If this is not the case, the findings of the report may change. TAS has applied the usual care and diligence of the profession prevailing at the time of preparing this report and commensurate with the information available. No other warranty or guarantee is implied in regard to the content and findings of the report. The report has been prepared exclusively for the use of the client, for the stated purpose and must be read in full. No responsibility is accepted for the use of the report or part thereof in any other context or by any third party.

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1 INTRODUCTION

The Western Sydney Planning Partnership (WSPP) provided a submission to both CSR's Advanced Manufacturing Hub modification applications (3 and 4), raising concern that the proposed modifications were inconsistent with the *Western Sydney Aerotropolis Land Use and Infrastructure Plan – Stage 1: Initial Precincts* (LUIIP).

CSR met with DPIE and WSPP on 3 July 2019 to discuss concerns raised in WSPPs submission on the consistency of the modification with the LUIIP. It was agreed in this meeting that the modifications would need to:

- discuss how and when parts of the site could be made available for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- that a 40m wide easement for the future realignment and extension of Martin Road through the site can be accommodated.

Following the 3 July meeting, CSR revisited their proposed modifications and developed a 'preferred project' which:

- reduces the extent and duration of quarrying on the site, thereby reducing the volume of virgin excavated natural material (VENM) and the duration of VENM importation required to backfill quarry pits on the site;
- removes the proposed Monier roof products manufacturing facility and solar farm;
- frees up all but a 30 hectare (Ha) portion of the 200 Ha site for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- accommodates a six lane road within a 40m wide easement for the future realignment and extension of Martin Road through the site.

CSR had an additional meeting with DPIE on 3 September 2019 to present the preferred project. DPIE requested that the response to submissions reports for modification 3 and 4 should include:

- a description of the preferred project and changes to the modification 3 and 4 project descriptions;
- a description of the changes to the impacts associated with the preferred project; and
- a response to all submissions received on the modification 3 and 4 EAs from government agencies and neighbouring landowners that are relevant to the preferred project.

Todoroski Air Sciences have previously prepared the *Air Quality Impact Assessment CSR Manufacturing HUB Modification 3* (MOD3) (**Todoroski Air Sciences, 2019a**) and the *Air Quality Impact Assessment CSR Manufacturing HUB Modification 4* (MOD4) (**Todoroski Air Sciences, 2019b**).

Todoroski Air Sciences has prepared this report for Element Environment on behalf of CSR Building Products Limited (hereafter referred to as the Proponent). It provides an assessment of the potential

air quality impacts associated with the proposed CSR Advanced Manufacturing Hub Preferred Project (hereafter referred to as the Project) located at Badgerys Creek.

The Project essentially seeks to re-commence operations at the site by extending and updating the brick manufacturing facility, extracting the remaining resource from the existing quarry pit (Pit 3) and the dewatering of existing pits and importation of VENM to backfill the existing quarry pits to natural ground level to allow for future development of this land.

To assess the potential air quality impacts associated with the Project, this report incorporates the following aspects:

- A background and description of the Project;
- An outline of the applicable criteria to assess air quality impacts from the Project;
- Review of the existing meteorological and air quality environment surrounding the Project site;
- Description of the dispersion modelling approach used to assess potential air quality impacts;
- Presentation of the predicted operational air quality levels in the surrounding environment; and,
- Discussion of the potential air quality impacts.

2 PROJECT SETTING

The Project site is located at 235 Martin Road, Badgerys Creek NSW, approximately 15 kilometres (km) west of Liverpool and covers an area of approximately 200 hectare (ha). The local land use surrounding the site is comprised of rural residences, quarrying, industrial and agricultural activities. The western boundary of the site borders the Western Sydney Airport.

Figure 2-1 presents the location of the Project and the existing sensitive receptor locations assessed as discrete receptors in this study. The nearest sensitive receptors to the Project are located along Lawson Road and Martin Road in Badgerys Creek (Receptors R5 and R9), approximately 40 and 20 metres (m) respectively to the north from the Project boundary.

Figure 2-2 presents a pseudo three-dimensional visualisation of the topography surrounding the Project location. The site topography has been shaped by historic quarrying activities and consists of pits, elevated stockpiles and flat areas. The area surrounding the Project site can be characterised as relatively flat and gently undulating in places. The terrain rises approximately 3km away from the Project site to the north east.

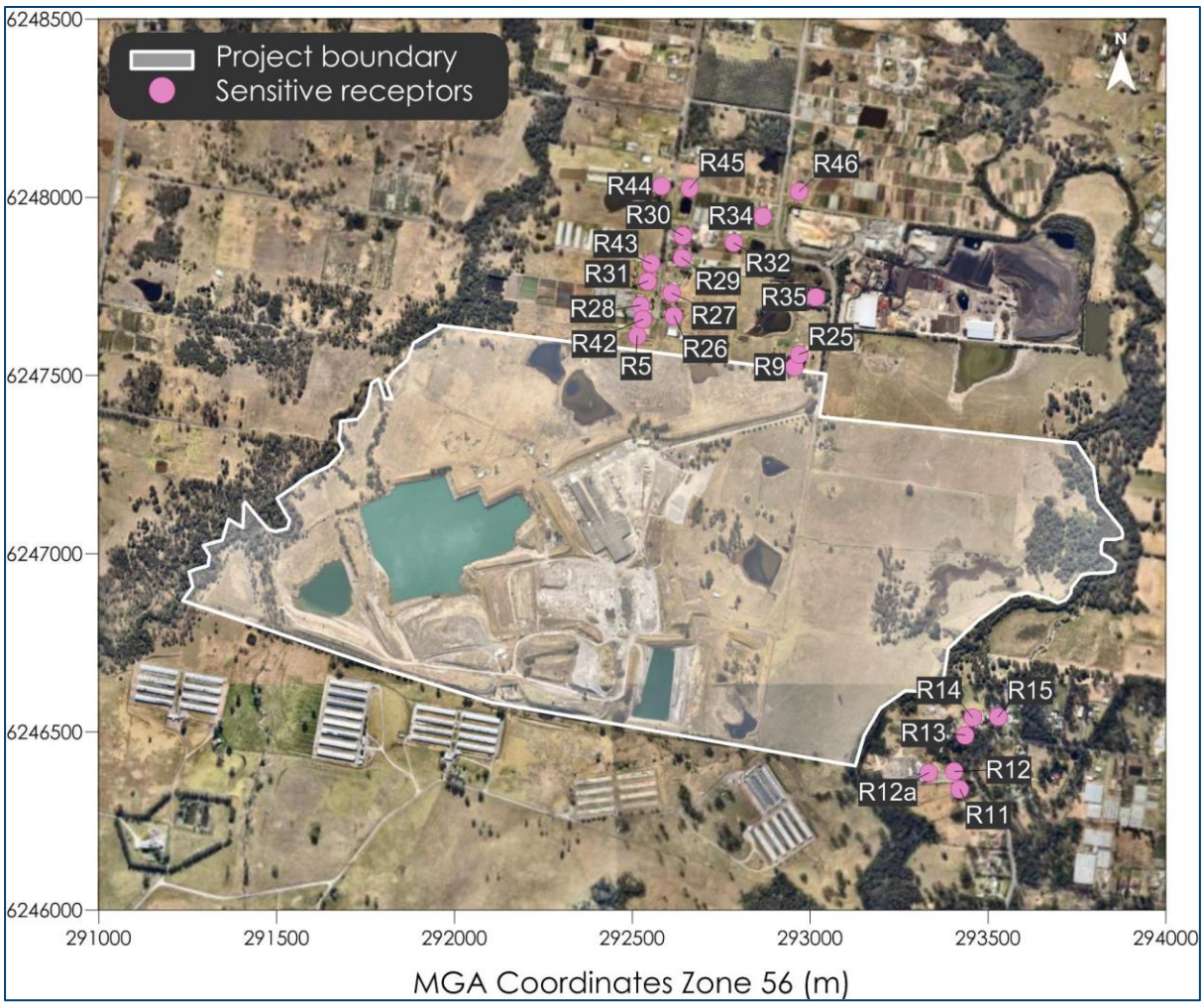


Figure 2-1: Project location

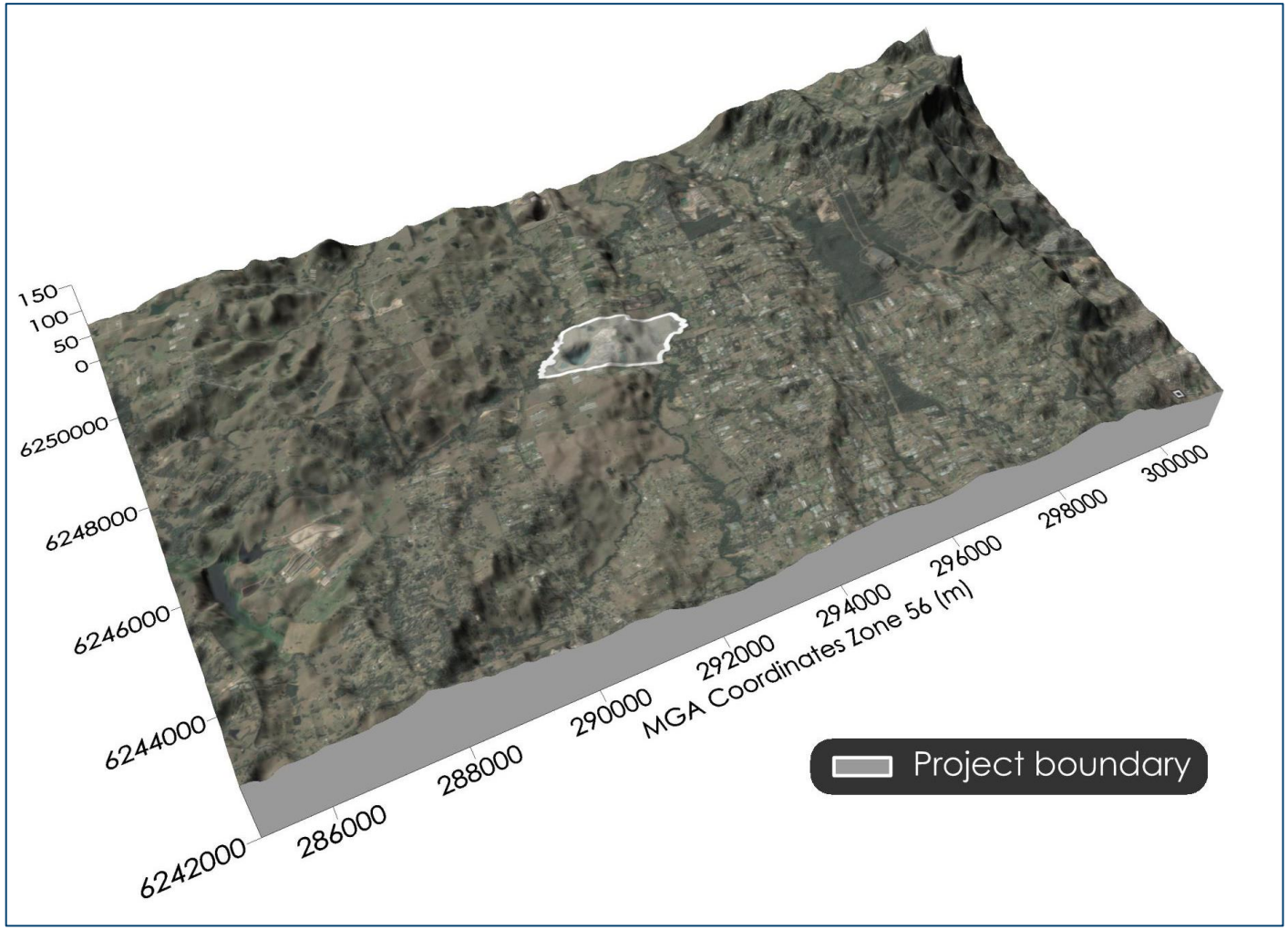


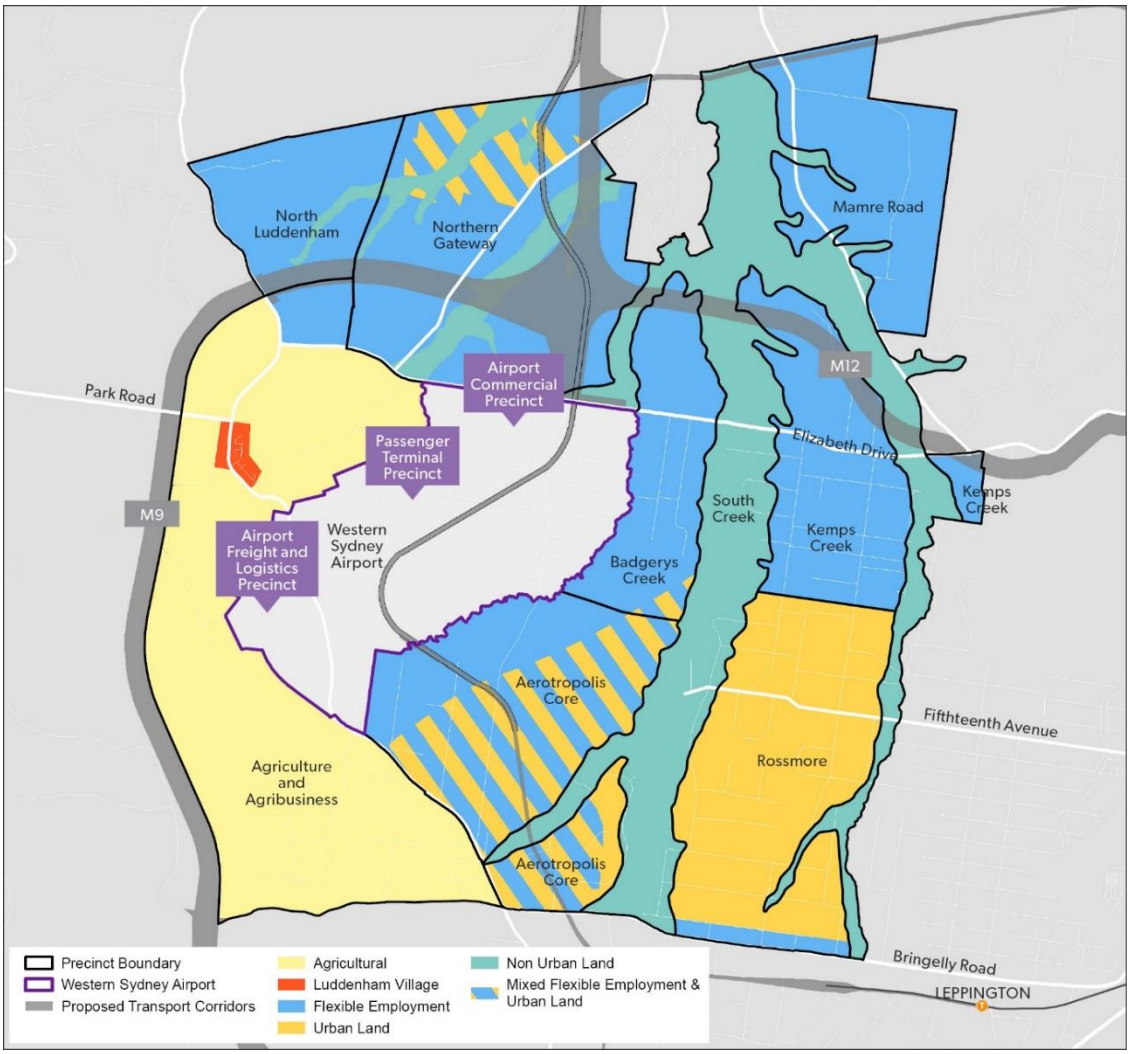
Figure 2-2: Representative view of topography surrounding the Project location

2.1 Western Sydney Aerotropolis

The Western Sydney Aerotropolis is the land encompassing the Western Sydney Airport and is designated for future development to accommodate the economic potential of the operation of the airport. The development of this area is defined in the LUIIP. **Figure 2-3** presents the Western Sydney Aerotropolis Stage 1 Structure Plan from the LUIIP.

The Project site is situated in the southern portion of the Badgerys Creek Precinct and adjoins the Western Sydney Airport western boundary. The area to the north of the Project is identified for "Flexible Employment", the area to the east is the South Creek Precinct identified as "Non Urban Land" and to the south is the Aerotropolis Core Precinct identified for a combination of "Flexible Employment" and "Mixed Flexible Employment and Urban Land".

There is potential for residential development to occur in the Aerotropolis Core immediately south of the Project and the potential for air quality impacts to arise in this area due to the Project have been considered in this assessment. The LUIIP recognises that residential development would be inappropriate in the Badgerys Creek Precinct.



Source: **NSW DP&E (2018)**

Figure 2-3: Western Sydney Aerotropolis Stage 1 Structure Plan

3 PREFERRED PROJECT DESCRIPTION

The Project is essentially comprised of four phases, with the progression through each stage allowing for more land to become available for development consistent with the objectives of the LUIIP.

The following sections provide an outline of each of the different phases of the Project.

3.1 Phase 1: Year 1-6

During Phase 1, the brick making facility is operational and produces 300,000 tonnes of bricks per annum. Clay is extracted from Pit 3 for use both in the brick making facility and also exported off-site to other facilities. Additional clay and other materials required for the brick manufacturing is imported to the site. Pit 1 and Pit 2 are dewatered and backfilled with VENM to a natural ground level during this phase and a landscaped earth bund is constructed around the raw material stockpile area.

Following the completion of this phase, the land associated with the Pit 1 and 2 area as well as additional land between the southern boundary and the raw material stockpile area is available for development. **Figure 3-1** presents indicative land use areas for Phase 1.

Key activities occurring in this phase include:

- Pit 1 and Pit 2 are backfilled using burden and imported VENM, (VENM is imported at a maximum of 200 trucks per weekday, 130 per Saturday and 100 per Sunday);
- 420,000 tonnes of clay is extracted from Pit 3 per calendar year;
- 275,000 tonnes of clay is exported from site to other PGH brick making facilities per calendar year;
- 215,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year;
- 330,000 tonnes of bricks are dispatched from site per calendar year; and
- a landscaped earth bund will be constructed along the western, southern and eastern sides of the brick making facility's raw material stockpile area by the end of year 6.

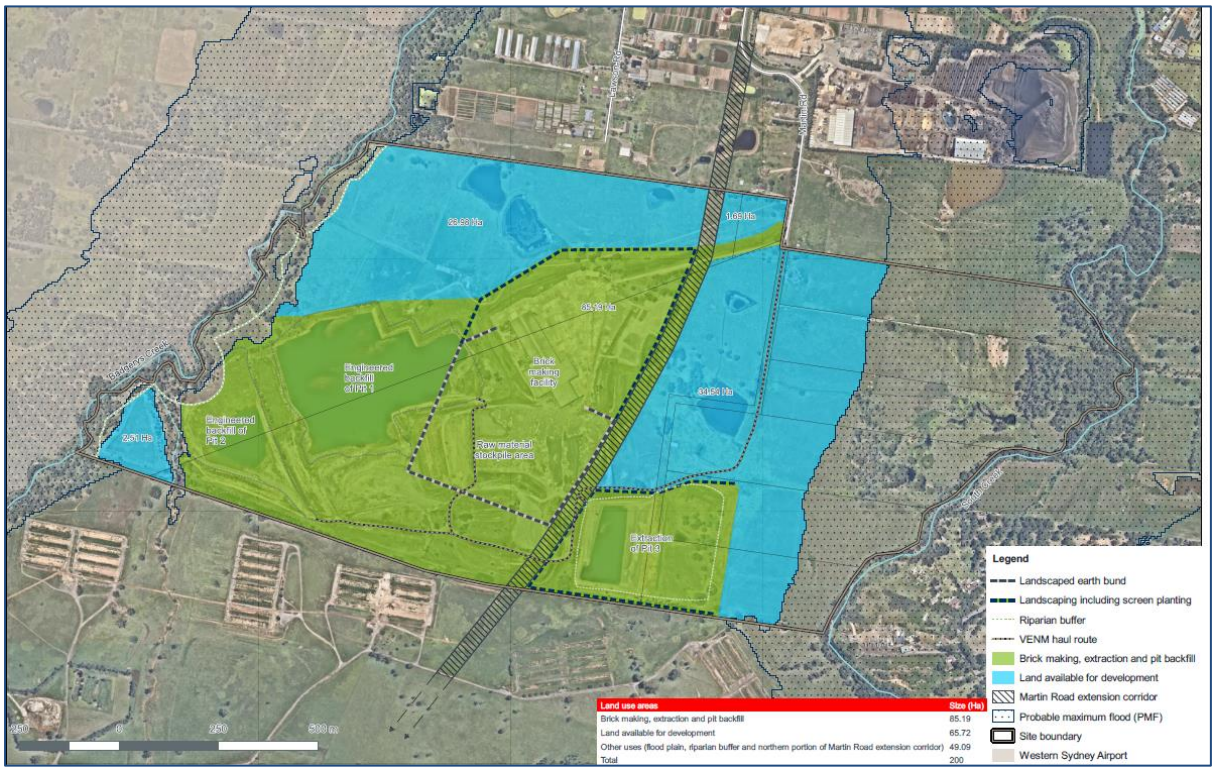


Figure 3-1: Indicative Phase 1 land use areas

3.2 Phase 2: Year 7-10

During Phase 2, the brick making facility continues to operate and produces 300,000 tonnes of bricks per annum. Clay is extracted from Pit 3 for use both in the brick making facility and also exported off-site to other facilities, with additional clay and other materials required for the brick manufacturing imported to the site. The backfilling of Pit 3 with VENM commences at the western end of the pit.

Figure 3-2 presents indicative land use areas for Phase 2. Key activities occurring in this phase include:

- Pit 3 is backfilled using imported VENM (VENM is imported at a maximum of 200 trucks per weekday, 130 per Saturday and 100 per Sunday);
- 420,000 tonnes of clay is extracted from Pit 3 per calendar year;
- 275,000 tonnes of clay is exported from site to other PGH brick making facilities per calendar year;
- 215,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year; and
- 330,000 tonnes of bricks are dispatched from site per calendar year.

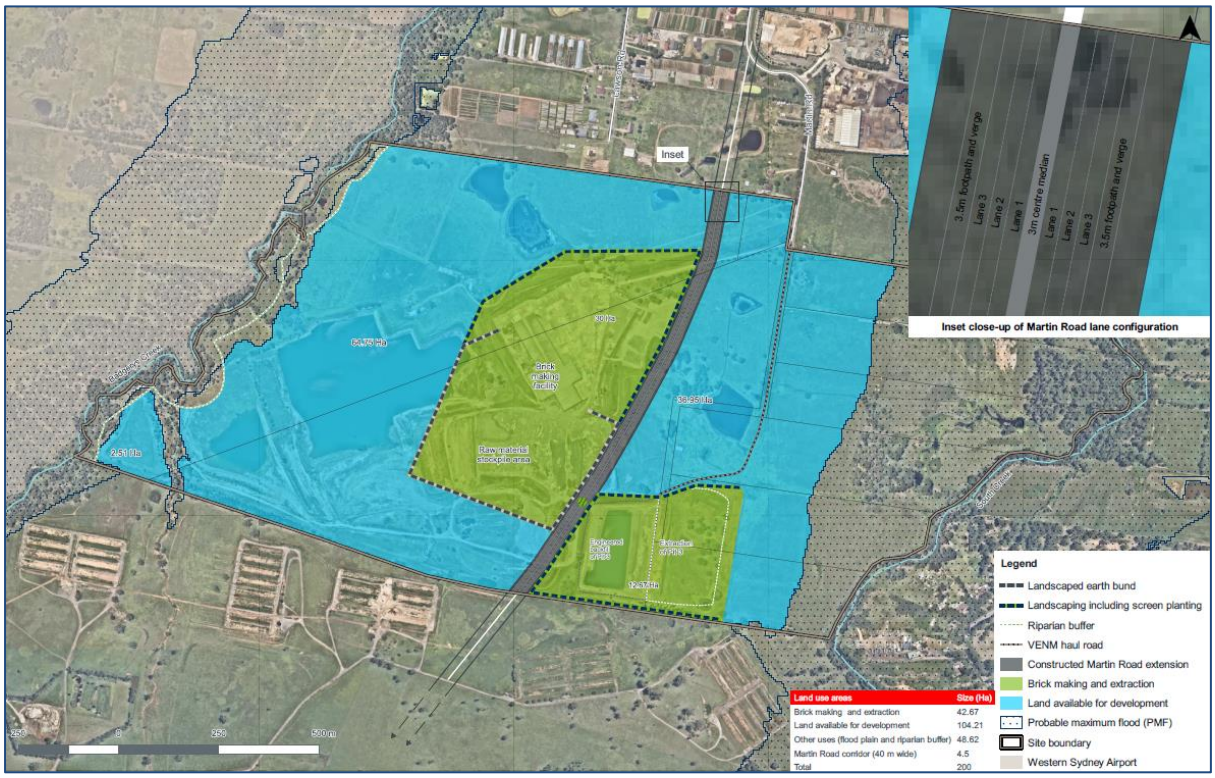


Figure 3-2: Indicative Phase 2 land use areas

3.3 Phase 3: Year 11-13

During Phase 3, the brick making facility continues to operate and produces 300,000 tonnes of bricks per annum. Clay is extracted from Pit 3 is exhausted and clay and other materials required for the brick manufacturing is imported to the site. The backfilling of Pit 3 with VENM continues to natural ground level.

Figure 3-3 presents indicative land use areas for Phase 3. Key activities occurring in this phase include:

- Pit 3 is backfilled using imported VENM (VENM is imported at a maximum of 200 trucks per weekday, 130 per Saturday and 100 per Sunday);
- 360,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year; and
- 330,000 tonnes of bricks are dispatched from site per calendar year.

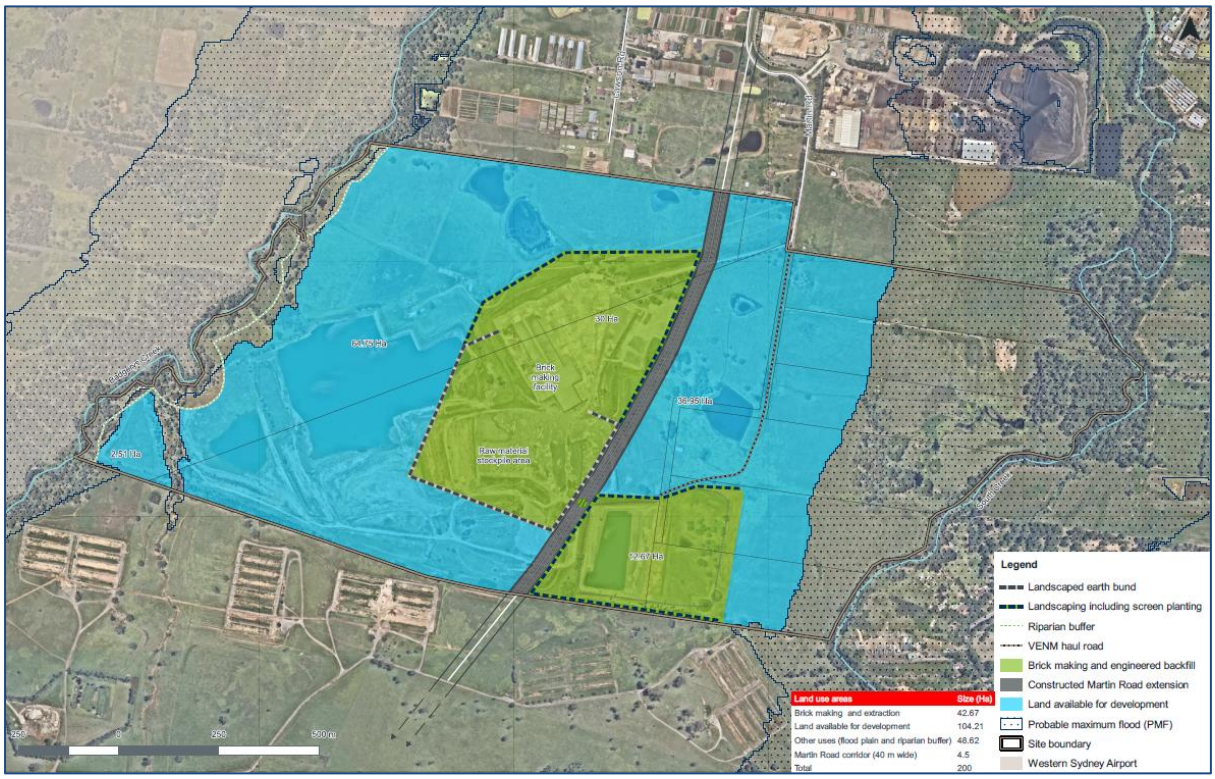


Figure 3-3: Indicative Phase 3 land use areas

3.4 Phase 4: Year 14 onwards

During Phase 4, the brick making facility continues to operate and produces 300,000 tonnes of bricks per annum. The clay and other materials required for the brick manufacturing is imported to the site.

During this phase, all extractive activities have ceased and the Pit 3 area has been backfilled and is available for development. Only the brick manufacturing facility continues to operate during this phase. **Figure 3-3** presents indicative land use areas for Phase 4. Key activities occurring in this phase include:

- 360,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year; and
- 330,000 tonnes of bricks are dispatched from site per calendar year.

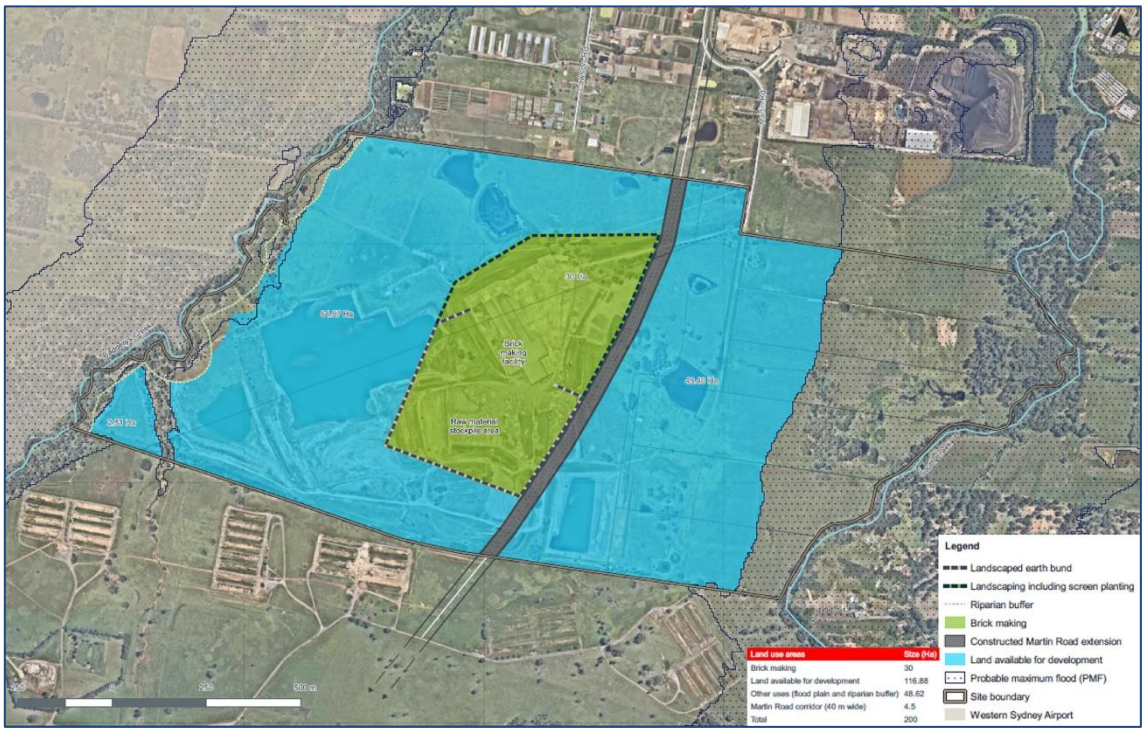


Figure 3-4: Indicative Phase 4 land use areas

3.5 Operating hours

A comparison of the existing approved operating hours for the site and the proposed Project operating hours are outlined in **Table 3-1**.

Table 3-1: Comparison of hours of operation for the approved and proposed Project

Activity	Existing Project Approval	Preferred Project	Variance to Approved Project
Quarrying operations (excluding removal of overburden, truck arrival, loading and dispatch)	Monday-Saturday 7:00am to 6:00pm Sunday and public holidays None	Monday-Saturday 7:00am to 6:00pm Sunday and public holidays None	No change
Removal of overburden and construction of noise bunds	Monday-Friday 7:00am to 6:00pm Saturday 8:00am to 1:00pm Sunday and public holidays None	Monday-Friday 7:00am to 6:00pm Saturday 8:00am to 1:00pm Sunday and public holidays None	No change
Brick making facility and storage yard	Monday-Sunday 24 hours	Monday-Sunday 24 hours	No change
Truck arrival and dispatch (excluding finished building products i.e. raw materials)	Monday-Friday 6:00am to 10:00pm Saturday 6:00am to 6:00pm	Monday-Friday 6:00am to 10:00pm Saturday 6:00am to 6:00pm	No change

Activity	Existing Project Approval	Preferred Project	Variance to Approved Project
	Sunday and public holidays None	Sunday and public holidays None	
Truck arrival and dispatch (finished building products only)	Monday-Saturday 7:00am to 10:00pm Sunday and public holidays None	Monday-Friday 5:00am to 10:00pm Saturday 6:00am to 6:00pm Sunday and public holidays None	Deliveries and dispatch to be extended by two hours earlier in the morning on a week day (Monday to Friday) and one hour earlier in the morning on a Saturday
Truck arrival and dispatch (VENM Importation)	Nil	Monday-Sunday 7:00am to 6:00pm	Additional operating hours for VENM importation
Sales Selection / Cash Sales	Nil	Monday-Saturday 6:00am to 6:00pm Sunday and public holidays None	Additional operating hours for sales selection and cash sales activities for finished brick products
Customer Display Centre	Nil	Monday-Sunday 8:00am to 5:00pm Public Holidays None	Additional operating hours for finished brick products customer display centre

4 AIR QUALITY CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sub-sections below identify the potential air emissions generated by the Project and the applicable air quality criteria.

4.1 NSW EPA impact assessment criteria

Table 4-1 summarises the air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2017**).

The air quality goals for total impact relate to the total pollutant burden in the air and not just the pollutants from the Project. Consideration of background pollutant levels needs to be made when using these goals to assess potential impacts.

Table 4-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Percentile	Impact	Criterion		Application
TSP	Annual	100	Total	90 µg/m³		Sensitive receptors
PM_{10}	Annual	100	Total	25 µg/m³		Sensitive receptors
	24 hour	100	Total	50 µg/m³		Sensitive receptors
$PM_{2.5}$	Annual	100	Total	8 µg/m³		Sensitive receptors
	24 hour	100	Total	25 µg/m³		Sensitive receptors
Deposited dust	Annual	100	Incremental	2 g/m²/month		Sensitive receptors
		100	Total	4 g/m²/month		Sensitive receptors
Sulfur dioxide (SO_2)	10 minutes	100	Total	712 µg/m³		Sensitive receptors
	1 hour	100	Total	570 µg/m³		Sensitive receptors
	24 hour	100	Total	228 µg/m³		Sensitive receptors
	Annual	100	Total	60 µg/m³		Sensitive receptors
Nitrogen dioxide (NO_2)	1 hour	100	Total	246 µg/m³		Sensitive receptors
	Annual	100	Total	62 µg/m³		Sensitive receptors
Hydrogen fluoride (HF)	90 days	100	Total	[1]0.5 µg/m³	[2]0.25 µg/m³	Sensitive receptors
	30 days	100	Total	[1]0.84 µg/m³	[2]0.4 µg/m³	Sensitive receptors
	7 days	100	Total	[1]1.7 µg/m³	[2]0.8 µg/m³	Sensitive receptors
	24 hours	100	Total	[1]2.9 µg/m³	[2]1.5 µg/m³	Sensitive receptors
Chlorine	1 hour	99.9	Incremental	0.05 mg/m³		Boundary
Sulfur trioxide (SO_3) as sulfuric acid (H_2SO_4)	1 hour	99.9	Incremental	0.018 mg/m³		Boundary
Odour	1 hour peak to mean corrected	99	Incremental	2 OU		Sensitive receptors

Source: NSW EPA, 2017

[1] General land use, which includes all areas other than specialised land use

[2] Specialised land use, which includes all areas with vegetation sensitive to fluoride, such as grape vines and stone fruit

µg/m³ = micrograms per cubic metre

g/m²/month = grams per square metre per month

4.2 NSW Voluntary Land Acquisition and Mitigation Policy

Part of the NSW Voluntary Land Acquisition and Mitigation Policy (VLAMP) dated September 2018 describes the NSW Government's policy for voluntary mitigation and land acquisition to address particulate matter impacts from state significant mining, petroleum and extractive industry developments.

Voluntary mitigation rights may apply per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 4-2** at any residence on privately owned land or workplace. [1]

Table 4-2: Particulate matter mitigation criteria

Pollutant	Averaging period	Mitigation criterion		Impact type
$PM_{2.5}$	Annual	8µg/m³*		Human health
$PM_{2.5}$	24 hour	25µg/m³**		Human health
PM_{10}	Annual	25µg/m³*		Human health
PM_{10}	24 hour	50µg/m³**		Human health
TSP	Annual	90µg/m³*		Amenity
Deposited dust	Annual	2g/m²/month**	4g/m²/month*	Amenity

Source: NSW Government (2018b)

*Cumulative impact (i.e. increase in concentration due to the development plus background concentrations due to all other sources).

**Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.

Voluntary acquisition rights may apply per the VLAMP where, even with best practice management, the development contributes to exceedances of the criteria in **Table 4-3** at any residence on privately owned land, workplace or on more than 25 per cent of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls (vacant land).

Table 4-3: Particulate matter acquisition criteria

Pollutant	Averaging period	Acquisition criterion		Impact type
$PM_{2.5}$	Annual	8µg/m³*		Human health
$PM_{2.5}$	24 hour	25µg/m³**		Human health
PM_{10}	Annual	25µg/m³*		Human health
PM_{10}	24-hour	50µg/m³**		Human health
TSP	Annual	90µg/m³*		Amenity
Deposited dust	Annual	2g/m²/month**	4g/m²/month*	Amenity

Source: NSW Government (2018b)

*Cumulative impact (i.e. increase in concentration due to the development plus background concentrations due to all other sources).

**Incremental impact (i.e. increase in concentrations due to the development alone), with up to five allowable exceedances of the criteria over the life of the development.

4.3 Protection of the Environment Operations Act 1997

The general obligations of the *Protection of the Environment Operations Act, 1997* and the Regulations made under the Act (namely the *Protection of the Environment Operations (Clean Air) Regulation, 2010*) would be followed at the Project. The Project would operate in accordance with the relevant regulatory framework for air quality to ensure compliance with this legislation.

[1] Where any exceedance would be unreasonably detrimental to workers health or carrying out of the business.

5 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the Project.

5.1 Local climatic conditions

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Badgerys Creek Automatic Weather Station (AWS) (Site No. 067108) were used to characterise the local climate in the proximity of the Project. The Badgerys Creek AWS is located approximately 1.5km west of the Project.

Table 5-1 and **Figure 5-1** present a summary of data from the Badgerys Creek station collected over an approximate 14 to 23 year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 30.1 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 4.1°C.

Rainfall exhibits variability and seasonal fluctuations across the year. The data indicate that February is the wettest month with an average rainfall of 98.5 millimetres (mm) over 7.3 days and July is the driest month with an average rainfall of 22.6mm over 3.7 days.

Humidity levels exhibit variability and seasonal flux across the year. Mean 9am humidity levels range from 62 per cent (%) in October to 84% in June. Mean 3pm humidity levels range from 44% in August and September to 56% in June.

Mean 9am wind speeds range from 8.4 kilometres per hour (km/h) in March to 11.8km/h in October. Mean 3pm wind speeds range from 13.7km/h in June to 19.9km/h in October.

Table 5-1: Monthly climate statistics summary – Badgerys Creek AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	30.1	28.8	26.9	24.1	20.8	17.8	17.5	19.2	22.6	24.9	26.4	28.5	24.0
Mean min. temp. (°C)	17.1	17.1	15.3	11.5	7.7	5.6	4.1	4.7	7.7	10.5	13.5	15.5	10.9
Rainfall													
Rainfall (mm)	79.4	98.5	81.3	49.4	37.0	61.4	22.6	35.4	33.2	53.8	69.0	57.1	680.9
No. of rain days (≥1mm)	7.0	7.3	7.4	5.7	3.8	5.5	3.7	3.4	4.7	5.7	7.0	6.6	67.8
9am conditions													
Mean temp. (°C)	21.8	21.2	19.0	17.3	13.7	10.5	9.8	11.7	15.5	18.1	19.1	20.9	16.6
Mean R.H. (%)	73	80	83	76	80	84	81	72	66	62	69	69	75
Mean W.S. (km/h)	9.4	8.7	8.4	9.8	9.6	9.1	9.6	10.6	11.7	11.8	11.0	9.8	10.0
3pm conditions													
Mean temp. (°C)	28.1	26.9	25.3	22.4	19.4	16.7	16.1	17.9	21.0	22.8	24.3	26.5	22.3
Mean R.H. (%)	49	55	55	52	53	56	50	44	44	45	50	48	50
Mean W.S. (km/h)	17.9	15.9	14.5	14.4	13.9	13.7	15.4	17.8	19.2	19.9	18.9	18.5	16.7

Source: **Bureau of Meteorology, 2018 (accessed November 2018)**

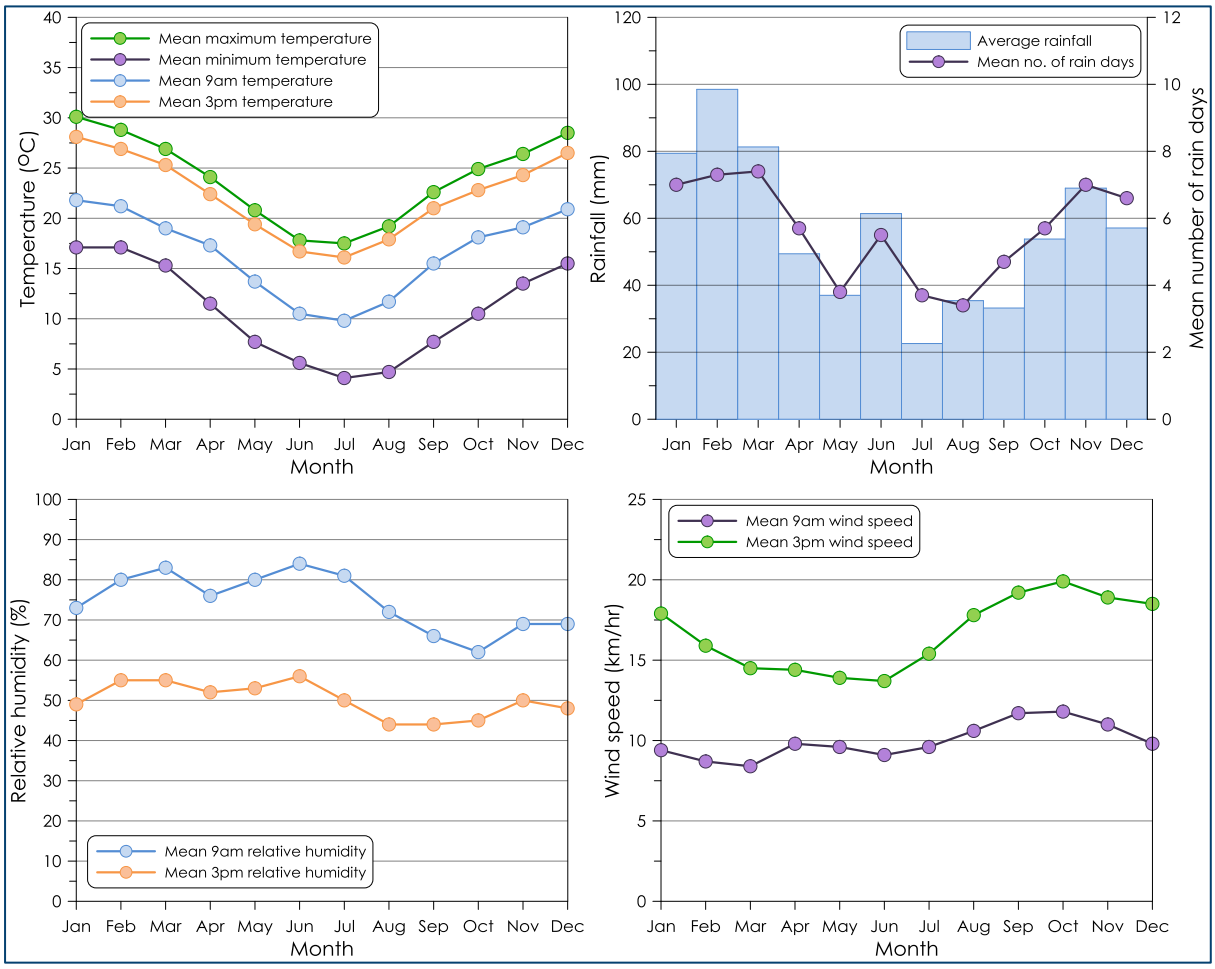


Figure 5-1: Monthly climate statistics summary – Badgerys Creek AWS

5.2 Local meteorological conditions

The Badgerys Creek (AWS) has been used to represent local meteorological conditions that would be experienced at the Project site. The Badgerys Creek AWS is located approximately 1.5km west of the Project. Annual and seasonal windroses prepared from data collected for the 2014 calendar year are presented in **Figure 5-2**. The 2014 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area, as outlined in **Appendix A**.

Analysis of the windroses shows that on an annual basis, winds are predominately from the southwest sector. During summer there is are high percentage of winds from the north-northeast to east-south-east sectors and southwest. In autumn, winter and spring prevailing winds the highest percentage of winds come from the southwest and west-southwest.

The windroses show a wind distribution pattern that is typical of the expected patterns for this area considering the location of the station in relation to local terrain features.



Figure 5-2: Annual and seasonal windroses for Badgerys Creek AWS (2014)

5.3 Ambient air quality

The main sources of air pollutants in the area surrounding the Project include emissions from local anthropogenic activities (such as motor vehicle exhaust and domestic wood heaters), industrial activities and agricultural activities.

This section reviews the available ambient air quality monitoring data sourced from on-site monitoring and other available ambient air quality monitors operated by the NSW Office of Environment and Heritage (OEH) and the Western Sydney Airport.

5.3.1 Onsite Monitoring

A high volume air sampler (HVAS) is operated on-site to measure ambient 24-hour average PM_{10} levels. **Figure 5-3** provides a summary of the available measured 24-hour average PM_{10} data from October 2016 to March 2018.

A review of **Figure 5-3** maximum 24-hour average PM_{10} concentrations recorded at the station found concentrations to be below the relevant criterion of 50µg/m³ during the review period.

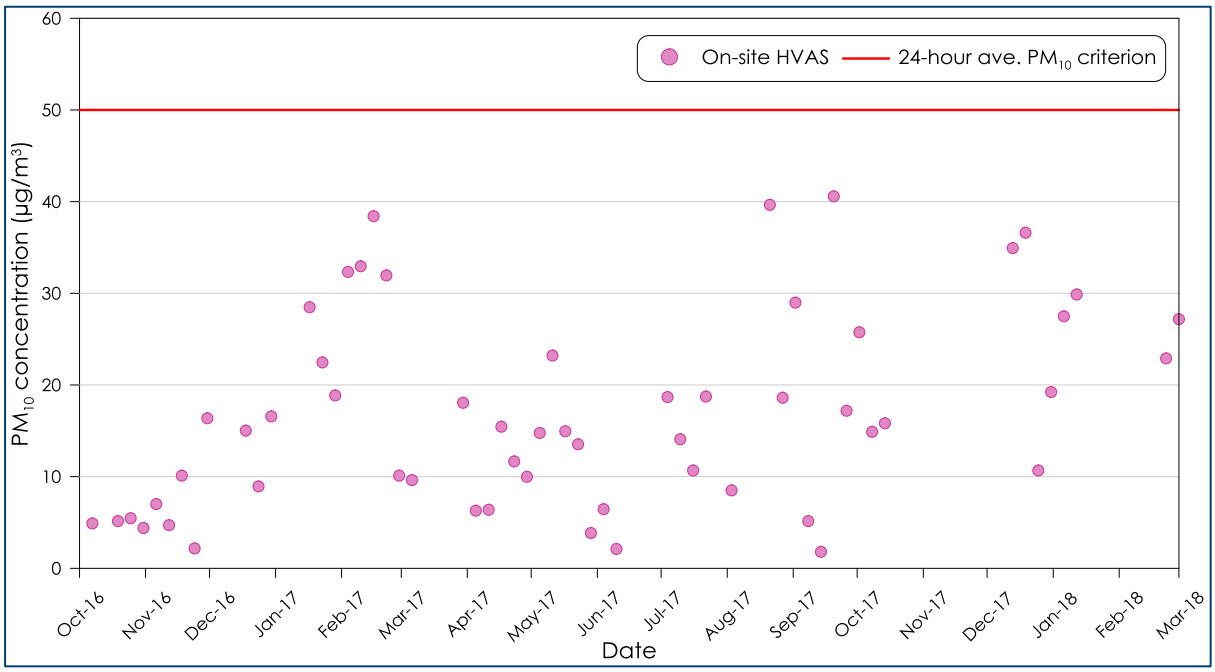


Figure 5-3: 24-hour average PM_{10} monitoring data - HVAS

The site also operates four dust deposited monitors and **Table 5-2** provides a summary of the measured annual average dust deposition data for 2017. The results indicate that dust deposition levels are below the relevant criterion of 4g/m²/month and indicate dust deposition levels are generally good in the vicinity of the Project.

Table 5-2: Summary of measured dust deposition

ID	Location	Annual average insoluble solids (g/m²/month)
D1	Martin Rd near resident	0.9
D2	Hay shed	1.5
D3	Bundwall near Inghams	1.4

ID	Location	Annual average insoluble solids (g/m²/month)
D4	Old house	1.7

5.3.2 NSW OEH Monitoring

The available PM_{10} monitoring data from the nearest air quality monitors operated by the NSW OEH have been reviewed and are summarised in **Table 5-3**. Recorded 24-hour average PM_{10} concentrations are presented graphically in **Figure 5-4**.

A review of **Table 5-3** indicates that the annual average PM_{10} concentrations at Bringelly, St Marys and Liverpool were below the relevant criterion of 25µg/m³. The maximum 24-hour average PM_{10} concentrations recorded at these stations exceed the relevant criterion of 50µg/m³ at times during the review period.

Examination of the potential cause of the elevated PM_{10} levels indicates that they typically coincide with regional dust events and bushfires which affect a wide area, for example as indicated by other air quality monitoring stations in the surrounding region also recording elevated levels on such days. At other times, potential sources such as local agricultural sources, industrial activity and other sources may have contributed to periods of elevated PM_{10} levels.

Table 5-3: Summary of PM_{10} levels from NSW OEH monitoring (µg/m³)

Year	Bringelly	St Marys	Liverpool
Annual average			
2013	17.0	16	21
2014	16.6	16.7	19.1
2015	15.8	15	18.5
2016	16.9	16.1	19.6
2017	19.8	16.2	20.8
Maximum 24-hour average			
2013	97.2	93.0	98.5
2014	42.6	45.0	40.8
2015	57.0	53.0	68.6
2016	61.6	100.2	68.7
2017	83.7	49.8	74.0
Number of days above criterion (50 µg/m³)			
2013	3	2	3
2014	0	0	0
2015	1	1	1
2016	3	3	3
2017	6	0	2

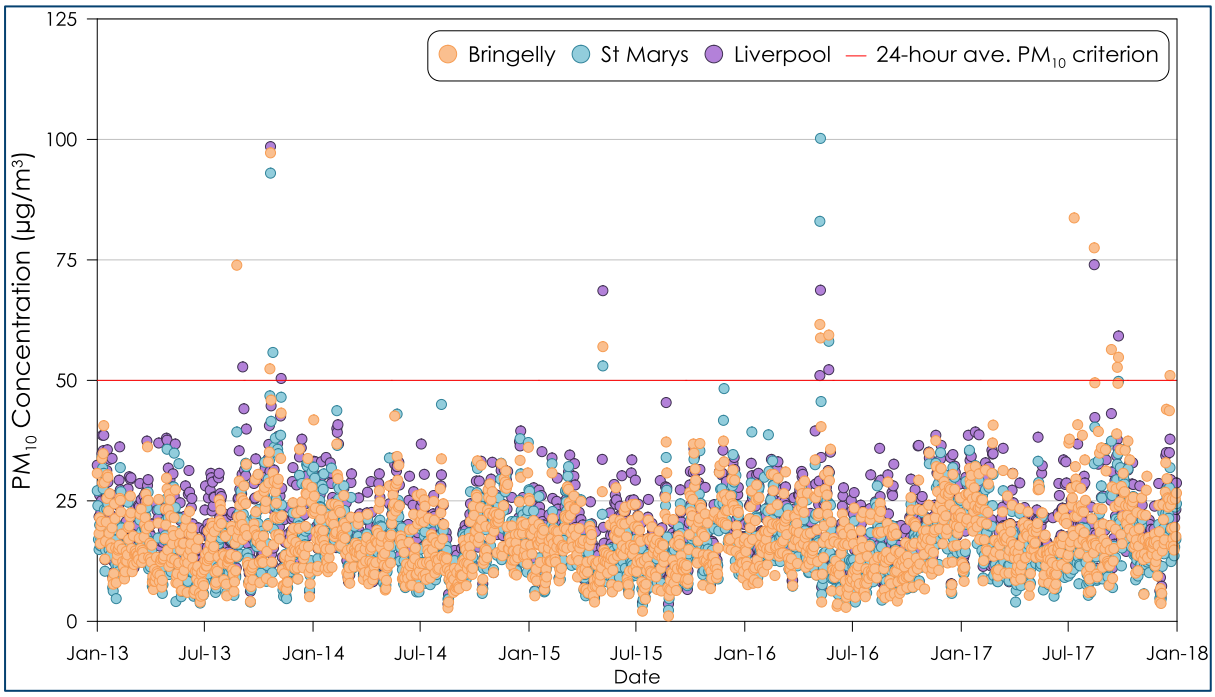


Figure 5-4: 24-hour average PM_{10} concentrations – NSW OEH

A summary of the available $PM_{2.5}$ monitoring data from the NSW OEH monitoring stations is presented in **Table 5-4**. Recorded 24-hour average $PM_{2.5}$ concentrations are presented graphically in **Figure 5-5**.

A review of **Table 5-4** indicates that the annual average $PM_{2.5}$ concentrations at Liverpool were above the relevant criterion of 8µg/m³ for the period reviewed. The annual average levels of $PM_{2.5}$ concentrations for the Bringelly and St Marys monitors were below the relevant criterion of 8µg/m³ for the 2017 period.

The maximum 24-hour average $PM_{2.5}$ concentrations recorded at the monitoring stations were found to exceed the relevant criterion of 25µg/m³ at times during the review period.

Recorded 24-hour average $PM_{2.5}$ concentrations are presented graphically in **Figure 5-5**. A seasonal trend in 24-hour average $PM_{2.5}$ concentrations for the monitoring stations can be seen in **Figure 5-5** with elevated levels occurring in the cooler months. This is opposite to the seasonal trend for PM_{10} concentrations which has elevated levels during the warmer months.

Table 5-4: Summary of $PM_{2.5}$ levels from NSW OEH monitoring (µg/m³)

Year	Bringelly	St Marys	Liverpool
Annual average			
2013	-	-	9.4
2014	-	-	8.6
2015	-	-	8.5
2016	-	-	8.7
2017	7.5	7	8.9
Maximum 24-hour average			
2013	-	-	73.8
2014	-	-	24.3
2015	-	-	32.2
2016	21.6	93.2	50.8
2017	52.5	38.2	56.4
Number of days above criterion (25 µg/m³)			
2013	-	-	2
2014	-	-	0
2015	-	-	2
2016	0	5	4
2017	2	3	3

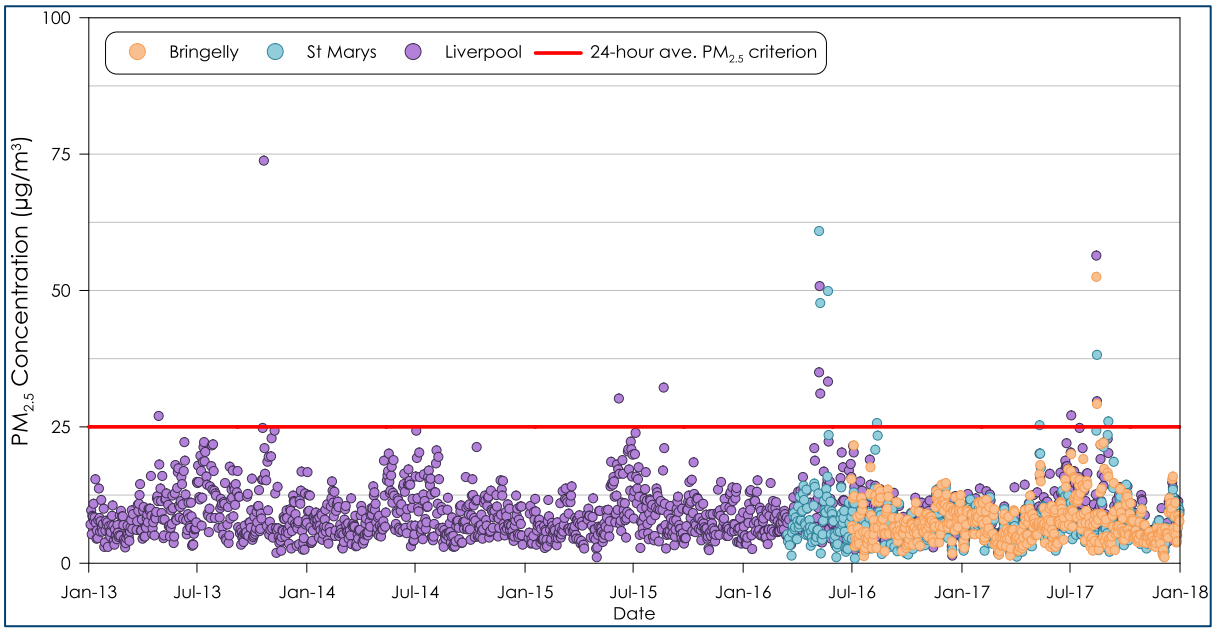


Figure 5-5: 24-hour average $PM_{2.5}$ concentrations – NSW OEH

A summary of the available SO_2 monitoring data from the NSW OEH monitoring stations is presented in **Table 5-5**. A review of **Table 5-5** indicates that the annual, 24-hour and 1-hour average SO_2 concentrations at the monitoring stations were below the relevant criterion of 60µg/m^3, 228µg/m^3 and 570µg/m^3, respectively.

Table 5-5: Summary of SO_2 levels from NSW OEH monitoring (µg/m^3)

Year	Bringelly	Liverpool
Annual average		
2013	0.7	-
2014	0.7	-
2015	0.4	-
2016	0.6	-
2017	0.7	2.9
Maximum 24-hour average		
2013	5.7	-
2014	8.6	-
2015	2.9	-
2016	5.7	5.7
2017	5.7	8.6
Maximum 1-hour average		
2013	31.5	-
2014	25.7	-
2015	20.0	-
2016	17.2	20.0
2017	25.7	31.5

A summary of the available NO_2 monitoring data from the NSW OEH monitoring stations is presented **Table 5-6**. A review of **Table 5-6** indicates that the annual and 1-hour average NO_2 concentrations at the monitoring stations were below the relevant criterion of 62µg/m^3 and 246µg/m^3, respectively.

Table 5-6: Summary of NO_2 levels from NSW OEH monitoring (µg/m^3)

Year	Bringelly	St Marys	Liverpool
Annual average			
2013	10.3	10.3	22.6
2014	8.2	8.2	20.5
2015	8.2	8.2	20.5
2016	10.3	8.2	24.6
2017	10.3	8.2	24.6
Maximum 1-hour average			
2013	75.9	75.9	114.8
2014	51.3	63.6	90.2
2015	55.4	65.6	123.0
2016	61.5	86.1	96.4
2017	73.8	75.9	131.2

5.3.3 Western Sydney Airport Monitoring

Ambient PM_{10} and $PM_{2.5}$ baseline monitoring has been undertaken in the vicinity of the site for the Western Sydney Airport using a Dust Master Pro 7200 real time particle counter. **Figure 5-6** presents the Western Sydney Airport baseline monitoring locations.

The PM_{10} and $PM_{2.5}$ baseline monitoring data have been obtained from various *Western Sydney Airport – air quality and noise monitoring* reports (**GHD 2017a, 2017b, 2017c, 2018a, 2018b, 2018c** and **2018d**).

Recorded 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented graphically in **Figure 5-7** and **Figure 5-8**, respectively. The graphs indicate that the 24-hour average PM_{10} and $PM_{2.5}$ concentrations exceed the relevant criterion on occasion for the Northern, Southern and Western monitoring sites during the review period. The Eastern monitoring site is closest to the Project and indicates much lower levels compared to the other monitoring sites.

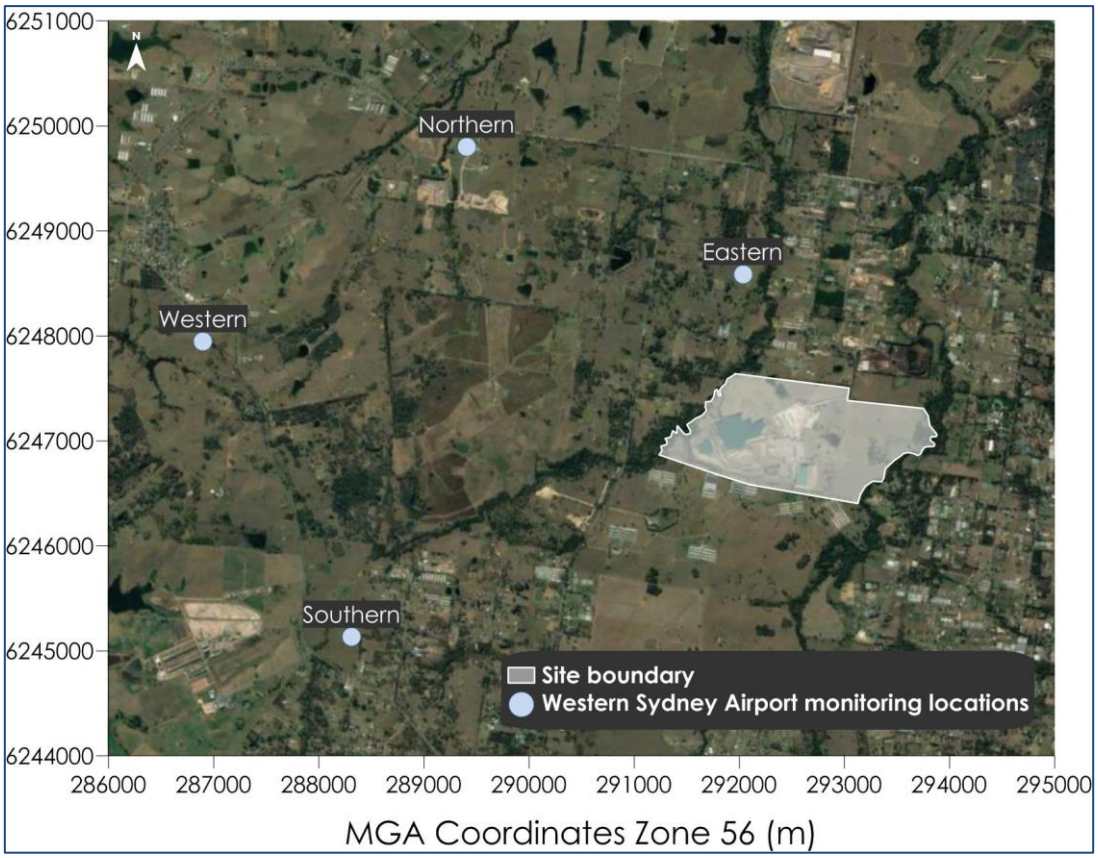


Figure 5-6: Western Sydney Airport baseline monitoring locations

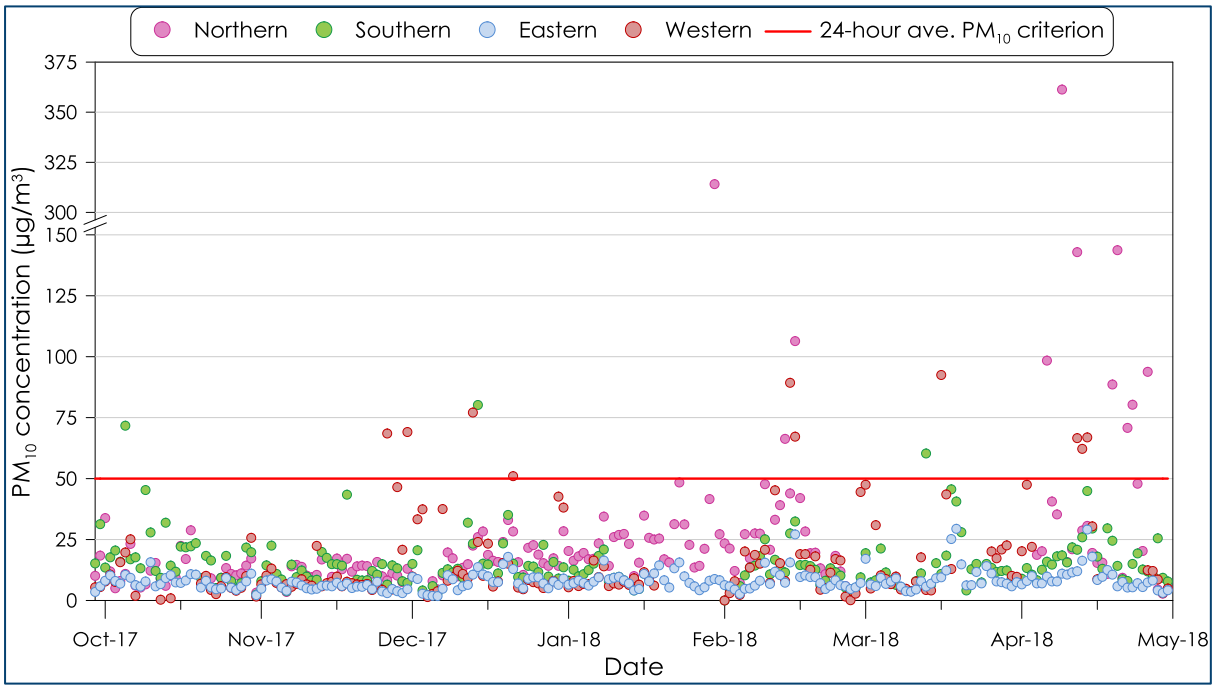


Figure 5-7: Western Sydney Airport baseline 24-hour PM_{10} monitoring data

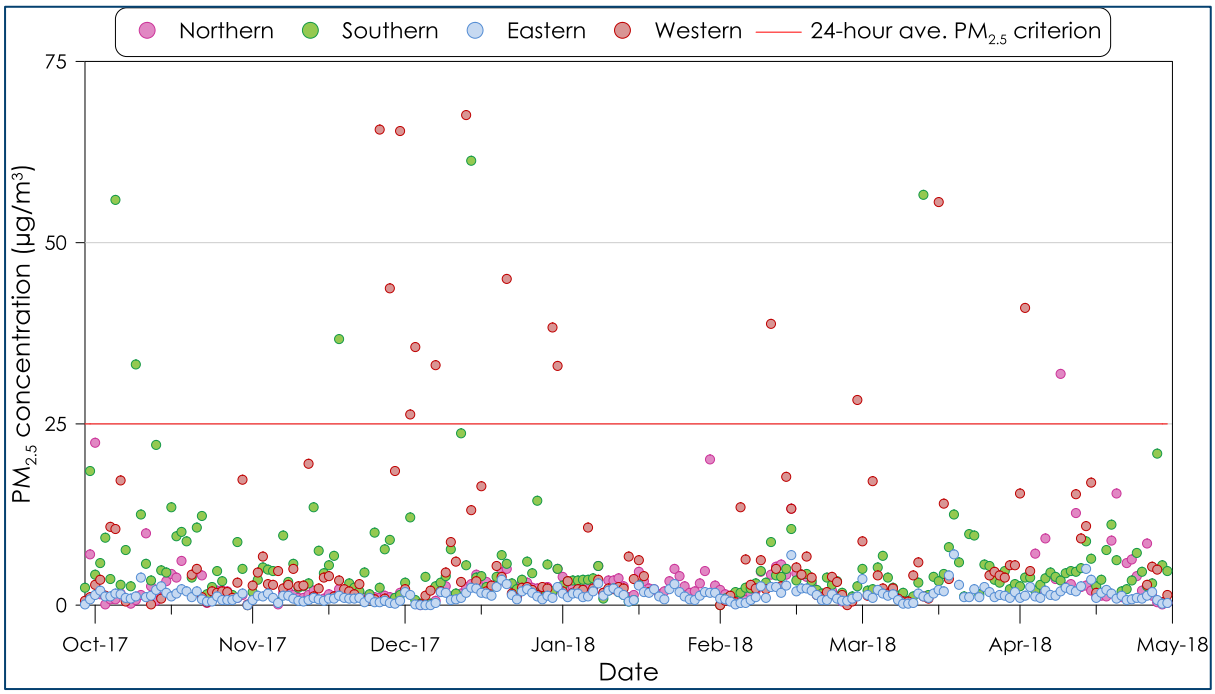


Figure 5-8: Western Sydney Airport baseline 24-hour $PM_{2.5}$ monitoring data

5.3.4 Estimated background air quality levels

In correlation with the meteorological data set used, the 2014 calendar year air quality monitoring data were selected to represent background concentrations at the Project site.

The NSW OEH Bringelly monitoring station, located approximately 1.7km southeast of the Project is considered generally most representative of the background levels in the vicinity of the site for the 2014

calendar year. We note that the measured HVAS data and Western Sydney Airport Eastern monitor data are lower than the NSW OEH Bringelly levels over the relevant monitoring periods. Thus the use of the NSW OEH monitoring data provide a conservative estimate of background levels in the vicinity of the Project site.

In the absence of available data, estimates of the annual average background TSP and deposited dust concentrations have be determined from a relationship between $PM_{10,}$ TSP and deposited dust concentrations and the measured PM_{10} levels.

This relationship assumes that an annual average PM_{10} concentration of 25µg/m^3 corresponds to a TSP concentration of 90µg/m^3 and a dust deposition value of 4g/m^2/month. This assumption is based on the NSW EPA air quality impact criteria.

Applying this relationship with the applied annual average PM_{10} concentration of 16.6µg/m^3 indicates an approximate annual average TSP concentration and deposition value of 59.8µg/m^3 and 2.7g/m^2/month, respectively.

We note that the NSW OEH Bringelly and St Marys monitoring stations did not record $PM_{2.5}$ data in the 2014 calendar year, however have available data for the 2017 calendar year. The NSW OEH Liverpool site has data for both periods, however due to differences in local land use and proximity to local sources is not considered to be suitably representative with regard to background $PM_{2.5}$ concentrations for the Project site.

To estimate background $PM_{2.5}$ concentrations for the Project site, we assumed the ratio of the average level at the Bringelly and St Marys monitoring stations during 2017 to the Liverpool monitoring station would be similar for the 2014 period. This results in an estimated background $PM_{2.5}$ concentration of 7µg/m^3.

A summary of the background concentrations applied in this assessment are outlined in **Table 5-7.**

Table 5-7: Summary of background pollutant concentrations

Pollutant	Averaging Period	Units	Concentration
TSP	Annual	µg/m³	59.8
PM_{10}	Annual	µg/m³	16.6
	24 Hour	µg/m³	42.6
$PM_{2.5}$	Annual	µg/m³	7
	24 Hour	µg/m³	24.3
Deposited dust	Annual	g/m²/month	2.7
NO_2	Annual	µg/m³	8.2
	1 Hour	µg/m³	51.3
SO_2	Annual	µg/m³	0.7
	24 Hour	µg/m³	8.6
	1 Hour	µg/m³	25.7

6 POTENTIAL CONSTRUCTION DUST EMISSIONS

The Project requires the construction of various infrastructure and associated facilities. These construction activities associated with the Project have the potential to generate dust emissions.

Potential construction dust emissions will be primarily generated from material handling, vehicle movements and windblown dust from exposed areas. The operation of construction vehicles and plant will also generate exhaust emissions.

The potential particulate impacts due to these activities is difficult to accurately quantify on any given day due to the short sporadic periods of dust generating activity which may occur over the construction time frame. The sources of construction dust are temporary in nature and will only occur during the construction period.

The total amount of dust generated from the construction process is unlikely to be significant given the nature of the activities. As these activities would be generally located away from the sensitive receptors, any potential dust impacts would be unlikely to be discernible beyond the existing levels of dust in the area surrounding the Project. Given that the activities would occur for a limited period, no significant or prolonged effect at any off-site receptor is predicted to arise due to the construction activity.

To ensure dust generation is controlled during the construction activities and the potential for off-site impacts is reduced, appropriate (operational and physical) mitigation measures in **Table 6-1** will be implemented as necessary.

Table 6-1: Construction dust mitigation measures

Source	Mitigation measure
General	Activities to be assessed during adverse weather conditions and modified as required (e.g. cease activity where reasonable levels of visible dust cannot be maintained)
	Engines of on-site vehicles and plant to be switched off when not in use
	Vehicles and plant are to be fitted with pollution reduction devices where practicable
	Vehicles are to be maintained and serviced according to manufacturer's specifications
	Visual monitoring of construction activities is to be undertaken to identify dust generation
Hauling material	Active haul roads are to be kept moist
	Public and private sealed haul roads are to be cleaned regularly
	Construction vehicle traffic is to be restricted to designated routes
	Construction speed limits are to be enforced
	Vehicle loads are to be covered when travelling off-site
	A wheel wash or rumble grids are to be established near exit points from construction sites onto public roads, to minimise mud/ dirt track out
Material handling	Drop heights from loading and handling equipment are to be reduced as much as practical
Exposed areas / stockpiles	The extent of exposed surfaces and stockpiles is to be kept to a minimum
	Exposed areas and stockpiles are to be dampened with water as far as is practicable if dust emissions are visible
	Disturbed areas are to be rehabilitated as soon as practicable after completion of works and in a staged manner

7 DISPERSION MODELLING APPROACH

7.1 Introduction

The following sections are included to provide the reader with an understanding of the model and modelling approach applied for the assessment.

The CALPUFF model is an advanced "puff" model which can deal with the effects of complex local terrain on the dispersion meteorology over the entire modelling domain in a three-dimensional, hourly varying time step. CALPUFF is an air dispersion model approved by NSW EPA for use in air quality impact assessments. The model setup used is in general accordance with methods provided in the NSW EPA document *Generic Guidance and Optimum Model Setting for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia* (**TRC**, **2011**).

7.2 Modelling methodology

7.2.1 Meteorological modelling

The meteorological modelling methodology applied a 'hybrid' approach which includes a combination of prognostic model data from The Air Pollution Model (TAPM) with surface observations from surrounding weather stations for input in the CALMET model.

The centre of analysis for TAPM was 33deg53.5min south and 150deg45min east (292330mE, 6247576mN). The simulation involved an outer grid of 30km, with three nested grids of 10km, 3km and 1km with 35 vertical grid levels.

The CALMET modelling used a nested approach where the 3D wind field from the coarser grid outer domain is used as the initial guess (or starting) field for the finer grid inner domain. This approach has several advantages over modelling a single domain. Observed surface wind field data from the near field as well as from far field monitoring sites can be included in the model to generate a more representative 3D wind field for the modelled area. Off domain terrain features for the finer grid domain can be allowed to take effect within the finer domain, as would occur in reality. Also, the coarse scale wind flow fields give a better set of starting conditions with which to operate the finer grid run.

The CALMET outer domain was run on a 30 x 30km area with a 0.6km grid resolution, refined for an inner domain on a 10 x 10km area with a 0.1km grid resolution.

The 2014 calendar year was selected as the meteorological year for the dispersion modelling based on analysis of long-term data trends in meteorological data recorded for the area. Further detail on the selection of the meteorological year is outlined in **Appendix A.**

The available meteorological data for January 2014 to December 2014 from relevant BoM meteorological monitoring sites were included in the simulation. **Table 7-1** outlines the parameters used from each station.

Table 7-1: Surface observation stations

Weather Stations	Parameters						
	WS	WD	CH	CC	T	RH	SLP
Badgerys Creek (BoM) (Station No. 067108)	✓	✓			✓	✓	
Bringelly (OEH)	✓	✓			✓	✓	
Horsley Park Equestrian Centre AWS (BoM) (Station No. 067119)	✓	✓			✓	✓	
Holsworthy Aerodrome (BoM) (Station No. 066161)	✓	✓	✓	✓	✓	✓	✓
Camden Airport (BoM) (Station No. 068192)	✓	✓	✓	✓	✓	✓	✓
Penrith Lakes (BoM) (Station No. 067113)	✓	✓			✓	✓	
Bankstown Airport (BoM) (Station No. 066137)	✓	✓	✓	✓	✓	✓	✓
Campbelltown (Mount Annan) (BoM) (Station No. 068257)	✓	✓			✓	✓	

WS = wind speed, WD= wind direction, CH = cloud height, CC = cloud cover, T = temperature, RH = relative humidity, SLP = station level pressure

The seven critical parameters used in the CALMET modelling are presented in **Table 7-2**.

Table 7-2: Seven critical parameters used in CALMET

Parameter	Value	
TERRAD	10	
IEXTRP	-4	
BIAS (NZ)	-1, -0.5, -0.25, 0, 0, 0, 0, 0	
R1 and R2	5,5	2,2
RMAX1 and RMAX2	10,10	5,5

The outputs of the CALMET modelling are evaluated using visual analysis of the wind fields and extracted data.

Figure 7-1 presents a visualisation of the wind field generated by CALMET for a single hour of the modelling period. The wind fields are seen to follow the terrain well and indicate the simulation produces realistic fine scale flow fields (such as terrain forced flows) in surrounding areas.

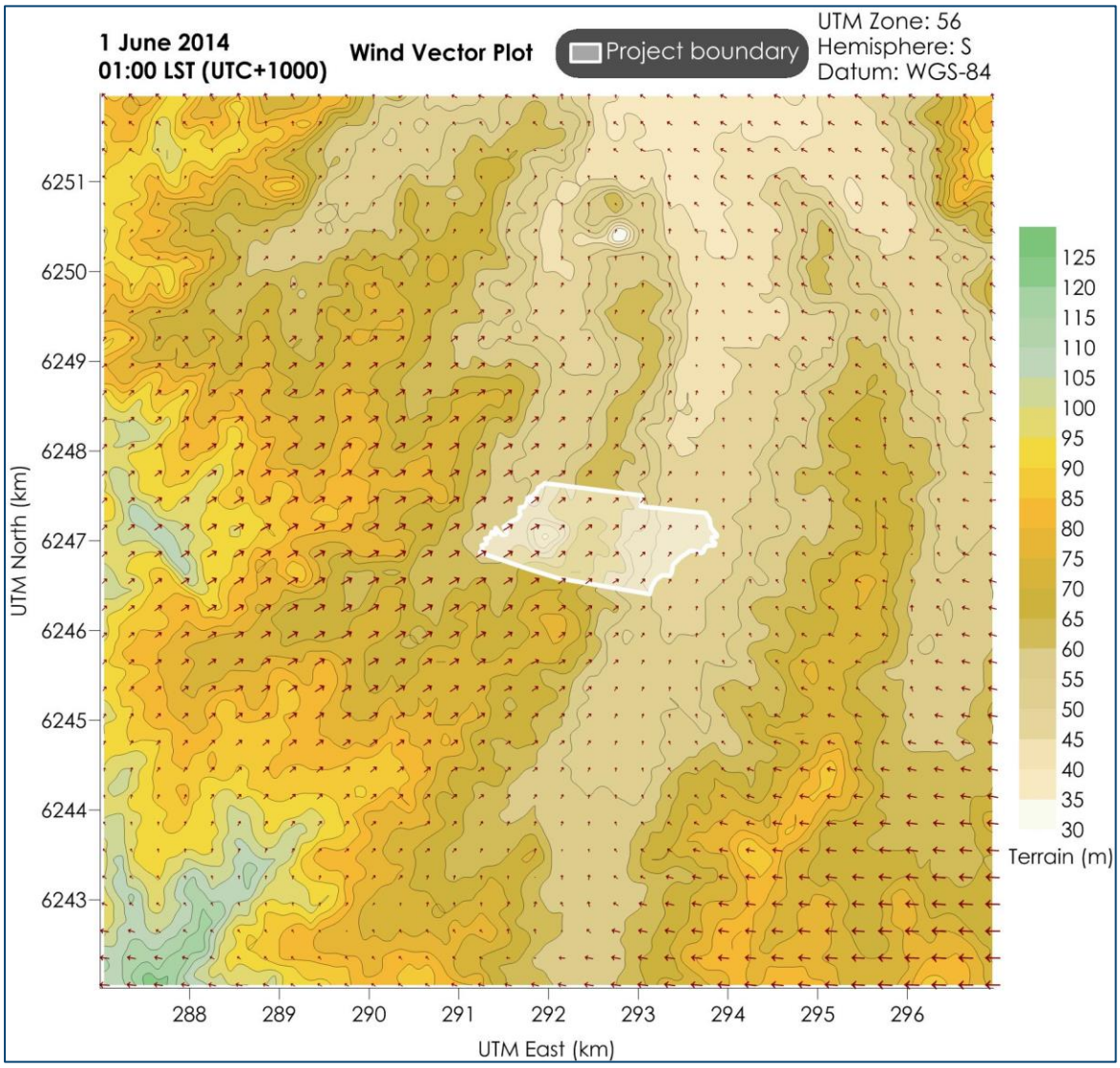


Figure 7-1: Example of the wind field for one of the 8,760 hours of the year that are modelled

CALMET generated meteorological data were extracted from a point within the CALMET domain and are represented in **Figure 7-2** and **Figure 7-3**.

Figure 7-2 presents the annual and seasonal windroses from the CALMET data. The CALMET modelling results reflect the expected wind distribution patterns of the area based on consideration of the measured data and the expected terrain effects on the prevailing winds.

Figure 7-3 includes graphs of the temperature, wind speed, mixing height and stability classification over the modelling period and is consistent with the conditions expected to occur in the area.

It is considered that the CALMET modelling reflects the expected wind distribution patterns of the area as determined based on the available measured data and the expected terrain effects on the prevailing winds.

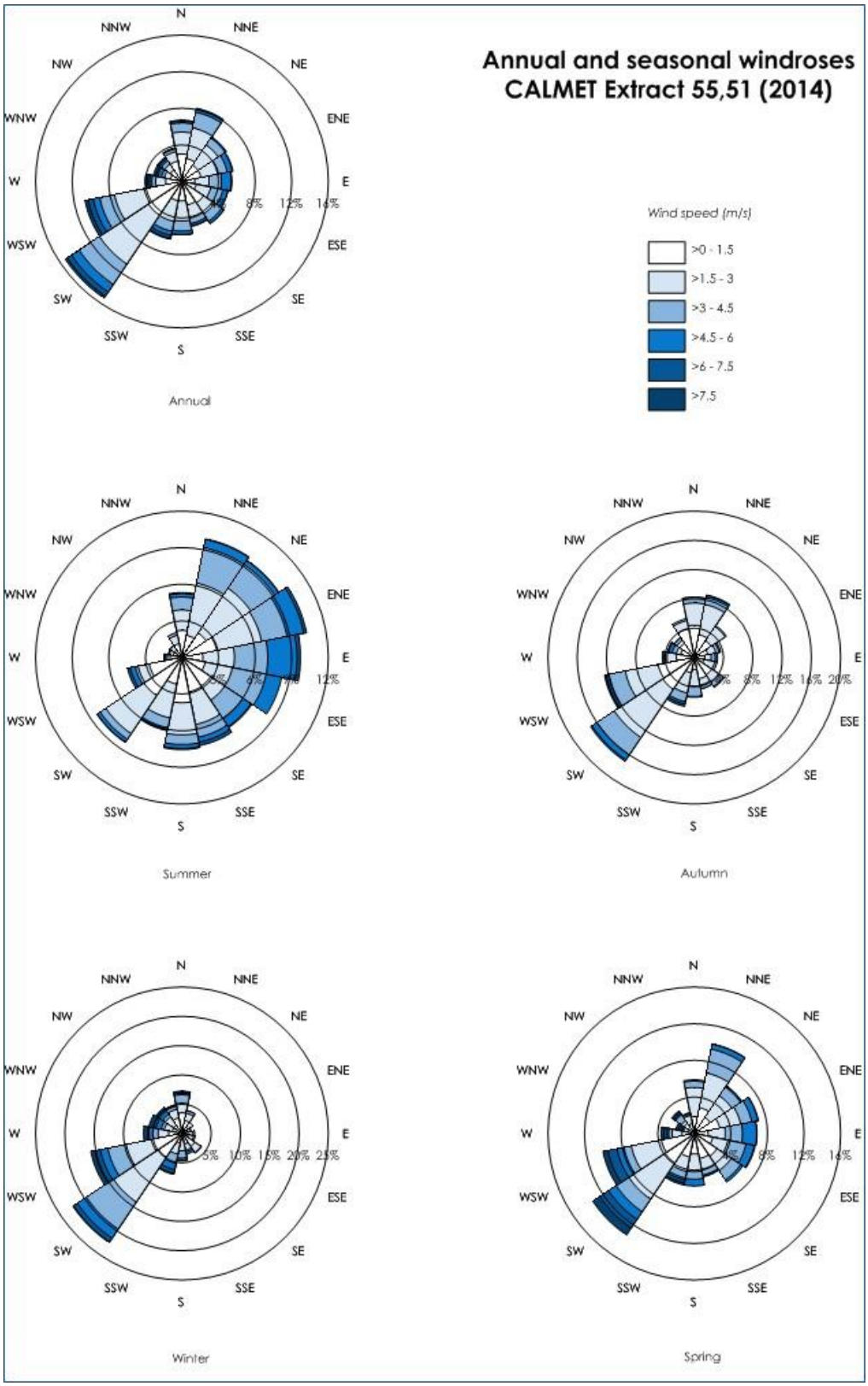


Figure 7-2: Windroses from CALMET extract (cell ref 5551)

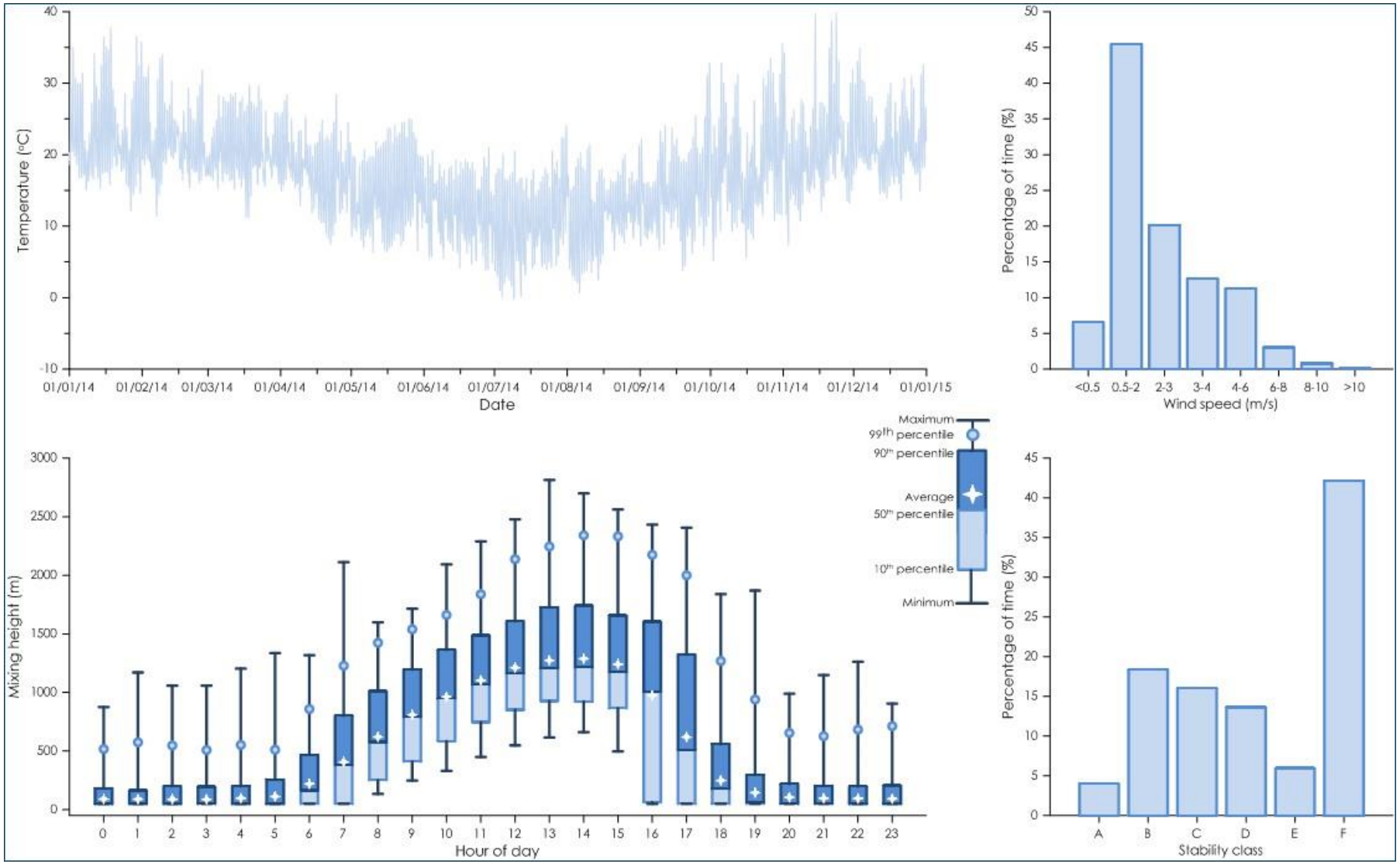


Figure 7-3: Meteorological analysis of CALMET extract (cell ref 5551)

7.2.2 Air dispersion modelling

The CALPUFF dispersion model, in conjunction with a CALMET generated meteorological data file, was applied to provide predictions of the ground level concentrations of pollutants based on the estimated emissions from the activities.

7.3 Modelling scenarios

This assessment considers the four operational phase scenarios to represent the activities at the Project as described in **Section 3**. The key activities at the Project occurring during the four operational phases can be separated into extraction activities, earth visual bund construction, brick making operations and VENM importation and engineered backfilling of pits.

The extraction activities at the Project occur only in Pit 3 at the approved production rate of 420,000 tonnes of clay per calendar year. Extraction activities occur on a campaign basis over a period of approximately 132 days per year with the clay material stored in the raw material stockpile. Burden removed from Pit 3 is used to backfill Pit 1 and Pit 2 during Phase 1 and then used to backfill Pit 3 in Phase 2.

The construction of the landscaped earth bund around the western, southern and eastern sides of the brick making facilities raw material stockpile area occurs in Phase 1. The earth bund requires approximately 43,200 tonnes of material to construct which would be sourced from on-site existing stockpiles or burden.

The brick making operations occur during all four phases with the facility producing 300,000 tonnes of bricks per annum. Raw materials are sourced from the on-site stockpiles (145,000 tonnes per annum) and off-site suppliers (215,000 tonnes per annum) during Phase 1 and 2. During Phase 3 and 4 all raw materials are sourced from off-site suppliers (360,000 tonnes per annum). The modelling assumes the maximum production rate of activity for brick manufacturing operations and that operations occur 24-hours per day, seven days per week.

VENM importation occurs at a maximum rate of 1,830,240 tonnes per annum during Phase 1, 2 and 3. The material is transported along Martin Road to Pit 3 and then across the southern end of the brick making facility to Pit 1 and Pit 2. VENM importation occurs seven days per week.

Figure 7-4 to **Figure 7-7** provide the indicative site layouts for the Phase 1 to Phase 4 scenarios respectively.

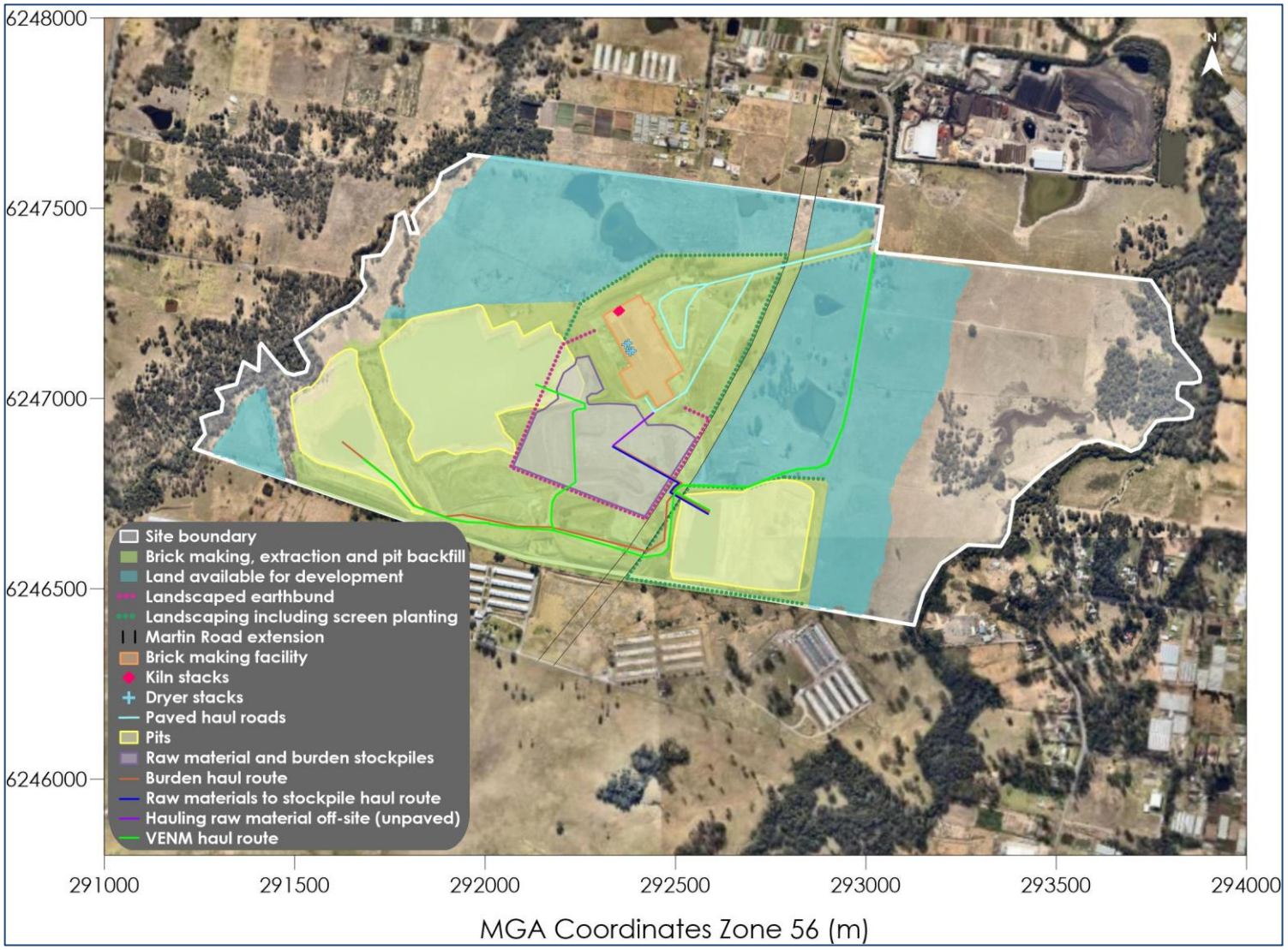


Figure 7-4: Indicative Phase 1 operating scenario

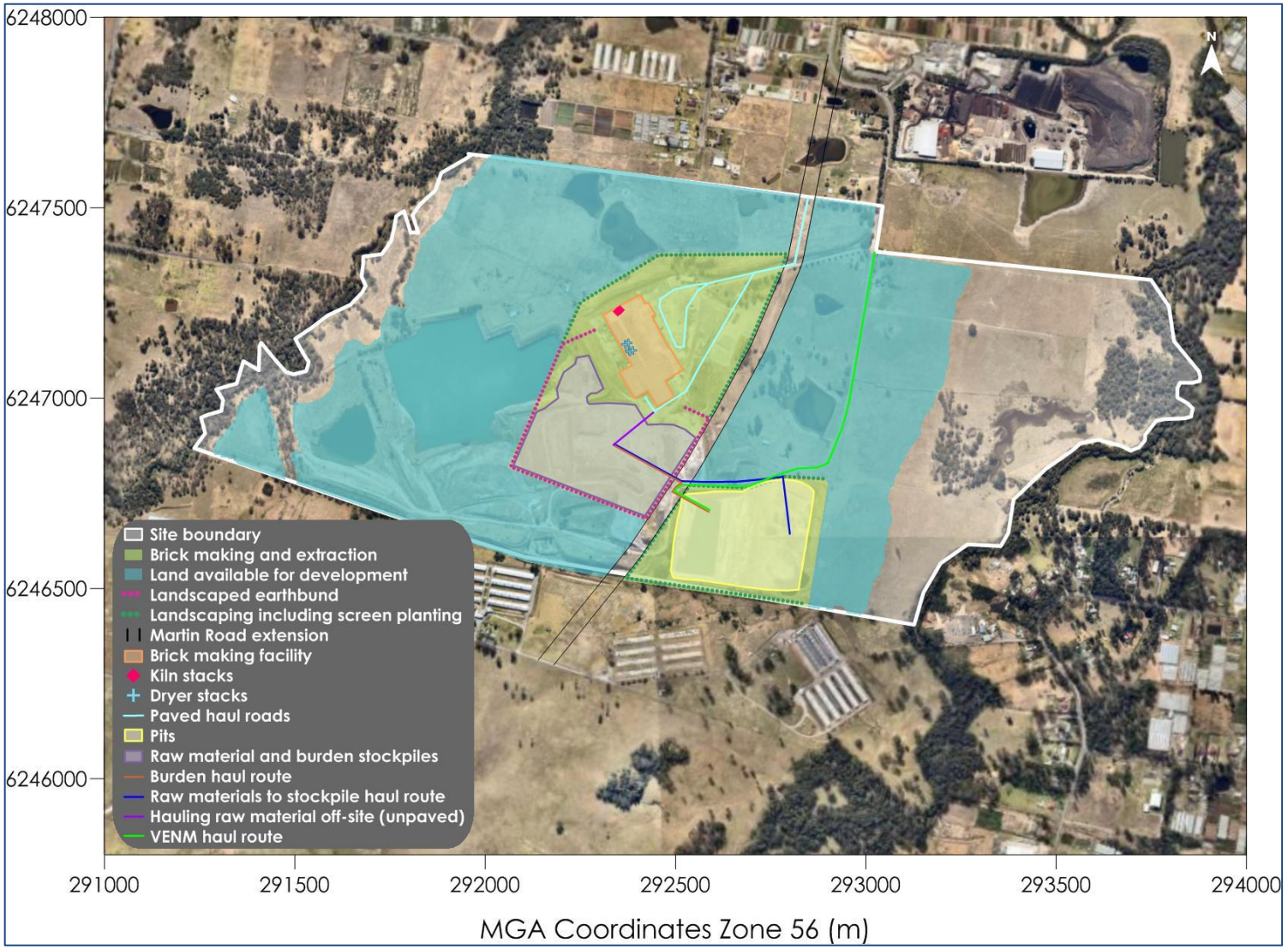


Figure 7-5: Indicative Phase 2 operating scenario

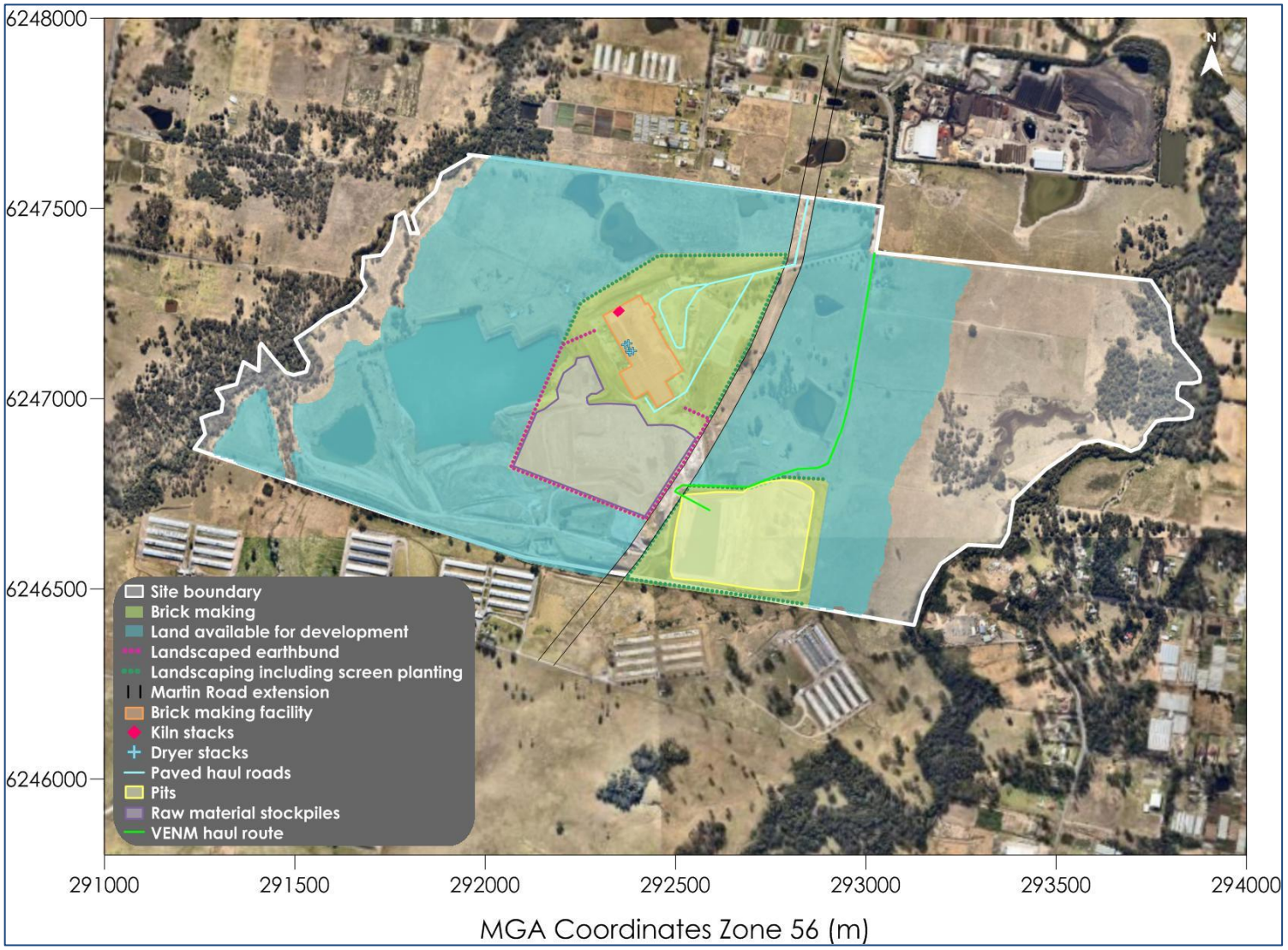


Figure 7-6: Indicative Phase 3 operating scenario

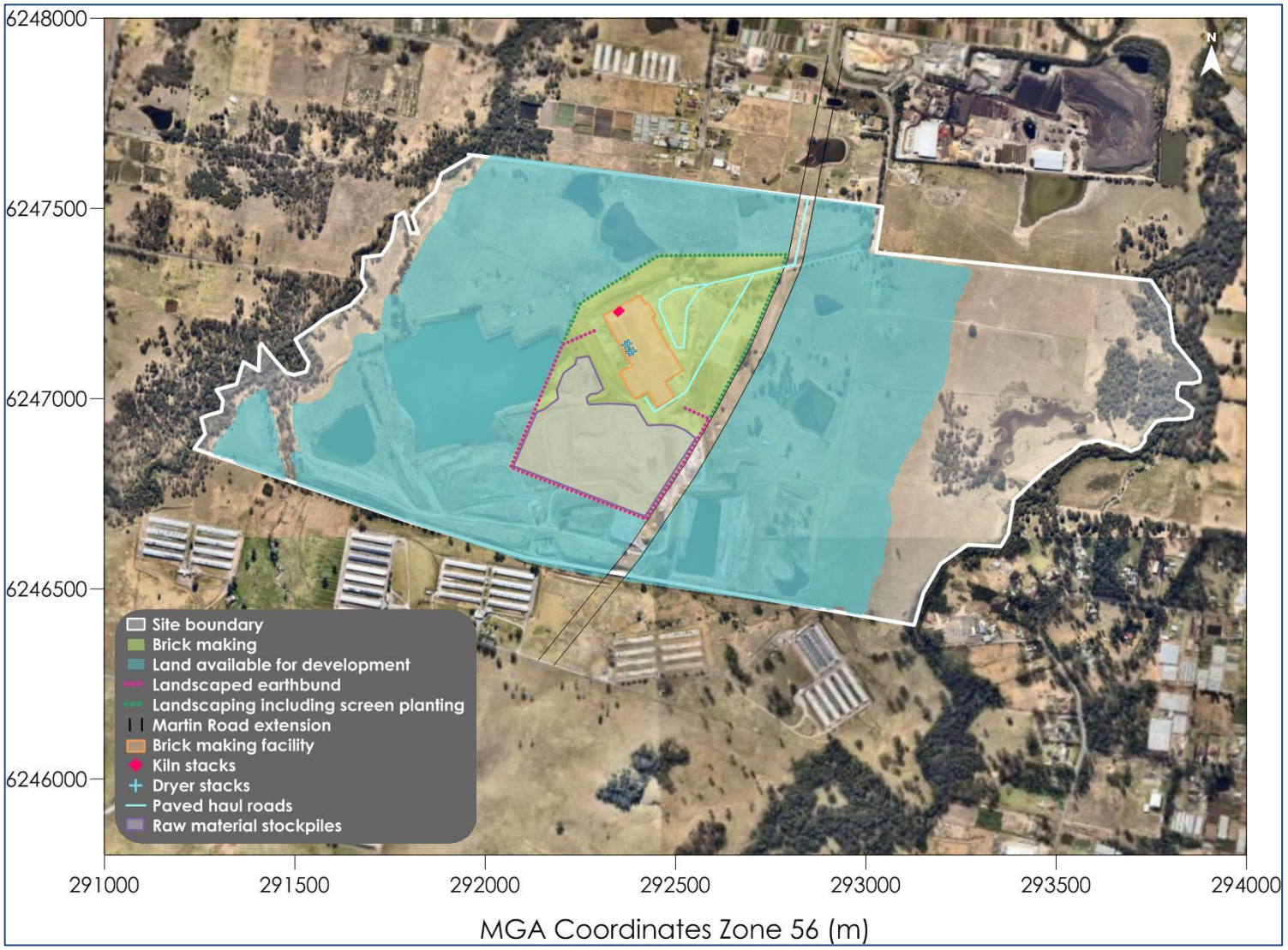


Figure 7-7: Indicative Phase 4 operating scenario

7.4 Emissions estimation

For the modelled scenarios, dust emission estimates have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors.

Activities associated with operation of the Project have the potential to generate dust emissions from various activities including; extraction activities, loading/unloading of material, vehicles travelling on-site, and windblown dust generated from stockpiles.

Dust emission estimates for the Project have been calculated by analysing the various types of dust generating activities taking place and utilising suitable emission factors sourced from both locally developed (**NPI 2012 and 2014**) and US EPA developed documentation (**US EPA 1998**, **US EPA 2006a, US EPA 2006b and US EPA 2011**).

Detailed calculations of the dust emission estimates are provided in **Appendix B**.

7.4.1 Best practice operational dust mitigation measures

The site has considered the possible range of air quality mitigation measures that are feasible and can be applied to achieve a standard of extraction operation consistent with current best practice for the control of dust emissions from mines in NSW, as outlined in the NSW EPA document, *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, prepared by Katestone Environmental (**Katestone Environmental, 2010**).

A summary of the key current dust controls, which would continue to be applied for the Project, is shown in **Table 7-3**. A control level of 75% for watering of unpaved haul routes has been applied in the dust emission estimates shown in the following sections.

Table 7-3: Best practice dust mitigation measures

Activity	Dust Control
General	Modify activities during periods of high visible dust Modify activities during high winds
Hauling on unsealed roads	Watering unpaved roads Regular cleaning of paved roads with sweeper Site speed restriction is 15km/h Shut down engines when vehicles are idle over prolonged periods Covering of all loads leaving the site
Loading/unloading material	Minimise drop heights Water spray used where required on unloading activities
Wind erosion on burden emplacements, stockpiles and exposed surfaces	Shaping of stockpiles where practical to avoid strong wind flows and smooth gradients to reduce turbulence at surface Rehabilitation long-term stockpiles and disturbed soil surfaces by revegetation as soon as practical Watering of active stockpiles when required
Road grading	Watering grader routes during grading

7.4.2 Extraction activities

The estimated dust emissions for activities associated with the extraction activities are presented in **Table 7-4** and **Table 7-5** for the Phase 1 and Phase 2 extraction scenarios respectively.

As the extraction activities occur over a period of approximately 132 days per year, but it is not known which period of the year this may be, the estimated emission rates have been adjusted (up by 365/132) over each day of a full year in order to correctly model the maximum 24-hour average impacts.

Table 7-4: Estimated annual TSP emission rate for extraction activities Phase 1 (kg/year)

Activity	TSP emissions	
	Annual	Modelled emissions for 24-hour impacts
Removal of topsoil / burden in Pit 3 (excavator)	100	277
Loading burden to haul truck	100	277
Hauling burden to Pit 1 and Pit 2 (unpaved)	2,933	8,111
Unloading burden at Pit 1 and Pit 2	100	277
Compactor in Pit 1 and Pit 2 (bulldozer)	1,902	5,259
Bulldozer for breaking up clay/ raw materials in Pit 3	1,902	5,259
Loading clay/ raw material to haul truck	113	313
Haul materials to raw materials stockpile area (unpaved)	4,928	13,627
Unloading clay/ raw materials to stockpile area	113	313
FEL shaping stockpiles	113	313
Grading haul roads	3,326	15,175
Wind erosion Pit 1	10,455	10,455
Wind erosion Pit 2	2,975	2,975
Wind erosion Pit 3	7,565	7,565
Total emissions	**36,627**	**70,198**

Table 7-5: Estimated annual TSP emission rate for extraction activities Phase 2 (kg/year)

Activity	TSP emissions	
	Annual	Modelled emissions for 24-hour impacts
Removal of topsoil / burden in Pit 3 (excavator)	100	277
Loading burden to haul truck	100	277
Hauling burden to emplacement	1,408	3,894
Unloading burden at emplacement	100	277
Compactor on emplacement	1,902	5,259
Bulldozer for breaking up clay/ raw materials in Pit 3	1,902	5,259
Loading clay/ raw material to haul truck	113	313
Haul materials to raw materials stockpile area (unpaved)	4,928	13,627
Unloading clay/ raw materials to stockpile area	113	313
FEL shaping stockpiles	113	313
Grading haul roads	3,326	15,175
Wind erosion Pit 3	7,565	7,565
Total emissions	**21,672**	**52,550**

7.4.3 Earth bund construction

The estimated dust emissions for activities associated with the construction of the earth bund are presented in **Table 7-6** for the Phase 1 scenario.

As the construction activities occur over a period of approximately three months, the estimated emission rates have been adjusted (up by 12/3) over each day of a full year in order to correctly model the maximum 24-hour average impacts.

Table 7-6: Estimated annual TSP emission rate for bund construction (kg/year)

Activity	TSP emissions	
	Annual	Modelled emissions for 24-hour impacts
Loading burden to haul truck	54	217
Hauling burden to bund (unpaved)	507	2,028
Unloading from truck (excavator)	54	217
Shaping bund	54	217
Bund wind erosion	893	893
Total emissions	**1,562**	**3,570**

7.4.4 Brick making facility

The estimated dust emissions for activities associated with the brick making facility for Phases 1 and 2 and Phases 3 and 4 are presented in **Table 7-7** and **Table 7-8** respectively.

Bricks produced from the facility are stored in the existing hardstand area and delivered off-site by trucks travelling on paved roads from the entrance of the site. Up to 330,000 tonnes of bricks are dispatched from the site per calendar year.

Table 7-7: Estimated annual TSP emission rate for the brick making facility Phase 1 and Phase 2 (kg/year)

Activity	TSP emissions
Loading clay material from stockpile to haul truck	39
Hauling clay materials to box feeder (unpaved)	756
Loading clay material from stockpile to box feeder	39
Hauling raw materials from off-site (paved)	2,379
Unloading raw materials from off-site to stockpile	270
Loading raw materials to box feeder	270
Hauling brick products off-site (paved)	3,000
Load clay/ raw material to truck from stockpile for dispatch off-site	74
Truck haulage of clay offsite (unpaved)	1,434
Truck haulage of clay offsite (paved)	3,294
Raw material and burden stockpile wind erosion	9,350
Total emissions	**20,905**

Table 7-8: Estimated annual TSP emission rate for the brick making facility Phase 3 and Phase 4 (kg/year)

Activity	TSP emissions
Hauling raw materials from off-site (paved)	3,984
Unloading raw materials from off-site to stockpile	452
Loading raw materials to box feeder	452
Hauling brick products off-site (paved)	3,000
Raw material stockpile wind erosion	9,350
Total emissions	**17,237**

7.4.5 VENM importation

The estimated dust emissions for activities associated with the importation of VENM are presented in **Table 7-9** and **Table 7-10** for phases 1, 2 and 3 respectively. The modelled emissions are based on the maximum number of truck movements per day. Note that pit wind erosion emissions for Phase 1 and Phase 2 are already included in the respective extraction activities tables.

Table 7-9: Estimated annual TSP emission rate for VENM importation Phase 1 (kg/year)

Activity	TSP emissions
Hauling VENM on-site (unpaved)	114,768
Unloading VENM to Pit 1&2	2,296
Compactor backfilling/shaping VENM	18,802
Total emissions	**135,866**

Table 7-10: Estimated annual TSP emission rate for VENM importation Phase 2 (kg/year)

Activity	TSP emissions
Hauling VENM on-site (unpaved)	63,123
Unloading VENM to Pit 3	2,296
Compactor backfilling/shaping VENM	18,802
Total emissions	**84,220**

Table 7-11: Estimated annual TSP emission rate for VENM importation Phase 3 (kg/year)

Activity	TSP emissions
Hauling VENM on-site (unpaved)	63,123
Unloading VENM to Pit 3	2,296
Compactor backfilling/shaping VENM	18,802
Wind erosion Pit 3	7,565
Total emissions	**91,785**

7.4.6 Stack emissions

Air emissions from the Project would also arise from various stack emission points at the brick making facility. **Table 7-12** provide the modelling parameters for each stack associated with the brick making facility.

The model included consideration of potential "building" wake effects on air dispersion which arise due to the effect of winds passing over the buildings within and around the Project site. The PRIME algorithm is used to model building downwash effects.

Table 7-12: Brick making facility stack modelling parameters

Source	X coordinate (m)	Y coordinate (m)	Height (m)	Diameter (m)	Exit temp (K)	Exit velocity (m/s)
Kiln 1	292349	6247228	41	1.42	385.8	22.3
Kiln 2	292355	6247232	41	1.42	385.8	22.3
Dryer 1	292369	624714	13	0.98	305	6.5
Dryer 2	292379	6247126	13	0.98	305	6.5
Dryer 3	292381	6247122	13	0.98	305	6.5
Dryer 4	292388	6247126	13	0.98	305	6.5

The emission rates for the kiln stacks and dryer stacks at the brick making facility are based on the expected stack concentrations from historical stack emissions testing for other similar facilities provided by the Proponent as well as stack emissions testing conducted for the existing facility (**EML, 2010** & **EML, 2011**).

The estimated stack emission rates used in this assessment for the brick making facility are presented in **Table 7-13**. We note that estimated stack emissions of $PM_{2.5}$ were conservatively assumed to be 100% of PM_{10} for the purpose of this assessment.

Table 7-13: Estimated stack emission rates – Brick making facility

Stack	Pollutant	Emission rate (g/s) or (OU/s)
Kiln 1 & Kiln 2	TSP	0.97
	PM_{10}	0.23
	$PM_{2.5}$	0.23
	SO_2	2.0
	NO_x	2.85
	HF	0.95
	Cl	0.005
	SO_3	0.06
	Odour	29726
Dryers 1- 5	TSP	0.019
	PM_{10}	0.013
	$PM_{2.5}$	0.013
	SO_2	0.0007
	NO_x	0.018
	HF	0.0001
	Cl	0.0002
	SO_3	0.01
	Odour	683

It has been conservatively assumed that all NO_x is converted to NO_2 for all sources.

Table 7-14 presents the applicable Group 6 standards of concentration for ceramic works as per the Protection of the Environment Operations (Clean Air) Regulation 2010 (POEO) alongside the commensurate stack concentrations for the stack sources associated with the brick making facility.

The comparison shows that the source emissions comply with the applicable concentration standards.

Table 7-14: Comparison of applicable POEO standards of concentration with modelled in-stack emission concentrations (mg/m^3)

Pollutant	Standard of concentration for ceramic works – Group 6	Brick making facility	
		Kiln 1 & 2	Dryer 1 to 5
TSP	50	39	4
NO_2	500	114	4
HF	50	38	<1

7.4.7 Emissions from other nearby operations

There are two facilities identified in the vicinity of the site which may contribute to local dust levels; Australian Native Landscapes (ANL) located at 210 Martin Road, Badgerys Creek and a Resource Recovery Facility at 25 Martin Road, Badgerys Creek.

Activities at the ANL facility include processing, handling, movement and storage of compost and garden products. It is noted that compost products have a relatively high moisture content thus would have a low potential for windblown dust emissions and from handling of the material and hence dust emissions from the ANL facility are anticipated to be low.

The Resource Recovery Facility at 25 Martin Road processes 50,000 tonnes per annum of construction and demolition waste and 10,000 tonnes per annum of green waste material. On-site activities include

the transfer, sorting, stockpiling and processing (crushing or mulching/chipping) of materials. The Resource Recovery Facility is located over 1km from the Project site and therefore it is unlikely that any dust emissions from the site would have a tangible cumulative impact at the receptors located near the Project.

We note that the local monitoring data presented in **Section 5.3** indicate that the existing air quality levels, which include the contribution from the existing facilities, were generally lower than the levels measured at the NSW OEH monitoring stations located further afield. Thus using the higher levels recorded at the NSW OEH monitoring stations to represent background air quality levels would account for any potential small contribution from the existing facilities nearby.

8 DISPERSION MODELLING RESULTS

The dispersion model predictions for each of the assessed scenarios are presented in this section. The results presented include those for the operation in isolation (incremental impact) and cumulative impacts with background levels.

8.1 Dust modelling predictions

The dispersion model predictions presented in this section include those for the operation of the Project in isolation (incremental impact) and the operation of the Project with consideration of other sources (total (cumulative) impact). The results show the predicted:

- Maximum 24-hour average $PM_{2.5}$ and PM_{10} concentrations;
- Annual average $PM_{2.5}$ and PM_{10} concentrations;
- Annual average TSP concentrations; and,
- Annual average dust (insoluble solids) deposition rates.

It is important to note that when assessing impacts per the maximum 24-hour average levels, the predictions are based on the highest predicted 24-hour average concentrations modelled at each grid (or discrete receptor) point in the modelling domain. At each point, this is the worst day (i.e. a 24-hour period) in the annual modelling period. The predictions thus do not represent just one particular day, but a combination of all of the worst case days at every point. Thus the extent of the predicted impacts is a large overestimation of what would actually occur on any single day.

Associated isopleth diagrams of the dispersion modelling results are presented in **Appendix C**.

Table 8-1 to **Table 8-4** present the predicted incremental particulate dispersion modelling results at each of the assessed sensitive receptor locations for the Phase 1 to Phase 4 modelling scenarios, respectively.

The results in **Table 7-1** to **Table 8-4** indicate the Project would be below the relevant incremental criteria at all the assessed existing receptor locations for all scenarios.

Table 8-1: Incremental particulate dispersion modelling results for sensitive receptors – Phase 1 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria / VLAMP					
	25	-	50	-	-	2
R5	3.5	0.5	22.7	2.3	6.1	0.2
R9	3.4	0.5	22.8	2.6	7.4	0.3
R11	2.7	0.1	17.5	0.7	1.6	0.1
R12	2.8	0.1	18.5	0.7	1.7	0.1
R12a	3.1	0.1	20.6	0.8	1.8	0.1
R13	2.8	0.1	18.6	0.7	1.7	0.1
R14	2.7	0.1	18.2	0.7	1.7	0.1
R15	2.4	0.1	16.1	0.6	1.5	0.1

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria / VLAMP					
	25	-	50	-	-	2
R25	3.1	0.4	20.2	2.3	6.3	0.3
R26	3.1	0.4	20.0	2.0	5.3	0.2
R27	2.9	0.4	18.8	1.8	4.5	0.2
R28	3.2	0.4	20.8	1.9	4.9	0.2
R29	2.6	0.3	16.6	1.4	3.6	0.1
R30	2.4	0.3	15.6	1.3	3.2	0.1
R31	3.0	0.3	19.0	1.6	4.1	0.2
R32	2.3	0.3	14.3	1.3	3.3	0.1
R34	2.2	0.2	13.9	1.2	2.8	0.1
R35	2.6	0.3	15.9	1.6	4.0	0.2
R42	3.3	0.4	21.6	2.1	5.4	0.2
R43	2.8	0.3	18.0	1.5	3.7	0.1
R44	2.2	0.2	13.8	1.0	2.4	0.1
R45	2.1	0.2	13.2	1.0	2.5	0.1
R46	2.1	0.2	13.4	1.0	2.5	0.1

Table 8-2: Incremental particulate dispersion modelling results for sensitive receptors – Phase 2 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria / VLAMP					
	25	-	50	-	-	2
R5	3.5	0.3	19.0	1.5	4.3	0.1
R9	4.6	0.4	27.0	2.3	6.8	0.3
R11	3.8	0.1	20.1	0.7	1.9	0.1
R12	4.0	0.2	21.3	0.8	2.0	0.1
R12a	4.6	0.2	24.3	0.9	2.3	0.1
R13	3.7	0.2	20.7	0.8	2.0	0.1
R14	3.5	0.2	19.8	0.8	2.0	0.1
R15	3.0	0.1	17.3	0.7	1.7	0.1
R25	4.1	0.4	23.9	2.0	5.6	0.2
R26	3.4	0.3	18.6	1.4	4.0	0.1
R27	3.1	0.3	16.8	1.2	3.4	0.1
R28	3.1	0.3	16.9	1.3	3.5	0.1
R29	2.7	0.2	14.7	1.0	2.7	0.1
R30	2.4	0.2	13.5	0.9	2.4	0.1
R31	2.8	0.3	15.5	1.1	3.0	0.1
R32	2.5	0.2	14.1	1.0	2.5	0.1
R34	2.2	0.2	12.4	0.8	2.2	0.1
R35	2.9	0.3	16.3	1.3	3.3	0.1
R42	3.3	0.3	18.0	1.4	3.9	0.1
R43	2.6	0.2	14.5	1.0	2.7	0.1
R44	2.0	0.2	10.8	0.7	1.8	0.1
R45	2.0	0.2	11.1	0.7	1.9	0.1

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria / VLAMP					
	25	-	50	-	-	2
R46	1.9	0.2	10.4	0.7	1.9	0.1

Table 8-3: Incremental particulate dispersion modelling results for sensitive receptors – Phase 3 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria / VLAMP					
	25	-	50	-	-	2
R5	2.6	0.3	13.4	1.3	3.6	0.1
R9	3.6	0.4	21.8	2.0	5.9	0.2
R11	2.7	0.1	14.1	0.7	1.7	0.1
R12	2.8	0.1	15.1	0.7	1.8	0.1
R12a	3.3	0.2	17.1	0.8	2.0	0.1
R13	2.7	0.1	15.0	0.7	1.8	0.1
R14	2.5	0.1	14.6	0.7	1.8	0.1
R15	2.2	0.1	12.8	0.6	1.6	0.1
R25	3.2	0.3	19.2	1.7	4.9	0.2
R26	2.4	0.3	13.2	1.2	3.3	0.1
R27	2.2	0.3	12.3	1.0	2.8	0.1
R28	2.3	0.3	12.3	1.1	2.9	0.1
R29	2.0	0.2	11.0	0.9	2.3	0.1
R30	1.8	0.2	10.2	0.8	2.0	0.1
R31	2.1	0.2	11.5	0.9	2.5	0.1
R32	1.8	0.2	10.3	0.8	2.2	0.1
R34	1.5	0.2	8.8	0.7	1.9	0.1
R35	2.2	0.2	12.8	1.1	2.9	0.1
R42	2.4	0.3	12.9	1.2	3.2	0.1
R43	2.0	0.2	11.0	0.9	2.3	0.1
R44	1.5	0.2	8.7	0.6	1.5	0.0
R45	1.5	0.2	8.7	0.6	1.6	0.0
R46	1.3	0.2	7.5	0.6	1.6	0.1

Table 8-4: Incremental particulate dispersion modelling results for sensitive receptors – Phase 4 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria / VLAMP					
	25	-	50	-	-	2
R5	0.8	0.2	2.7	0.6	1.9	<0.1
R9	0.9	0.2	3.9	0.9	3.0	0.1
R11	0.4	<0.1	1.6	0.1	0.2	<0.1
R12	0.4	<0.1	1.8	0.1	0.3	<0.1
R12a	0.4	<0.1	1.8	0.1	0.3	<0.1

Receptor ID	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		TSP (µg/m³)	DD (g/m²/month)
	24-hour average	Annual average	24-hour average	Annual average	Annual average	Annual average
	NSW EPA Air Quality Impact Criteria / VLAMP					
	25	-	50	-	-	2
R13	0.5	<0.1	1.8	0.1	0.3	<0.1
R14	0.5	<0.1	1.7	0.1	0.3	<0.1
R15	0.4	<0.1	1.6	0.1	0.3	<0.1
R25	0.7	0.2	3.3	0.7	2.3	0.1
R26	0.9	0.2	2.4	0.5	1.7	<0.1
R27	0.7	0.2	2.0	0.4	1.4	<0.1
R28	0.7	0.2	2.2	0.5	1.5	<0.1
R29	0.6	0.1	1.6	0.3	1.1	<0.1
R30	0.5	0.1	1.4	0.3	0.9	<0.1
R31	0.7	0.1	1.8	0.4	1.2	<0.1
R32	0.8	0.1	1.5	0.3	1.0	<0.1
R34	0.7	0.1	1.4	0.3	0.8	<0.1
R35	0.5	0.1	2.0	0.4	1.3	<0.1
R42	0.7	0.2	2.4	0.5	1.6	<0.1
R43	0.6	0.1	1.6	0.3	1.1	<0.1
R44	0.5	0.1	1.1	0.2	0.7	<0.1
R45	0.5	0.1	1.1	0.2	0.7	<0.1
R46	0.7	0.1	1.3	0.2	0.7	<0.1

The cumulative (total) impact is the impact associated with the operation of the Project combined with the ambient background levels in **Section 5.3.4**. The predicted cumulative annual average $PM_{2.5}$, PM_{10}, TSP and dust deposition levels due to the Project for the Phase 1 to Phase 4 scenarios is shown in **Table 8-5** to **Table 8-8**, respectively.

Cumulative 24-hour average $PM_{2.5}$ and PM_{10} impacts need to be assessed differently to annual average values because there are 365 days in the year with different levels of impact and also different background levels on each day. Cumulative 24-hour impacts are considered in detail in **Section 7.2**.

The results in **Table 8-5** and **Table 8-8** indicate that the predicted levels would be below the relevant annual average particulate criteria at the assessed receptor locations for both modelling scenarios.

Table 8-5: Cumulative annual average particulate dispersion modelling results for sensitive receptors – Phase 1 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.5	18.9	65.9	2.9
R9	7.5	19.2	67.2	3.0
R11	7.1	17.3	61.4	2.8
R12	7.1	17.3	61.5	2.8
R12a	7.1	17.4	61.6	2.8
R13	7.1	17.3	61.5	2.8
R14	7.1	17.3	61.5	2.8
R15	7.1	17.2	61.3	2.8
R25	7.4	18.9	66.1	3.0

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R26	7.4	18.6	65.1	2.9
R27	7.4	18.4	64.3	2.9
R28	7.4	18.5	64.7	2.9
R29	7.3	18.0	63.4	2.8
R30	7.3	17.9	63.0	2.8
R31	7.3	18.2	63.9	2.9
R32	7.3	17.9	63.1	2.8
R34	7.2	17.8	62.6	2.8
R35	7.3	18.2	63.8	2.9
R42	7.4	18.7	65.2	2.9
R43	7.3	18.1	63.5	2.8
R44	7.2	17.6	62.2	2.8
R45	7.2	17.6	62.3	2.8
R46	7.2	17.6	62.3	2.8

Table 8-6: Cumulative annual average particulate dispersion modelling results for sensitive receptors – Phase 2 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.3	18.1	64.1	2.8
R9	7.4	18.9	66.6	3.0
R11	7.1	17.3	61.7	2.8
R12	7.2	17.4	61.8	2.8
R12a	7.2	17.5	62.1	2.8
R13	7.2	17.4	61.8	2.8
R14	7.2	17.4	61.8	2.8
R15	7.1	17.3	61.5	2.8
R25	7.4	18.6	65.4	2.9
R26	7.3	18.0	63.8	2.8
R27	7.3	17.8	63.2	2.8
R28	7.3	17.9	63.3	2.8
R29	7.2	17.6	62.5	2.8
R30	7.2	17.5	62.2	2.8
R31	7.3	17.7	62.8	2.8
R32	7.2	17.6	62.3	2.8
R34	7.2	17.4	62.0	2.8
R35	7.3	17.9	63.1	2.8
R42	7.3	18.0	63.7	2.8
R43	7.2	17.6	62.5	2.8
R44	7.2	17.3	61.6	2.8
R45	7.2	17.3	61.7	2.8
R46	7.2	17.3	61.7	2.8

Table 8-7: Cumulative annual average particulate dispersion modelling results for sensitive receptors – Phase 3 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)

	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.3	17.9	63.4	2.8
R9	7.4	18.6	65.7	2.9
R11	7.1	17.3	61.5	2.8
R12	7.1	17.3	61.6	2.8
R12a	7.2	17.4	61.8	2.8
R13	7.1	17.3	61.6	2.8
R14	7.1	17.3	61.6	2.8
R15	7.1	17.2	61.4	2.8
R25	7.3	18.3	64.7	2.9
R26	7.3	17.8	63.1	2.8
R27	7.3	17.6	62.6	2.8
R28	7.3	17.7	62.7	2.8
R29	7.2	17.5	62.1	2.8
R30	7.2	17.4	61.8	2.8
R31	7.2	17.5	62.3	2.8
R32	7.2	17.4	62.0	2.8
R34	7.2	17.3	61.7	2.8
R35	7.2	17.7	62.7	2.8
R42	7.3	17.8	63.0	2.8
R43	7.2	17.5	62.1	2.8
R44	7.2	17.2	61.3	2.7
R45	7.2	17.2	61.4	2.7
R46	7.2	17.2	61.4	2.8

Table 8-8: Cumulative annual average particulate dispersion modelling results for sensitive receptors – Phase 4 scenario

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R5	7.2	17.2	61.7	2.7
R9	7.2	17.5	62.8	2.8
R11	7.0	16.7	60.0	2.7
R12	7.0	16.7	60.1	2.7
R12a	7.0	16.7	60.1	2.7
R13	7.0	16.7	60.1	2.7
R14	7.0	16.7	60.1	2.7
R15	7.0	16.7	60.1	2.7
R25	7.2	17.3	62.1	2.8
R26	7.2	17.1	61.5	2.7
R27	7.2	17.0	61.2	2.7
R28	7.2	17.1	61.3	2.7
R29	7.1	16.9	60.9	2.7
R30	7.1	16.9	60.7	2.7
R31	7.1	17.0	61.0	2.7
R32	7.1	16.9	60.8	2.7
R34	7.1	16.9	60.6	2.7
R35	7.1	17.0	61.1	2.7
R42	7.2	17.1	61.4	2.7
R43	7.1	16.9	60.9	2.7

Receptor ID	$PM_{2.5}$ (µg/m³)	PM_{10} (µg/m³)	TSP (µg/m³)	DD (g/m²/month)
	NSW EPA Air Quality Impact Criteria / VLAMP			
	8	25	90	4
R44	7.1	16.8	60.5	2.7
R45	7.1	16.8	60.5	2.7
R46	7.1	16.8	60.5	2.7

8.2 Assessment of Total (Cumulative) 24-hour average $PM_{2.5}$ and PM_{10} Concentrations

An assessment of total (cumulative) 24-hour average $PM_{2.5}$ and PM_{10} impacts was undertaken in accordance with the methods outlined in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA**, **2017**).

The NSW EPA applies a Level 2 contemporaneous assessment approach where the measured background levels are added to the day's corresponding predicted dust level from the Project. Ambient (background) $PM_{2.5}$ and PM_{10} concentration data corresponding with the year of modelling (2014 calendar year) from the NSW OEH monitoring sites at Bringelly and Liverpool respectively have been applied in this case to represent the prevailing background levels in the vicinity of the Project and representative sensitive receptor locations.

Table 8-9 to **Table 8-12** provide a summary of the findings from the Level 2 assessment at representative receptor locations for the phase 1 to Phase 4 scenarios respectively. Detailed tables of the assessment results are provided in **Appendix D**.

The results in **Table 8-9** to **Table 8-12** indicate that the Project will not increase the number of days above the 24-hour average criterion at the most impacted receptors, and thus meets the EPA cumulative impact assessment criteria at all receptors at all times.

Table 8-9: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion – Phase 1 scenario

Receptor ID	$PM_{2.5}$	PM_{10}
R5	0	0
R9	0	0
R12a	0	0
R26	0	0

Table 8-10: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion – Phase 2 scenario

Receptor ID	$PM_{2.5}$	PM_{10}
R5	0	0
R9	0	0
R12a	0	0
R26	0	0

Table 8-11: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion – Phase 3 scenario

Receptor ID	$PM_{2.5}$	PM_{10}
R5	0	0

Receptor ID	$PM_{2.5}$	PM_{10}
R9	0	0
R12a	0	0
R26	0	0

Table 8-12: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion – Phase 4 scenario

Receptor ID	$PM_{2.5}$	PM_{10}
R5	0	0
R9	0	0
R12a	0	0
R26	0	0

8.3 Dust impacts on more than 25 per cent of privately-owned land

The potential for dust impacts due to the Project to extend over more than 25 per cent of any privately-owned land, has been evaluated using the tabulated results in **Section 8.1** and predicted pollutant dispersion contours in **Appendix C**.

The results indicate that the relevant assessment criteria in **Table 4-2** and **Table 4-3** would not be exceeded on more than 25 per cent of any parcel(s) of privately-owned land, and thus that the VLAMP criterion is met for the existing receptors.

8.4 Other pollutants

A summary of the maximum cumulative impacts of SO_2, NO_2 and HF at sensitive receptors is shown in **Table 8-13**. The modelling predictions indicate they would be below the relevant criteria at all sensitive receptor locations.

Table 8-14 provides a summary of the predicted incremental impacts of chlorine, sulfuric acid and odour from the Project at the site boundary and sensitive receptors. No exceedances of the criteria for these pollutants are predicted at any sensitive receptors or the site boundary due to emissions from the Project.

Isopleths showing the spatial distribution of the predicted incremental impacts for selected pollutants associated with the Project over the modelling domain are presented in **Appendix C**.

Table 8-13: Maximum dispersion modelling results - SO_2, NO_2, and HF

Pollutant	Averaging period	Maximum incremental impact at receptor	Background concentration	Maximum cumulative impact at receptor	Criteria	Units
SO_2	1 hour	56.3	25.7	82.0	570	µg/m³
	24 hour	4.8	8.6	13.4	228	µg/m³
	Annual	0.7	0.7	1.4	60	µg/m³
NO_2	1 hour	80.7	51.3	132	246	µg/m³
	Annual	1.2	8.2	9.4	62	µg/m³
HF	24 hours	2.3	-	-	2.9	µg/m³
	7 days	0.9	-	-	1.7	µg/m³
	30 days	0.63	-	-	0.84	µg/m³
	90 days	0.47	-	-	0.5	µg/m³

-No background data available

Table 8-14: Dispersion modelling results – chlorine, sulfuric acid and odour

Pollutant	Averaging period	Percentile	Maximum incremental impact at boundary*	Maximum incremental impact at receptor	Criteria	Units
Cl	1 hour	99.9th	0.00008	0.00009	0.05	mg/m³
H_2SO_4	1 hour	99.9th	0.0022	0.0018	0.018	mg/m³
Odour	1 hour peak to mean corrected	99th	<1	<1	2	OU

*Phase 4 brick making boundary

8.5 CASA plume rise assessment

The Project is located within close proximity to the Western Sydney Airport and has potential to affect the protected airspace known as the Obstacle Limitation Surface (OLS). A plume rise assessment is required where tall structures and exhaust plumes are within the OLS and have the potential to impact aircraft safety.

A form 1247 was submitted to the Civil Aviation Safety Authority (CASA) requesting a plume rise assessment for the Project. CASA assessed all exhaust plumes from the Project and found that:

"there is no infringement of the Obstacle Limitation Surfaces at a critical velocity of 4.3m/sec and CASA considers that there will be an Acceptable Level of Safety. No additional mitigations would be required."

8.6 Consideration of bulk earthworks associated with Western Sydney Airport

Bulk earthworks activities at the Western Sydney Airport (WSA) are scheduled to occur from Year 1 Q4 to Year 3 Q1 in the east and from Year 4 Q2 to Year 5 Q1 for the northwest and southwest of the airport site (**Pacific Environment Limited, 2015**). Based on the projected 2026 opening of the WSA this equates to bulk earthwork activities occurring approximately between 2019 and 2023.

In relation to the activity occurring at the Project, the Phase 1 scenario would overlap with the timing of WSA bulk earthworks.

The total annual average cumulative dust levels are shown in **Table 8-15** for the most impacted receptor. The results are less than the applicable criteria for annual average $PM_{2.5}$ and PM_{10}.

Table 8-15: Estimated cumulative levels for Phase 1 scenario + WSA bulk earthworks (µg/m³)

Pollutant	Maximum incremental level from the Project	Estimated contribution from WSA bulk earthworks	Background level	Total cumulative level	Criteria
$PM_{2.5}$	0.5	0.1	7.0	7.6	8
PM_{10}	2.6	<0.5	16.6	<19.7	25

8.6.1 Short-term, 24-hour average impacts

The receptors most impacted by the Project or bulk earthworks activities at the WSA are receptors situated (generally) between the two projects (to the north of the Project and east of the WSA). These receptors are also most impacted cumulatively by both projects on an annual average basis, but cannot be significantly cumulatively impacted on a short-term basis, as one project will always be down wind when the receptor is most impacted by the other. For this reason, at these in-between receptors, it is

not valid to conduct a Level 1 assessment (by adding together the maximum short-term impacts from both projects).

In terms of cumulative short-term impacts at other receptors, only the receptors further from bulk earthworks activities at the WSA i.e. receptors to the southeast of the Project, can be downwind of both projects at the same time, and thus experience short-term cumulative impacts.

We note that the isopleth diagrams for the WSA bulk earthworks activity are erroneous, given that the predicted 24-hour average $PM_{2.5}$ level is larger than the PM_{10} level in most areas (refer to Figure G1 and Figure G3 of **Pacific Environment Limited (2015)**), and these diagrams cannot be used to make any reasonable assessment of 24-hour average cumulative impacts.

A conservative Level 1 assessment can be made however by adding the WSA maximum tabled results (which do appear to be correct) together with the maximum predicted results for the Project. It is highly unlikely that maximum activities at both WSA and the Project would occur simultaneously on the worst case impacting day for each activity at the most impacted receptor. The actual nature of any 24-hour average impacts would vary greatly from day to day for the Project and the WSA bulk earthworks activities, thus the potential cumulative 24-hour average impacts are difficult to estimate accurately. Hence, a potentially large degree of conservatism (overestimation) is inherent in this approach.

The maximum 24-hour dust levels, due to only the Project and WSA respectively, at the most impacted receptor that may possibly be affected by both projects are; 22.8 and 1.4 $\mu g/m^3$ for 24-hr average PM_{10}: and 3.5 and 0.7 $\mu g/m^3$ for 24-hr average $PM_{2.5}$.

An additional WSA 24-hour average PM_{10} and $PM_{2.5}$ contribution of 1.4$\mu g/m^3$ and 0.7$\mu g/m^3$ respectively is relatively small, e.g. less than 3% of the criteria. This is well within the $\pm$25% measurement tolerance of monitoring instruments per the *Approved Methods for Sampling and Analysis of Air Pollutants in NSW* (**NSW, EPA, 2007**).

For the various reasons above, it can be reasonably concluded that the additional cumulative effect due to the WSA bulk earthwork activities is unlikely to tangibly alter the predicted 24-hr average cumulative assessment in the AQIA. Nevertheless, any potential for cumulative 24-hour average impacts to arise would be managed by the Project in accordance with the air quality management plan and it is reasonable to expect that appropriate management measures would also be applied by WSA.

8.7 Potential for impacts on adjacent land

The potential for air quality impacts on adjacent land in the Aerotropolis Core Precinct have been evaluated using the predicted pollutant dispersion contours. As Phase 1 is expected to be completed prior to the WSA being finished, it is unlikely that any significant development would have started in the Aerotropolis Core Precinct by this time. Hence there is only potential for air quality impact on the adjacent Aerotropolis Core Precinct to arise during Phase 2 onwards.

Figure 8-1 presents the maximum extent of potential impacts for Phase 2 and 3 combined.

The limiting extent of each of the assessed dust metrics based on the assessment criteria outlined in **Table 4-3** have been overlayed and combined to show the maximum extent of potential impacts in **Figure 8-1**. The contour plot indicates that the air quality criteria in **Table 4-3** is predicted to be exceeded along the southern boundary of the site, in the extreme northern boundary of the Aerotropolis

Core Precinct during Phase 2 and 3 and therefore this area may not initially be suitable for residential development.

During Phase 4, extraction and backfilling activities of the quarry pits have ceased, and the brick making facility operations are confined to a 30 Ha area in the centre of the site. The predicted dust impacts during this phase would be reduced and limited to the boundary of the brick making facility operations. From this phase onwards, the northern boundary of the Aerotropolis Core Precinct would be suitable for residential development.

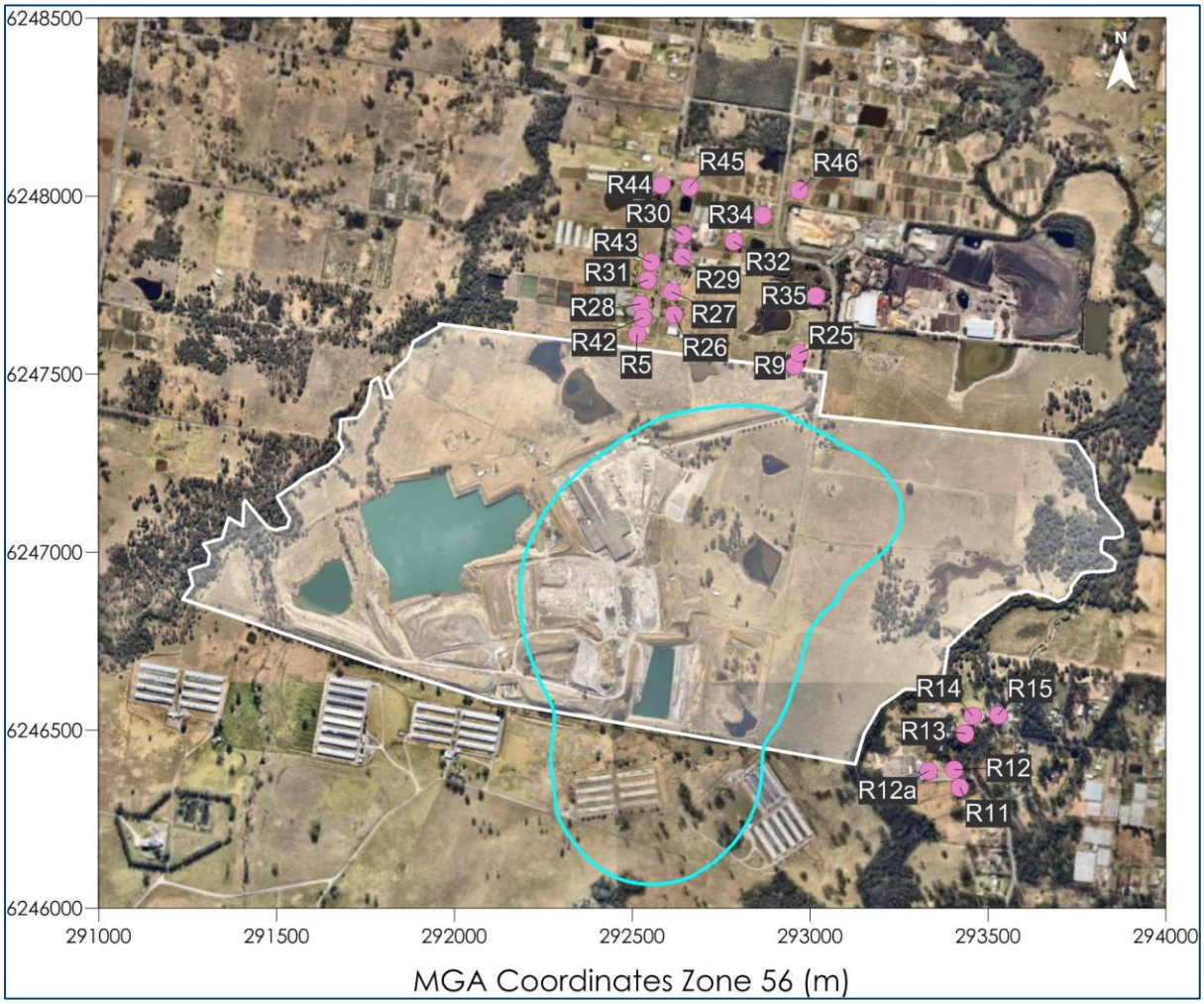


Figure 8-1: Predicted maximum extent of impact for Phase 2 & 3 combined

9 MITIGATION AND MANAGEMENT

The site will continue to operate in accordance with the *Badgerys Creek Quarry and Brick Making Facility – Air Quality and Greenhouse Gas Management Plan* (**APP, 2013**).

The air quality modelling predictions for the operation of the Project demonstrates compliance with the assessment criteria for all dust metrics at the assessed receptor locations and thus the Reactive Dust Management Program as per the *Badgerys Creek Quarry and Brick Making Facility – Air Quality and Greenhouse Gas Management Plan* (**APP, 2013**) is no longer necessary.

The existing HVAS monitor is recommended to be relocated to a position more representative of the surrounding receptor locations, such as to the northern boundary of the site. The HVAS monitor would measure the environmental performance of the Project and facilitate the management of air quality impacts.

If any exceedances are identified due to the Project through air quality monitoring or from ongoing dust related complaints, a reactive dust management strategy would be recommended to be implemented to assist with the management of dust emissions from the ongoing activity.

10 SUMMARY AND CONCLUSIONS

This report has assessed the potential worst-case air quality impacts associated with the proposed CSR Advanced Manufacturing Hub Preferred Project.

Air dispersion modelling using the CALPUFF model was used, with generally conservative assumptions to predict the potential for off-site air quality impacts in the surrounding area due to the Project.

It is predicted that the operation of the Project would comply with all assessment criteria for all assessed air pollutants at all existing receptors.

The modelling predictions also indicate that residential development along the extreme northern boundary of the Aerotropolis Core Precinct, is only likely to be appropriate from year 14 of the Project (2032) onwards, once engineered backfilling of Pit 3 is complete.

The site would apply appropriate dust management measures to ensure it minimises the potential occurrence of excessive air emissions from the site.

Overall, the assessment demonstrates that the operation of the Project would not cause any unacceptable air quality impact in the surrounding environment.

11 REFERENCES

AECOM (2011)

"Revised Air Quality Impact Assessment Boral Quarry and Brick Making Facility, Badgerys Creek", prepared for Boral Bricks by AECOM Australia Pty Ltd, March 2011.

APP (2013)

"Air Quality and Greenhouse Gas Management Plan – Badgerys Creek Quarry and Brick Making Facility", APP Corporation, May 2013.

Bureau of Meteorology (2018)

Climate statistics for Australian locations, Bureau of Meteorology website, accessed November 2018. http://www.bom.gov.au/climate/averages

EML (2010)

"Badgerys Creek Plant Emission Testing Report", EML Air, October 2010.

EML (2011)

"Badgerys Creek Plant Emission Testing Report", EML Air, September 2011.

GHD (2017a)

"Western Sydney Airport- air quality and noise monitoring October 2017 monthly report", GHD.

GHD (2017b)

"Western Sydney Airport- air quality and noise monitoring November 2017 monthly report", GHD.

GHD (2017c)

"Western Sydney Airport- air quality and noise monitoring December 2017 monthly report", GHD.

GHD (2018a)

"Western Sydney Airport- air quality and noise monitoring January 2018 monthly report", GHD.

GHD (2018b)

"Western Sydney Airport- air quality and noise monitoring February 2018 monthly report", GHD.

GHD (2018c)

"Western Sydney Airport- air quality and noise monitoring March 2018 monthly report", GHD.

GHD (2018d)

"Western Sydney Airport- air quality and noise monitoring April 2018 monthly report", GHD.

Katestone Environmental Pty Ltd (2010)

"NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining", Katestone Environmental Pty Ltd prepared for DECCW, 2010.

NPI (2011)

"Emission Estimation Technique Manual for Combustion in Boilers", National Pollutant Inventory, December 2011.

NPI (2012)

"Emission Estimation Technique Manual for Mining", National Pollutant Inventory, January 2012.

NPI (2014)

"Emission Estimation Technique Manual for Mining and Processing of Non-Metallic Minerals", National Pollutant Inventory, September 2014.

NSW DEC (2006)

"Assessment and Management of Odour from Stationary Source in NSW", NSW Department of Environment and Conservation, November 2006.

NSW DP&E (2018)

"Western Sydney Aerotropolis Land Use and Infrastructure Implementation Plan Stage 1: Initial Precincts", NSW Department of Planning and Environment, August 2018.

NSW EPA (2007)

"Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales", prepared by the NSW EPA, January 2007.

NSW EPA (2017)

"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales", NSW Environment Protection Authority, January 2017.

NSW Government (2018a)

"Protection of the Environment Operations (Clean Air) Regulation 2010", NSW Government, current version August 2018.

NSW Government (2018b)

"Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments", NSW Government, September 2018.

NSW Government (2018c)

"Protection of the Environment Operations Act 1997", NSW Government, current version December 2018.

Pacific Environment Limited (2015)

"Western Sydney Airport EIS – Local Air Quality and Greenhouse Gas Assessment", prepared for Department of Infrastructure and Regional Development by Pacific Environment Limited, October 2015.

TAS (2019a)

"Air Quality Impact Assessment, CSR Advanced Manufacturing Hub Modification 3", prepared for Element Environment by Todoroski Air Sciences, February 2019.

TAS (2019b)

"Air Quality Impact Assessment, CSR Advanced Manufacturing Hub Modification 4", prepared for Element Environment by Todoroski Air Sciences, February 2019.

TRC (2011)

"Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia", Prepared for the NSW Office of Environment and Heritage by TRC Environmental Corporation.

US EPA (1998)

"AP42: Compilation of Air Emission Factors, Chapter 11.9 Western Surface Coal Mining", United States Environment Protection Authority, October 1998.

US EPA (2006a)

"AP42: Compilation of Air Emission Factors, Chapter 11.12 Concrete Batching", United States Environment Protection Authority, June 2006.

US EPA (2006b)

"AP42: Compilation of Air Emission Factors, Chapter 13.2.2 Unpaved Roads", United States Environment Protection Authority, November 2006.

US EPA (2011)

"AP42: Compilation of Air Emission Factors, Chapter 13.2.1 Paved Roads", United States Environment Protection Authority, January 2011.

Appendix A

Selection of Meteorological Year

Selection of meteorological year

The 2014 calendar year has been selected as the meteorological year for the dispersion modelling based on an analysis of the latest five years of meteorological data and wind patterns which reflect those patterns experienced in latest five years.

A statistical analysis of the latest five years of meteorological data from the nearest BoM weather station with suitable available data, Badgerys Creek AWS, is presented in **Table A-1**. The standard deviation of five years of meteorological data spanning 2013 to 2017 was analysed against the mean measured wind speed, wind direction, temperature and relative humidity.

The analysis indicates that 2014 is closest to the average for wind speed, 2014 is the closest to the average wind direction, 2016 is the closest to the average for temperature and 2013 is closest for relative humidity.

Figure A-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity of the 2014 year compared with the mean of the 2013 to 2017 data set. The 2014 year data appears to be well aligned with the mean data for wind speed and wind direction which are the most critical parameters for dispersion.

Therefore, based on this analysis it was determined that 2014 is generally representative of the long-term trends compared to other years and is thus suitable for the purpose of modelling.

Table A-1: Statistical analysis results of standard deviation from mean five year meteorological data at Badgerys Creek AWS

Year	Wind speed	Wind direction	Temperature	Relative humidity
2013	0.25	0.17	0.13	0.18
2014	0.14	0.15	0.19	0.23
2015	0.38	0.21	0.19	0.28
2016	0.47	0.27	0.09	0.21
2017	0.52	0.24	0.28	0.33

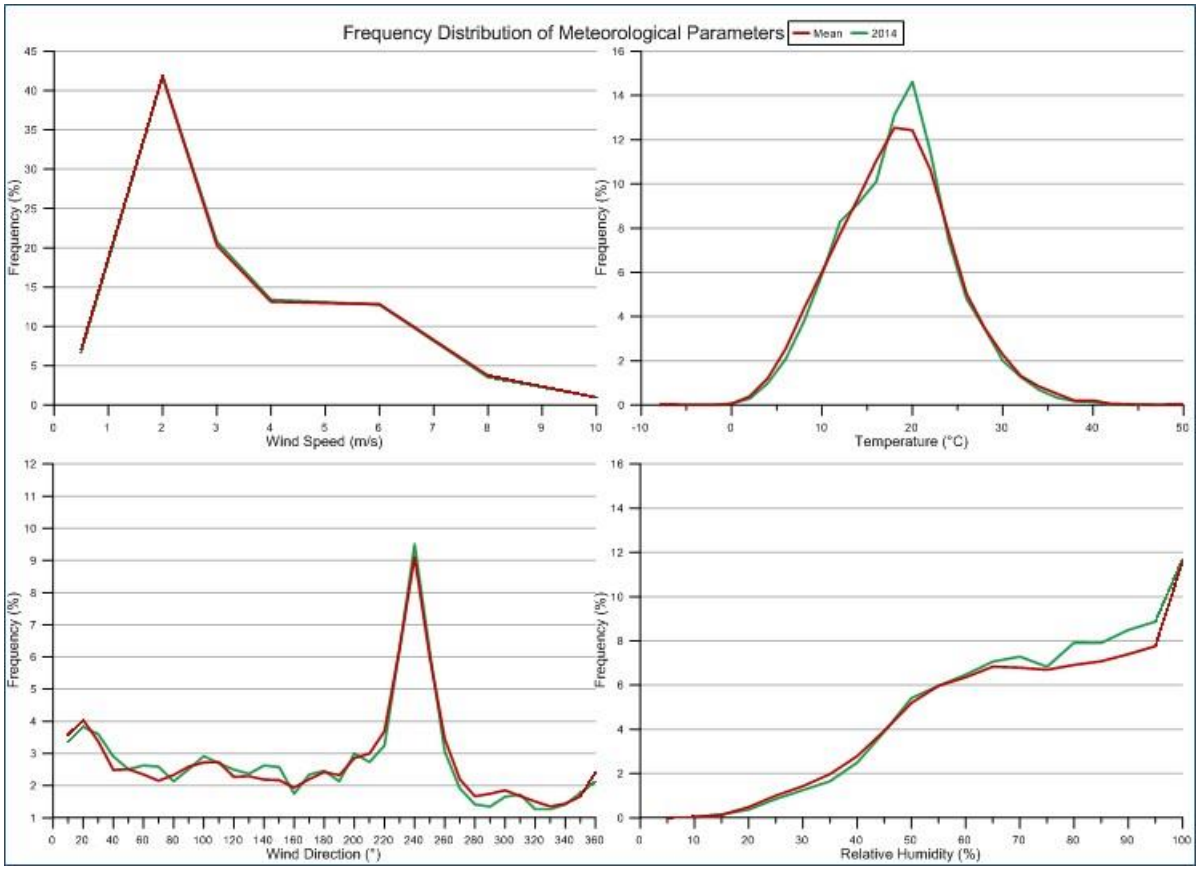


Figure A-1: Frequency distribution of meteorological parameters

Annual and seasonal windroses prepared from data collected for the 2014 calendar year are presented in **Figure A-2**.

A five year annual and seasonal windrose for the Badgerys Creek AWS spanning 2013 to 2017 is presented in **Figure A-3**. The windrose indicates little variation when compared to the individual year presented in **Figure A-2** for the 2014 period. This further suggests that the 2014 calendar year is representative of the available data and is a suitable period for modelling.



Figure A-2: Annual and seasonal windroses for Badgerys Creek AWS (2014)

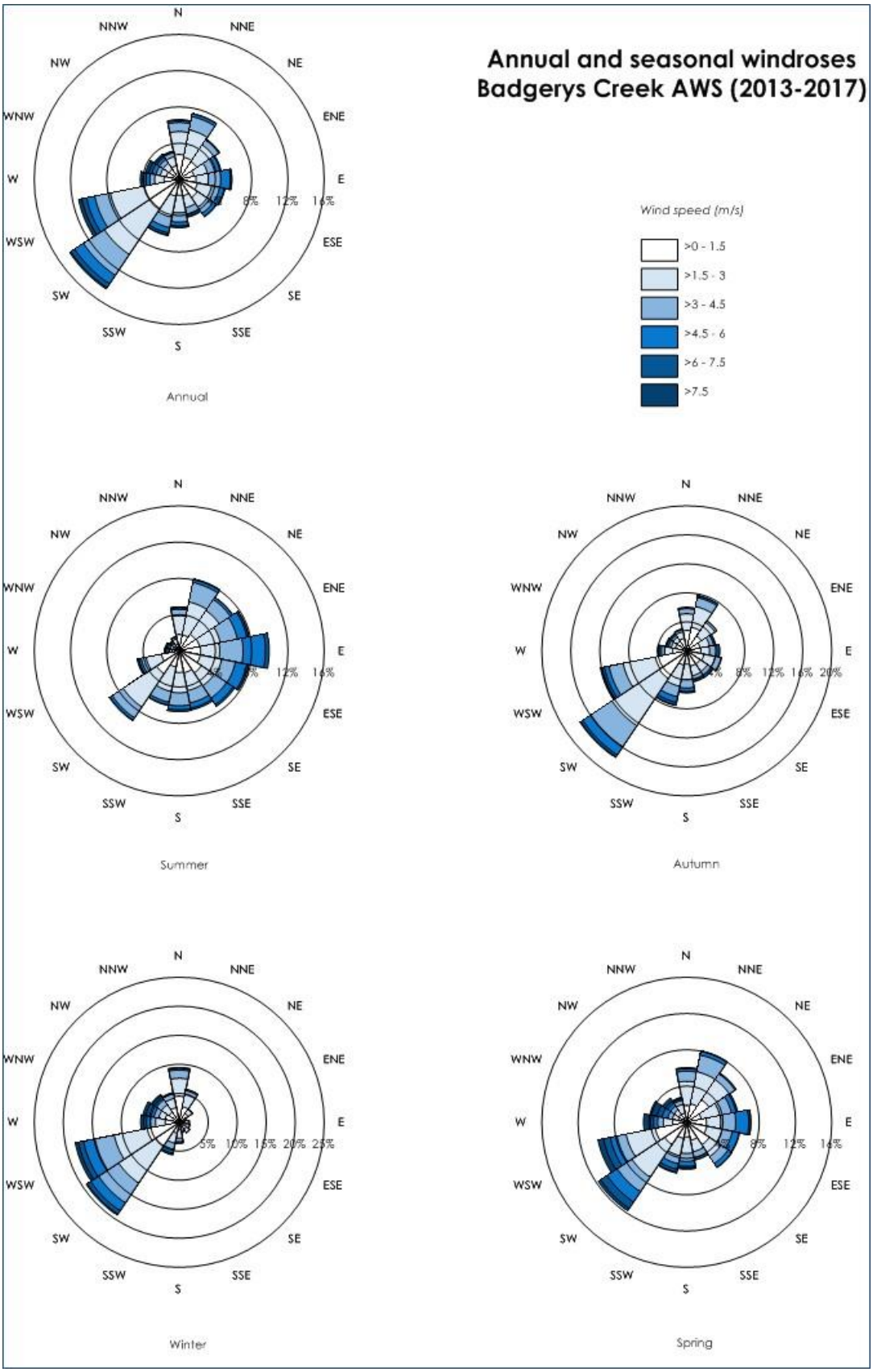


Figure A-3: Annual and seasonal windroses for Badgerys Creek AWS (2013-2017)

Appendix B

Emissions Calculations

Emissions calculations

The dust emissions from the extraction activities have been estimated from the operational pit scenario descriptions provided by the Proponent and have been combined with emissions factor equations that relate to the quantity of dust emitted from particular activities based on intensity, the prevailing meteorological conditions and composition of the material being handled.

Emission factors and associated controls have been sourced from the National Pollutant Inventory Emission Estimation Technique Manuals (**NPI 2012** and **NPI 2014**) and US EPA AP42 Emission Factors (**US EPA 1998**, **US EPA 2006a, US EPA 2006b,** and **US EPA 2011**).

Table C-1: Emission factor equations

Activity	Emission factor equation	Variable
Bulldozers	$EF_{TSP} = 2.6 \times \left(\frac{s^{1.2}}{M^{1.3}}\right) kg/hr/vehicle$	s = surface material silt content (%) M = moisture content (%)
Material handling/ loading/ unloading	$EF_{TSP} = k \times 0.0016 \times \left(\frac{U}{2.2}^{1.3} \Big/ \frac{M}{2}^{1.4}\right) kg/tonne$	k_{tsp} = 0.74 U = wind speed (m/s) M = moisture content (%)
Hauling on unsealed surfaces	$EF_{TSP} = 0.2819 \times k \times \left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b} kg/VKT$	k_{TSP} = 4.9 s = surface material silt content (%) W = average weight of vehicles (tonnes) a_{TSP} = 0.7 b_{TSP} = 0.45 75% control factor for watering applied
Hauling on paved surfaces	$EF_{TSP} = \frac{k \times (sL)^{0.91} \times (W)^{1.02}}{1000} kg/VKT$	**k_{tsp}** = 3.23 (g/VKT) sL = road surface silt loading (g/m²) W = average weight of vehicles (tons)
Wind erosion	$EF_{TSP} = 850\, kg/ha/year$	-
Grading	$EF_{TSP} = 0.0034 \times S^{2.5} kg/VKT$	S = vehicle speed (km/hr)
Unload sand to ground bin	$EF_{TSP} = 0.0011\, kg/tonne$	-
Unloading cement/flyash to silos	$EF_{TSP} = 0.0005\, kg/tonne$	-
Crushing reject tiles	$EF_{TSP} = 0.0006\, kg/tonne$	-

Table B-2: Emissions inventory – Brick making facility Phase 1 and Phase 2

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4 - TSP	Variable 4 - PM10	Variable 4 - PM25	Units	Variable 5	Units	DUST CONTROLS	Assumptions
Loading clay material from stockpile to haul truck (on-site)	39	18	2	145,000	t/yr	0.0003	0.0001	0.00001	kg/t	1.1	mean WS m/s/2.2 ^1.3	6.0	moisture content %										
Hauling clay material to box feeder (unpaved)	756	194	19	145,000	t/yr	0.021	0.005	0.001	kg/t	30	t/load	0.3	km/trip	5.0	silt content %	2.103	0.540	0.054	kg/VKT	33	Ave GMV (tonnes)	75	watering
Loading clay material from stockpile to box feeder	39	18	2	145,000	t/yr	0.0003	0.0001	0.0000	kg/t	1.1	mean WS m/s/2.2 ^1.3	6	moisture content %										
Hauling raw materials from off-site (paved)	2,379	457	110	215,000	t/yr	0.011	0.002	0.001	kg/t	33	t/load	1.7	km/trip	2.0	S.L. (g/m²)	0.216	0.041	0.010	kg/VKT	33.167	Ave GMV (tonnes)		
Unloading raw materials from off-site to stockpile	270	128	13	215,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Loading raw materials to box feeder	270	128	13	215,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Hauling brick products off-site (paved)	3,000	576	139	330,000	t/yr	0.009	0.002	0.0004	kg/t	30	t/load	1.4	km/trip	2.0	S.L. (g/m²)	0.192	0.037	0.009	kg/VKT	29.500	Ave GMV (tonnes)		
Load clay/ raw material to truck from stockpile for dispatch off-site	74	35	4	275,000	t/yr	0.0003	0.0001	0.00001	kg/t	1.1	mean WS m/s/2.2 ^1.3	6.0	moisture content %										
Truck haulage of clay offsite (unpaved)	1,434	368	37	275,000	t/yr	0.021	0.005	0.001	kg/t	30	t/load	0.3	km/trip	5.0	silt content %	2.103	0.540	0.054	kg/VKT	33	Ave GMV (tonnes)	75	watering
Truck haulage of clay offsite (paved)	3,294	632	153	275,000	t/yr	0.01197785	0.002	0.001	kg/t	30	t/load	1.7	km/trip	2.0	S.L. (g/m²)	0.213	0.041	0.010	kg/VKT	32.750	Ave GMV (tonnes)		
Raw material and burden stockpile wind erosion	9,350	4,675	701	11	ha	850	425	64	kg/ha/yr														
Total	**20,905**	**7,230**	**1,193**																				

Table B-3: Emissions inventory – Brick making facility Phase 3 and Phase 4

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4 - TSP	Variable 4 - PM10	Variable 4 - PM25	Units	Variable 5	Units	DUST CONTROLS	Assumptions
Hauling raw materials from off-site (paved)	3,984	765	185	360,000	t/yr	0.011	0.002	0.001	kg/t	33	t/load	1.7	km/trip	2.0	S.L. (g/m²)	0.216	0.041	0.010	kg/VKT	33.167	Ave GMV (tonnes)		
Unloading raw materials from off-site to stockpile	452	214	21	360,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Loading raw materials to box feeder	452	214	21	360,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Hauling brick products off-site (paved)	3,000	576	139	330,000	t/yr	0.009	0.002	0.0004	kg/t	30	t/load	1.4	km/trip	2.0	S.L. (g/m²)	0.192	0.037	0.009	kg/VKT	29.500	Ave GMV (tonnes)		
Raw material and burden stockpile wind erosion	9,350	4,675	701	11	ha	850	425	64	kg/ha/yr														
Total	**17,237**	**6,443**	**1,068**																				

Table B-4: Emissions inventory – Bund construction

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4 - TSP	Variable 4 - PM10	Variable 4 - PM25	Units	Variable 5	Units	DUST CONTROLS	Assumptions
Loading burden to haul truck	54	26	3	43,200	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Hauling burden to bund (unpaved)	507	130	13	43,200	t/yr	0.047	0.012	0.001	kg/t	39	t/load	0.8	km/trip	5.0	silt content %	2.288	0.588	0.059	kg/VKT	40	Ave GMV (tonnes)	75	watering
Unloading from truck(excavator)	54	26	3	43,200	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Shaping bund	54	26	3	43,200	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Bund wind erosion	893	446	67	2	ha	850	425	64	kg/ha/yr													30	primary rehabilitiation
Total	**1,562**	**653**	**88**																				

Table B-5: Emissions inventory – Extraction activities Phase 1

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4 - TSP	Variable 4 - PM10	Variable 4 - PM25	Units	Variable 5	Units	DUST CONTROLS	Assumptions
Removal of topsoil / burden in Pit 3 (excavator)	100	47	5	80,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Loading burden to haul truck	100	47	5	80,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Hauling burden to stockpile (unpaved)	2,933	754	75	80,000	t/yr	0.147	0.038	0.004	kg/t	39	t/load	2.5	km/trip	5.0	silt content %	2.288	0.588	0.059	kg/VKT	40	Ave GMV (tonnes)	75	watering
Unloading burden at Pit 1&2	100	47	5	80,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Compactor in Pit 1&2 (bulldozer)	1,902	337	190	1,089	hrs/yr	1.75	0.31	0.17	kg/hr	5.0	silt content %	6	moisture content %										
Bulldozer for breaking up clay/ raw materials in Pit 3	1,902	337	190	1,089	hrs/yr	1.75	0.31	0.17	kg/hr	5.0	silt content %	6	moisture content %										
Loading clay/ raw material to haul truck	113	54	5	420,000	t/yr	0.0003	0.0001	0.00001	kg/t	1.1	mean WS m/s/2.2 ^1.3	6	moisture content %										
Haul materials to raw materials stockpile area (unpaved)	4,928	1,266	127	420,000	t/yr	0.047	0.012	0.001	kg/t	39	t/load	0.8	km/trip	5.0	silt content %	2.288	0.588	0.059	kg/VKT	40	Ave GMV (tonnes)	75	watering
Unloading clay/ raw materials to stockpile area	113	54	5	420,000	t/yr	0.0003	0.0001	0.00001	kg/t	1.1	mean WS m/s/2.2 ^1.3	6	moisture content %										
FEL shaping stockpiles	113	54	5	420,000	t/yr	0.0003	0.0001	0.0000	kg/t	1.1	mean WS m/s/2.2 ^1.3	6	moisture content %										
Grading haul roads	3,326	1,149	106	5,280	km/yr	0.630	0.218	0.020	kg/vkt	8	speed of graders in km/h												
Wind erosion pit 1	10,455	5,228	784	12	ha	850	425	64	kg/ha/yr														
Wind erosion pit 2	2,975	1,488	223	4	ha	850	425	64	kg/ha/yr														
Wind erosion pit 3	7,565	3,783	567	9	ha	850	425	64	kg/ha/yr														
Total	**36,627**	**14,643**	**2,294**																				

Table B-6: Emissions inventory – Extraction activities Phase 2

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4 - TSP	Variable 4 - PM10	Variable 4 - PM25	Units	Variable 5	Units	DUST CONTROLS	Assumptions
Removal of topsoil / burden in Pit 3 (excavator)	100	47	5	80,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Loading burden to haul truck	100	47	5	80,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Hauling burden to emplacement	1,408	362	36	80,000	t/yr	0.070	0.018	0.002	kg/t	39	t/load	1.2	km/trip	5.0	silt content %	2.288	0.588	0.059	kg/VKT	40	Ave GMV (tonnes)	75	watering
Unloading burden at emplacement	100	47	5	80,000	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Compactor on emplacement (bulldozer)	1,902	337	190	1,089	hrs/yr	1.75	0.31	0.17	kg/hr	5.0	silt content	6	moisture content %										
Bulldozer for breaking up clay/ raw materials in Pit 3	1,902	337	190	1,089	hrs/yr	1.75	0.31	0.17	kg/hr	5.0	silt content	6	moisture content %										
Loading clay/ raw material to haul truck	113	54	5	420,000	t/yr	0.0003	0.0001	0.00001	kg/t	1.1	mean WS m/s/2.2 ^1.3	6	moisture content %										
Haul materials to raw materials stockpile area (unpa	4,928	1,266	127	420,000	t/yr	0.047	0.012	0.001	kg/t	39	t/load	0.8	km/trip	5.0	silt content %	2.288	0.588	0.059	kg/VKT	40	Ave GMV (tonnes)	75	watering
Unloading clay/ raw materials to stockpile area	113	54	5	420,000	t/yr	0.0003	0.0001	0.00001	kg/t	1.1	mean WS m/s/2.2 ^1.3	6	moisture content %										
FEL shaping stockpiles	113	54	5	420,000	t/yr	0.0003	0.0001	0.0000	kg/t	1.1	mean WS m/s/2.2 ^1.3	6	moisture content %										
Grading haul roads	3,326	1,149	106	5,280	km/yr	0.630	0.218	0.020	kg/vkt	8	speed of graders in km/h												
Wind erosion pit 3	7,565	3,783	567	9	ha	850	425	64	kg/ha/yr														
Total	**21,672**	**7,536**	**1,247**																				

Table B-7: Emissions inventory – VENM importation Phase 1

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4 - TSP	Variable 4 - PM10	Variable 4 - PM25	Units	Variable 5	Units	DUST CONTROLS	Assumptions
Hauling VENM on-site (unpaved)	114,768	29,490	2,949	1,830,240	t/yr	0.251	0.064	0.006	kg/t	36	t/load	4.0	km/trip	5.0	silt content %	2.257	0.580	0.058	kg/VKT	38	Ave GMV (tonnes)	75	watering
Unloading VENM to Pit 1&2	2,296	1,086	109	1,830,240	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Compactor backfilling/shaping VENM (dozer)	18,802	3,718	1,880	2,581	hrs/yr	7.28	1.44	0.73	kg/hr/vehicle	5.0	silt content %	2	moisture content %										
Total	**135,866**	**34,294**	**4,938**																				

Table B-8: Emissions inventory – VENM importation Phase 2 and Phase 3

ACTIVITY	TSP emission (kg/y)	PM10 emission (kg/y)	PM25 emission (kg/y)	Intensity	Units	Emission Factor - TSP	Emission Factor - PM10	Emission Factor - PM25	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4 - TSP	Variable 4 - PM10	Variable 4 - PM25	Units	Variable 5	Units	DUST CONTROLS	Assumptions
Hauling VENM on-site (unpaved)	63,123	16,220	1,622	1,830,240	t/yr	0.138	0.035	0.004	kg/t	36	t/load	2.2	km/trip	5.0	silt content %	2.257	0.580	0.058	kg/VKT	38	Ave GMV (tonnes)	75	watering
Unloading VENM to Pit 3	2,296	1,086	109	1,830,240	t/yr	0.0013	0.0006	0.0001	kg/t	1.1	mean WS m/s/2.2 ^1.3	2	moisture content %										
Compactor backfilling/shaping VENM (dozer)	18,802	3,718	1,880	2,581	hrs/yr	7.28	1.44	0.73	kg/hr/vehicle	5.0	silt content %	2	moisture content %										
Total	**84,220**	**21,023**	**3,611**																				

Appendix C

Isopleth Diagrams

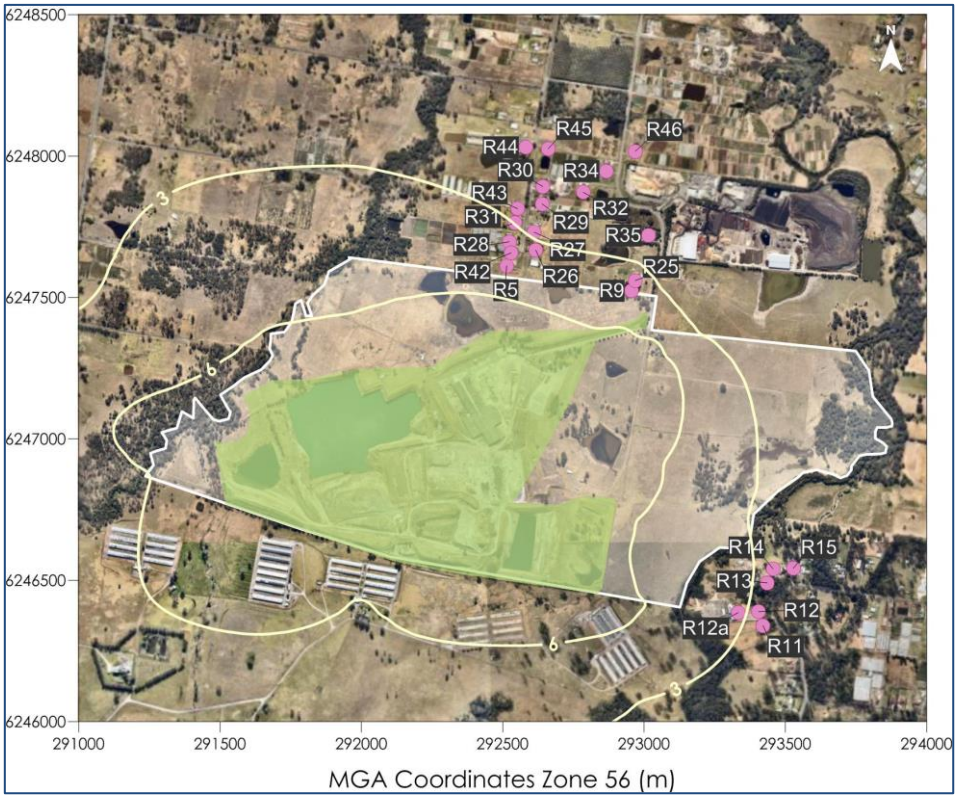


Figure C-1: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations – Phase 1 scenario (µg/m³)

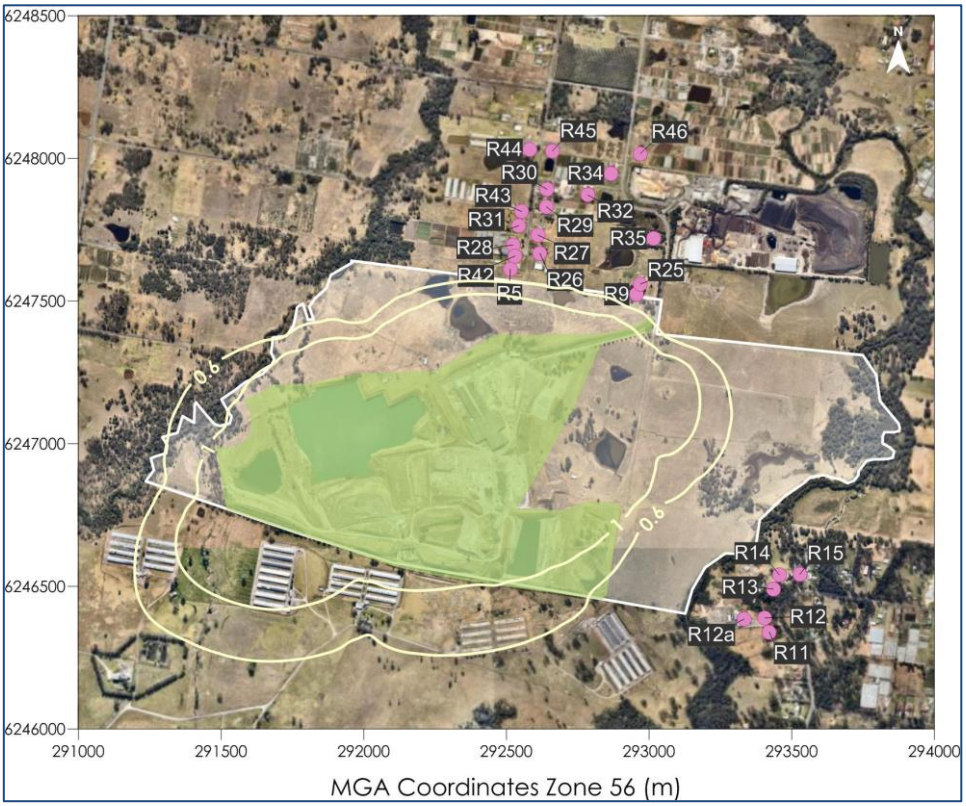


Figure C-2: Predicted incremental annual average $PM_{2.5}$ concentrations – Phase 1 scenario (µg/m³)

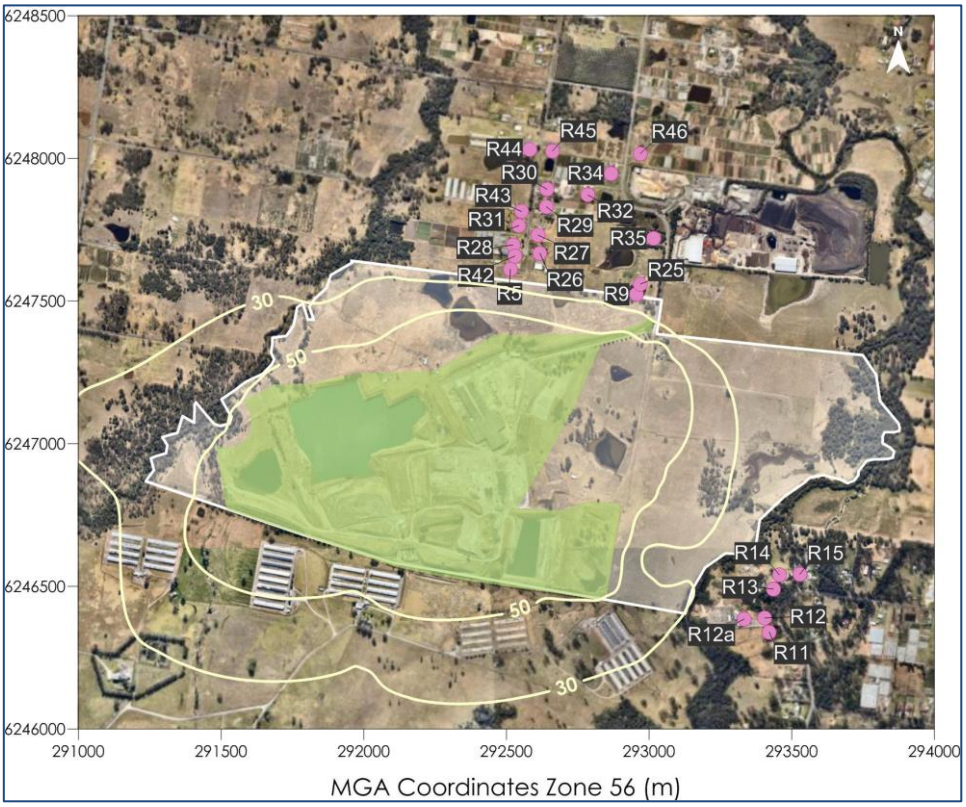


Figure C-3: Predicted incremental maximum 24-hour average PM_{10} concentrations – Phase 1 scenario (µg/m³)

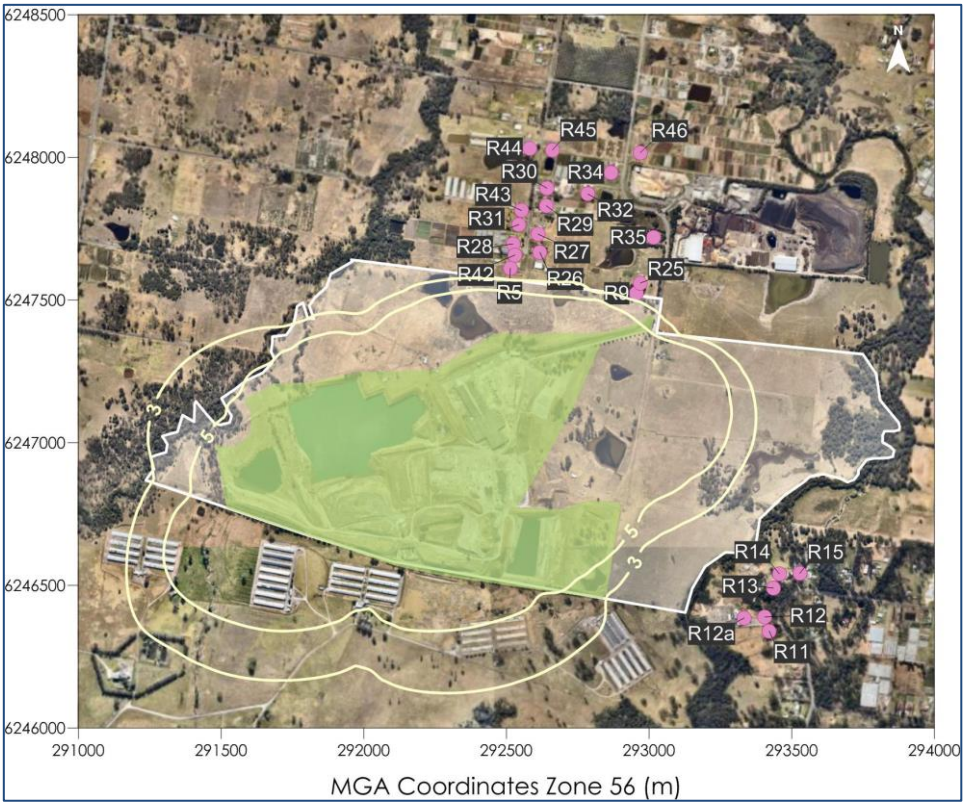


Figure C-4: Predicted incremental annual average PM_{10} concentrations – Phase 1 scenario (µg/m³)

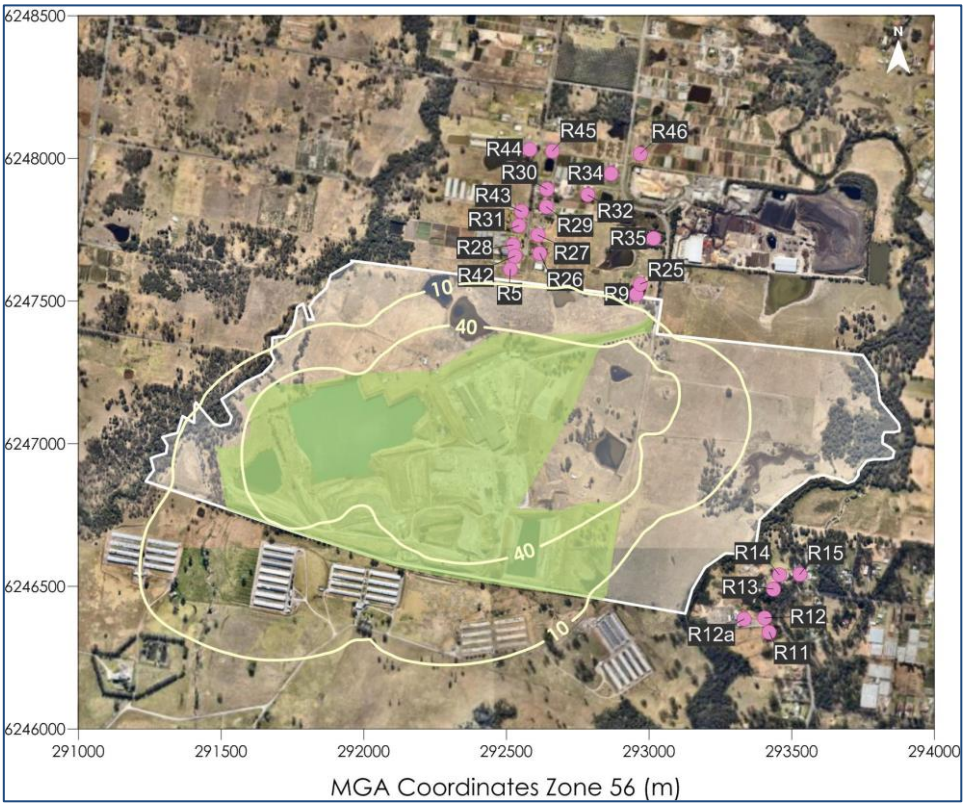


Figure C-5: Predicted incremental annual average TSP concentrations – Phase 1 scenario (µg/m³)

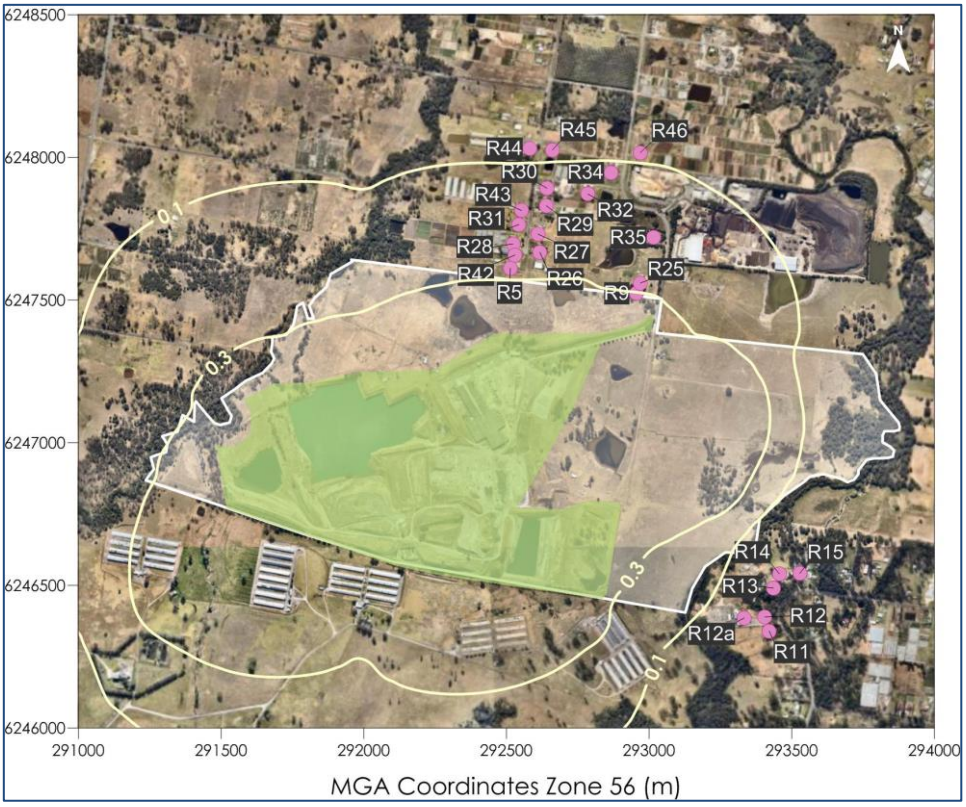


Figure C-6: Predicted incremental annual average dust deposition levels – Phase 1 scenario (g/m²/month)

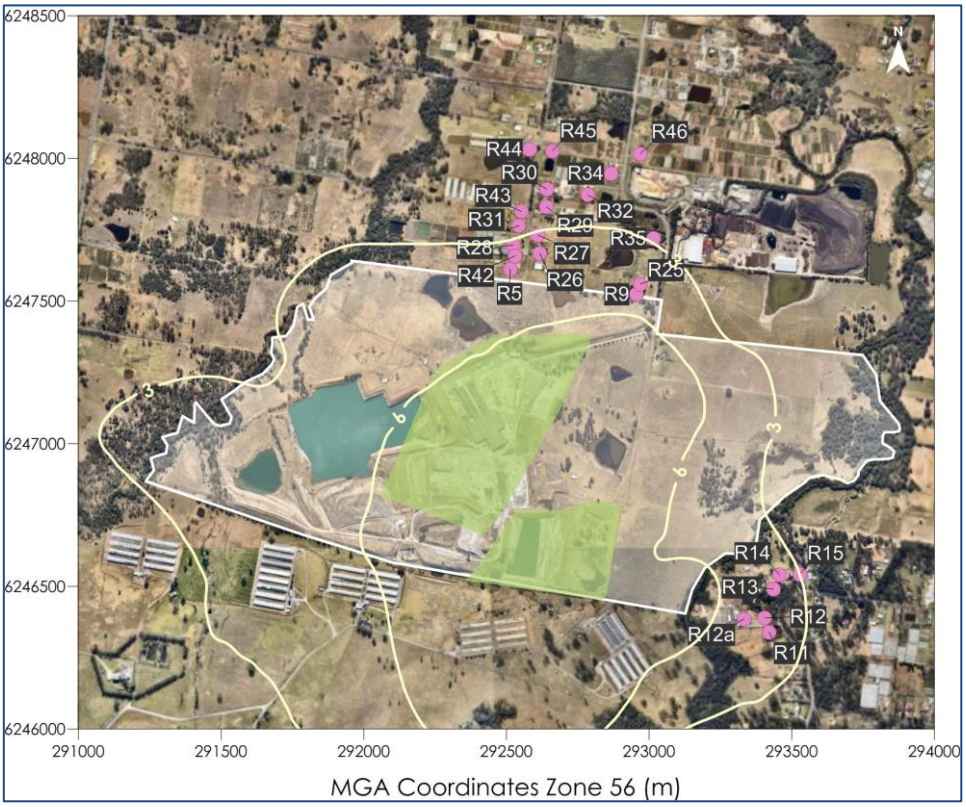


Figure C-7: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations – Phase 2 scenario (µg/m³)

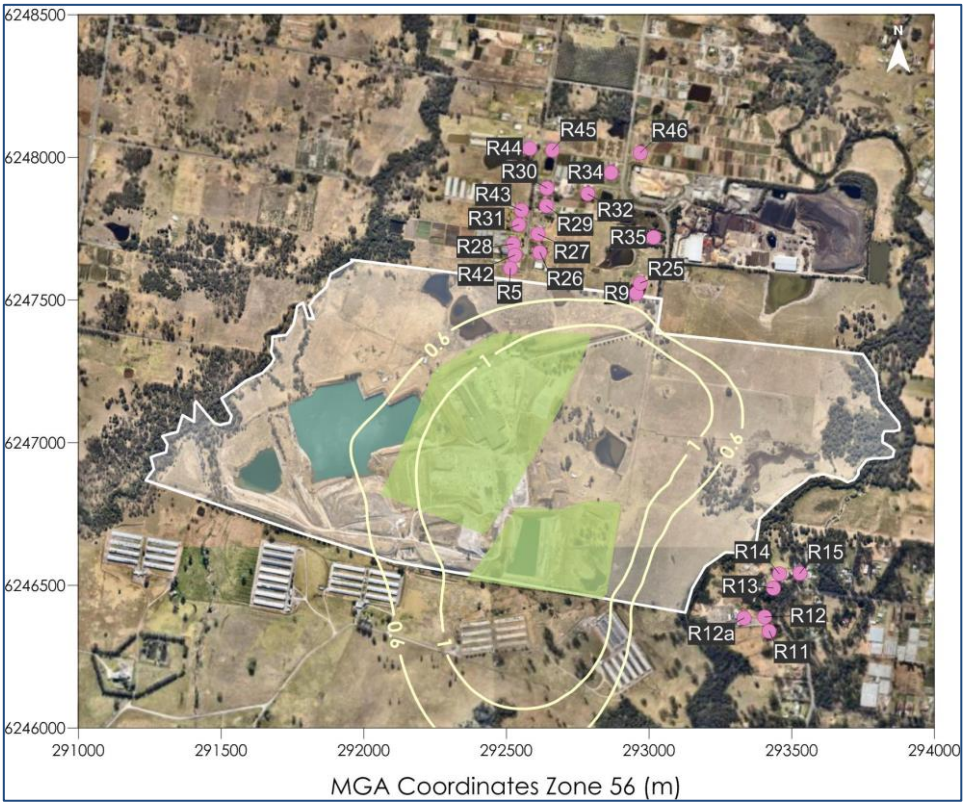


Figure C-8: Predicted incremental annual average $PM_{2.5}$ concentrations – Phase 2 scenario (µg/m³)

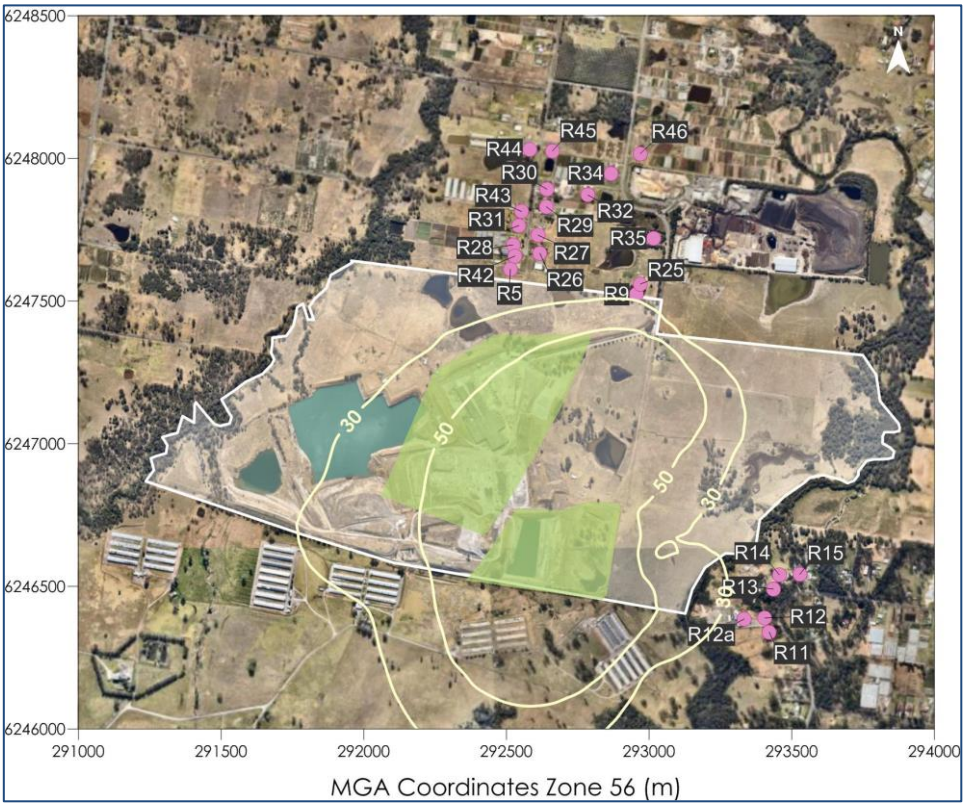


Figure C-9: Predicted incremental maximum 24-hour average PM_{10} concentrations – Phase 2 scenario (µg/m³)

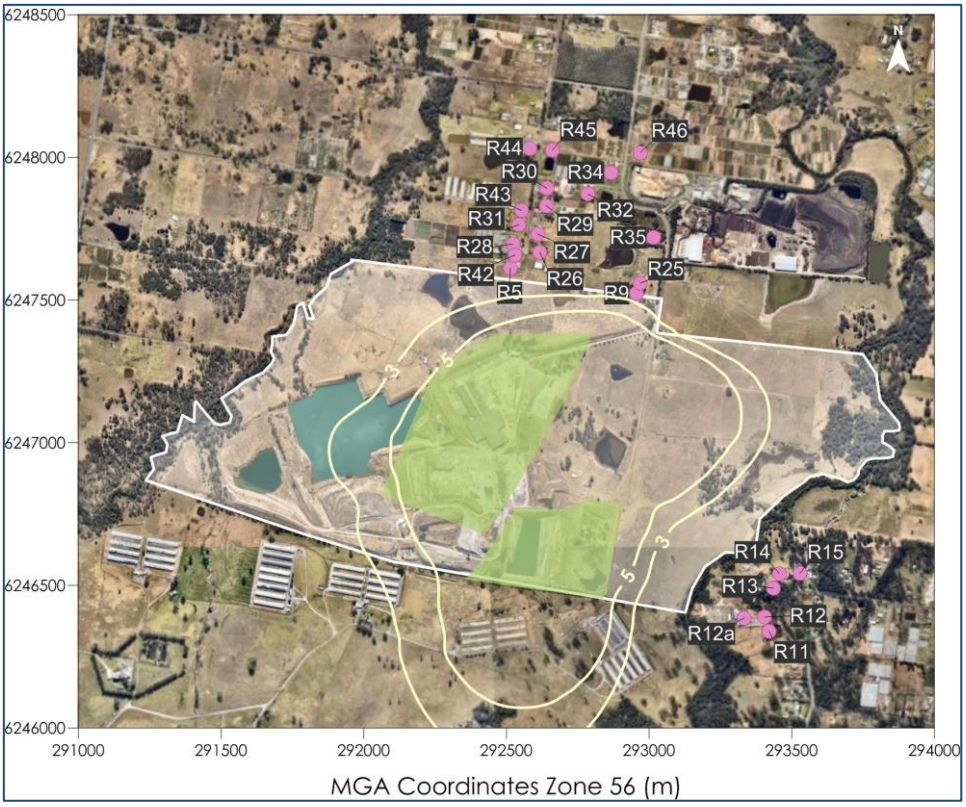


Figure C-10: Predicted incremental annual average PM_{10} concentrations – Phase 2 scenario (µg/m³)

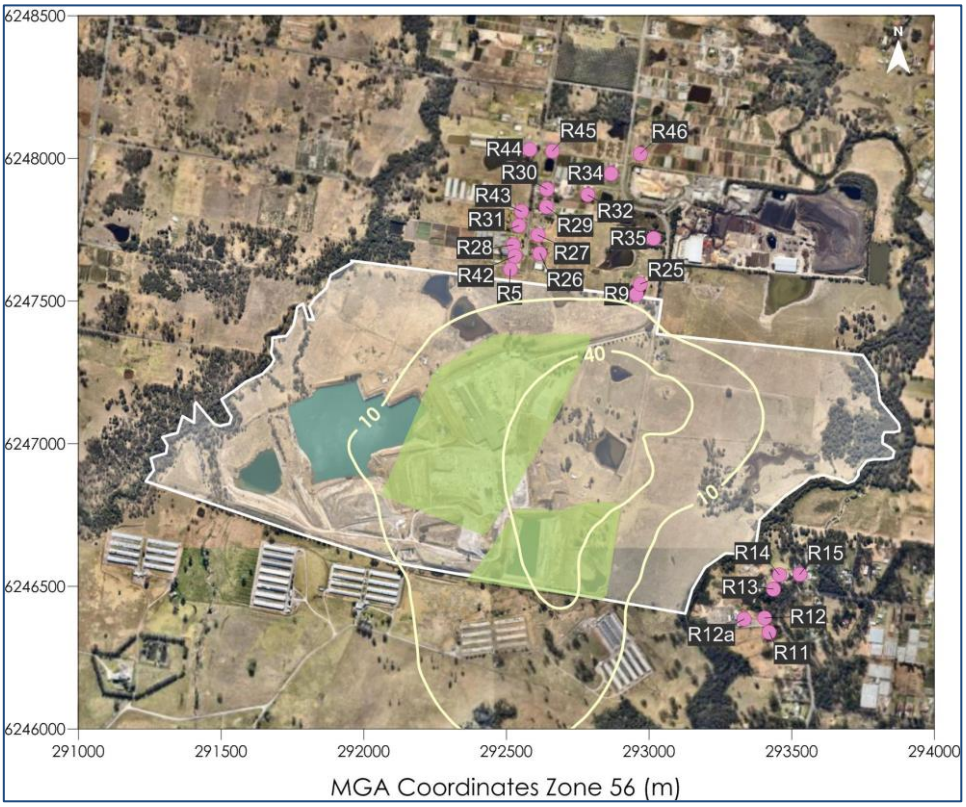


Figure C-11: Predicted incremental annual average TSP concentrations – Phase 2 scenario (µg/m³)

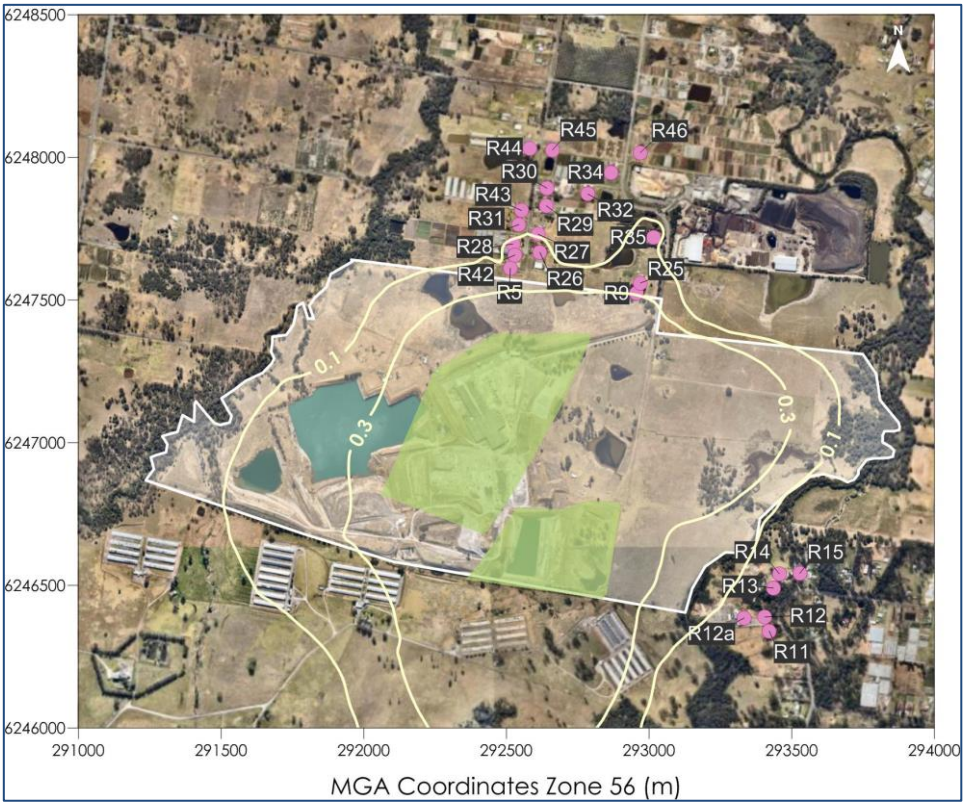


Figure C-12: Predicted incremental annual average dust deposition levels – Phase 2 scenario (g/m²/month)

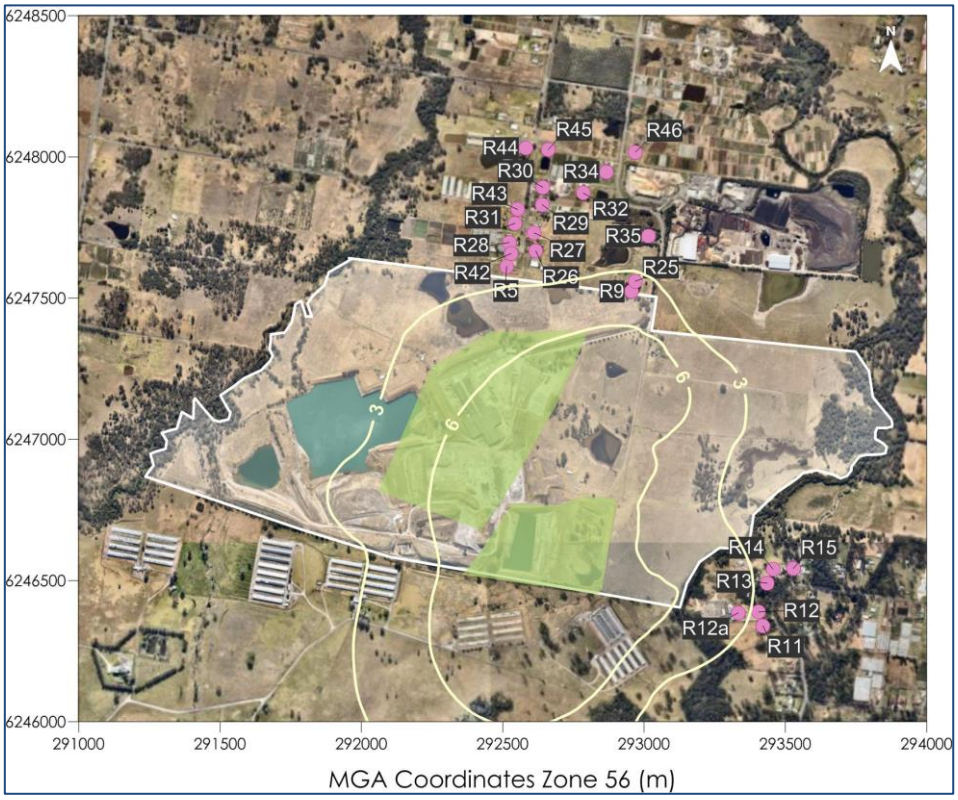


Figure C-13: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations – Phase 3 scenario (µg/m³)

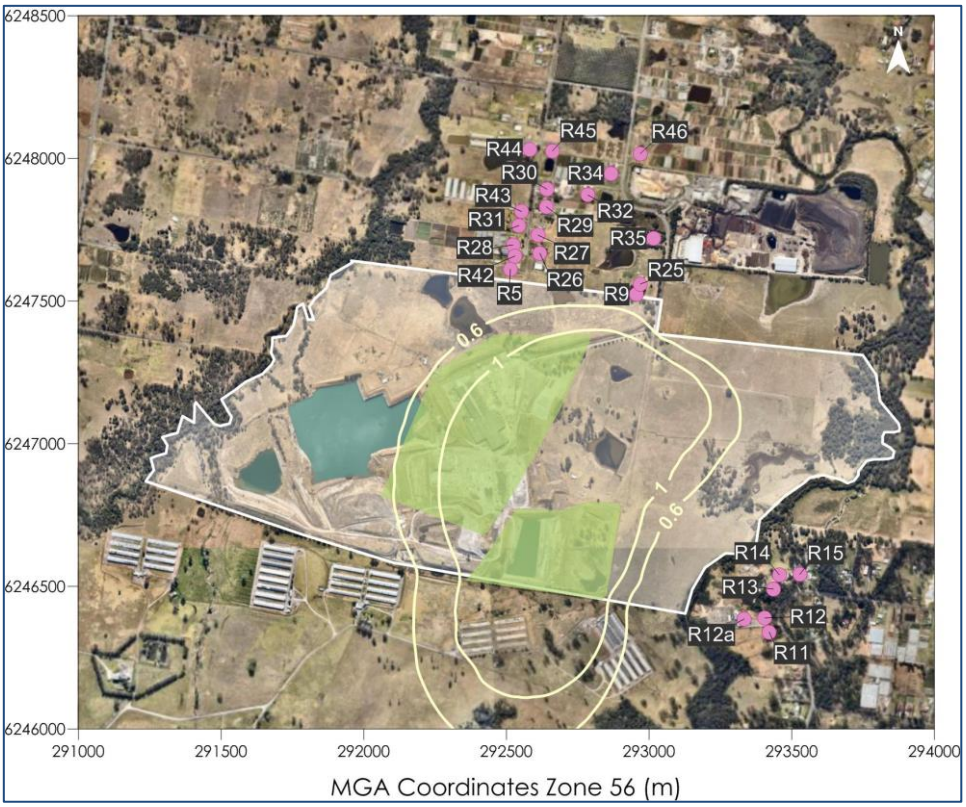


Figure C-14: Predicted incremental annual average $PM_{2.5}$ concentrations – Phase 3 scenario (µg/m³)

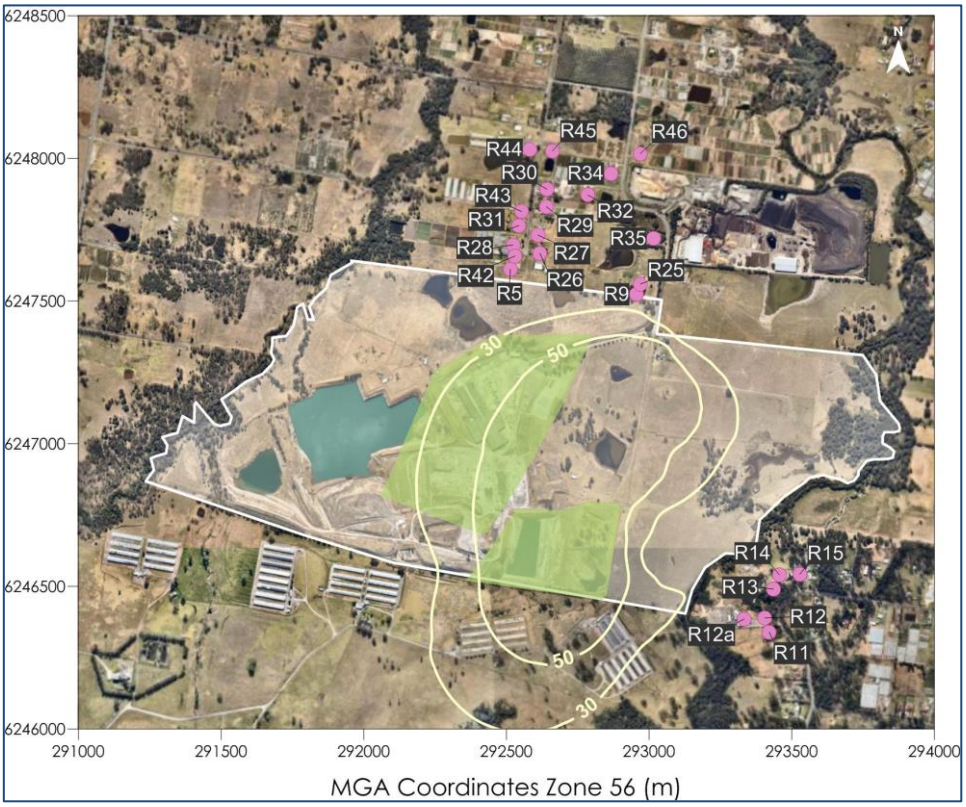


Figure C-15: Predicted incremental maximum 24-hour average PM_{10} concentrations – Phase 3 scenario (µg/m³)

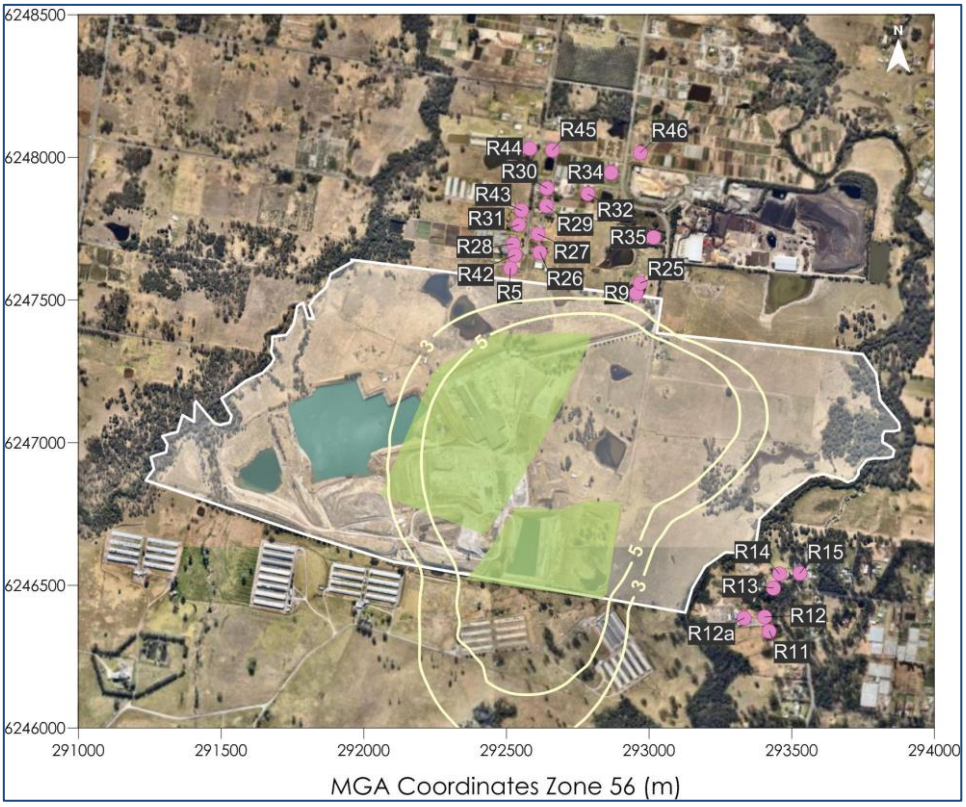


Figure C-16: Predicted incremental annual average PM_{10} concentrations – Phase 3 scenario (µg/m³)

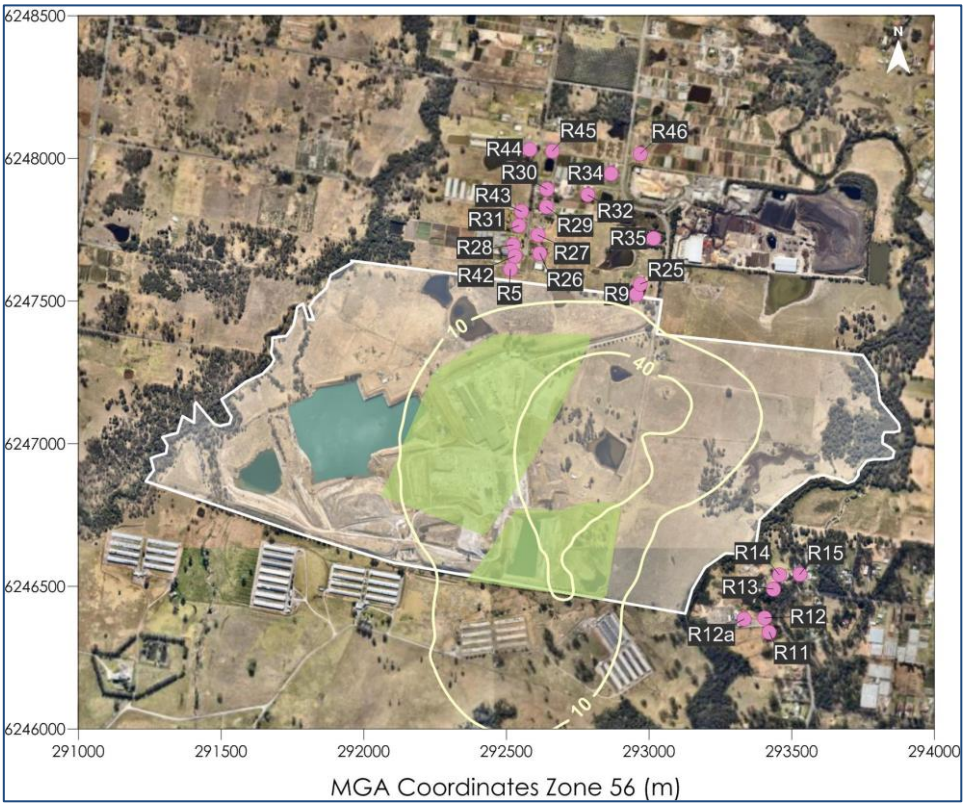


Figure C-17: Predicted incremental annual average TSP concentrations – Phase 3 scenario (µg/m³)

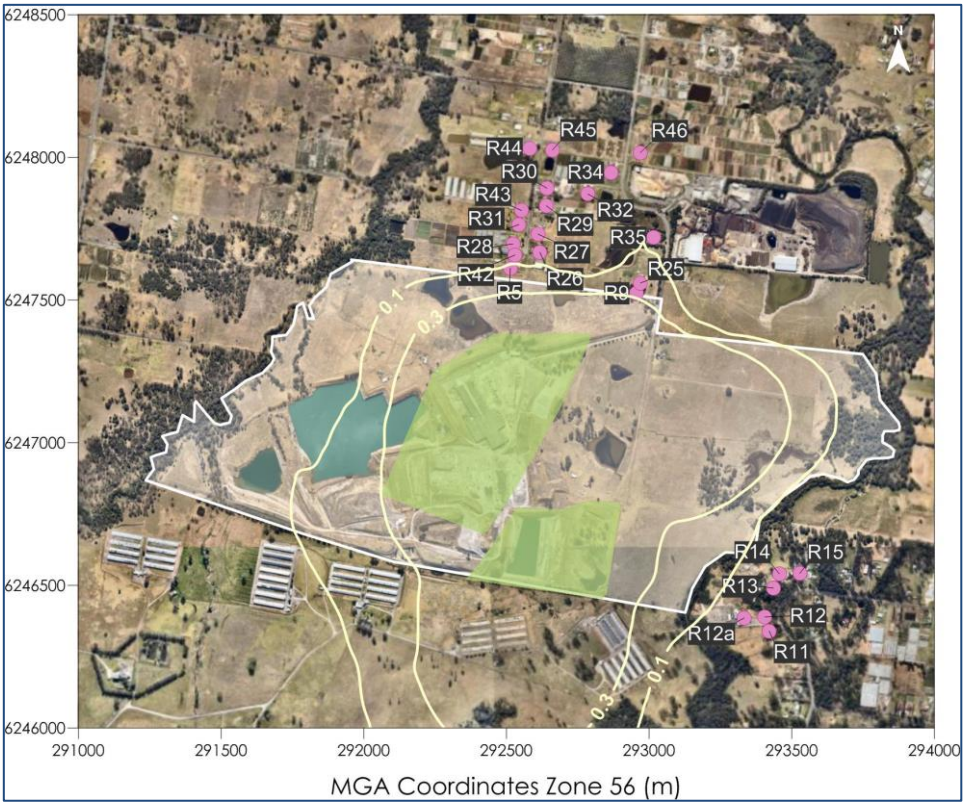


Figure C-18: Predicted incremental annual average dust deposition levels – Phase 3 scenario (g/m²/month)

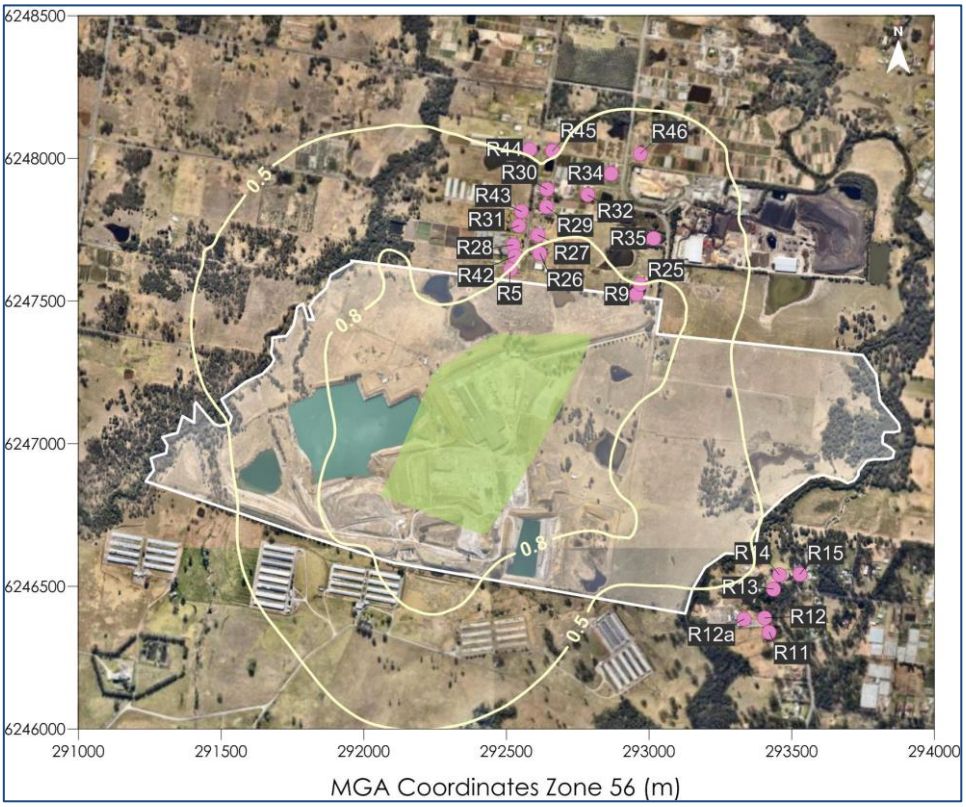


Figure C-19: Predicted incremental maximum 24-hour average $PM_{2.5}$ concentrations – Phase 4 scenario (µg/m³)

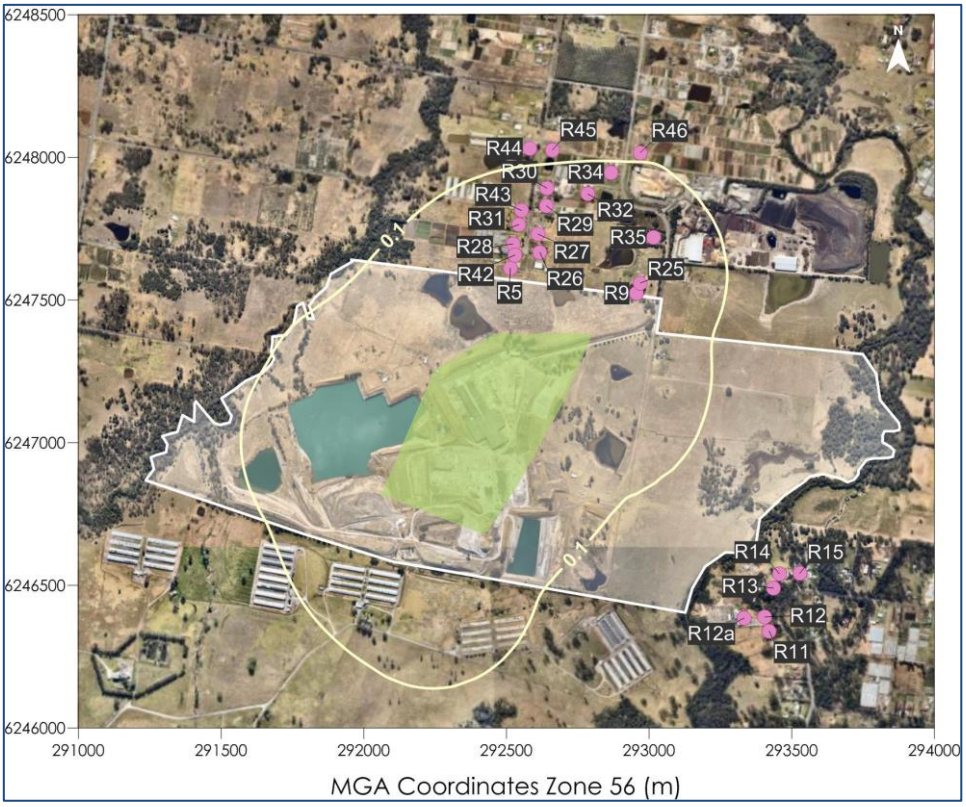


Figure C-20: Predicted incremental annual average $PM_{2.5}$ concentrations – Phase 4 scenario (µg/m³)

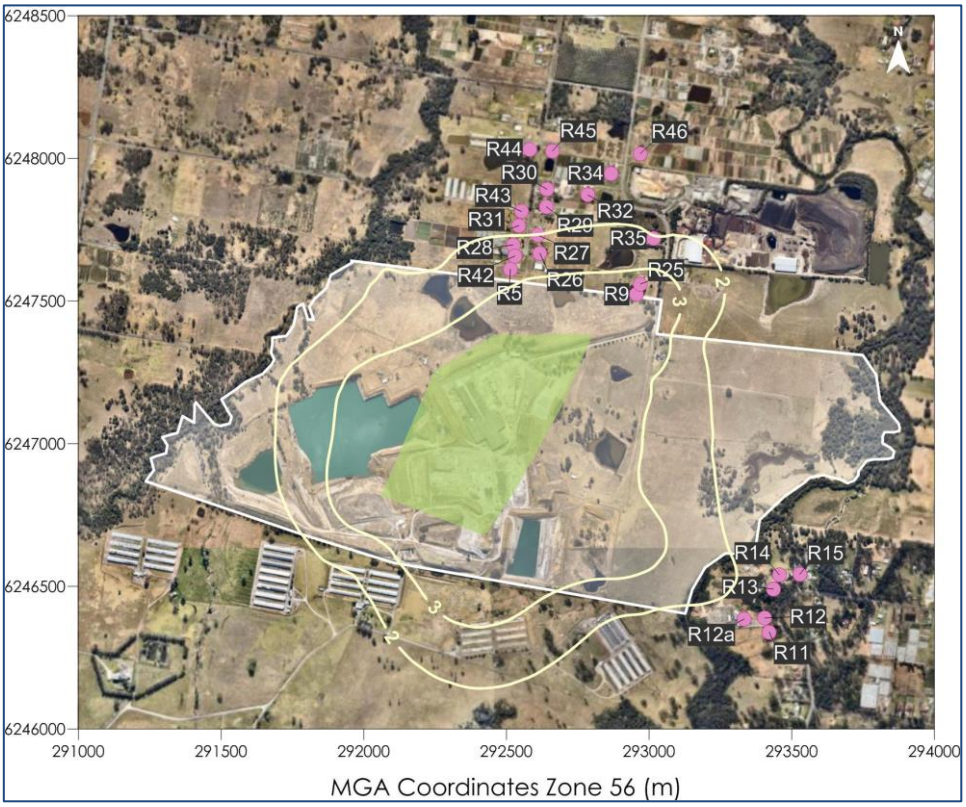


Figure C-21: Predicted incremental maximum 24-hour average PM_{10} concentrations – Phase 4 scenario (µg/m³)

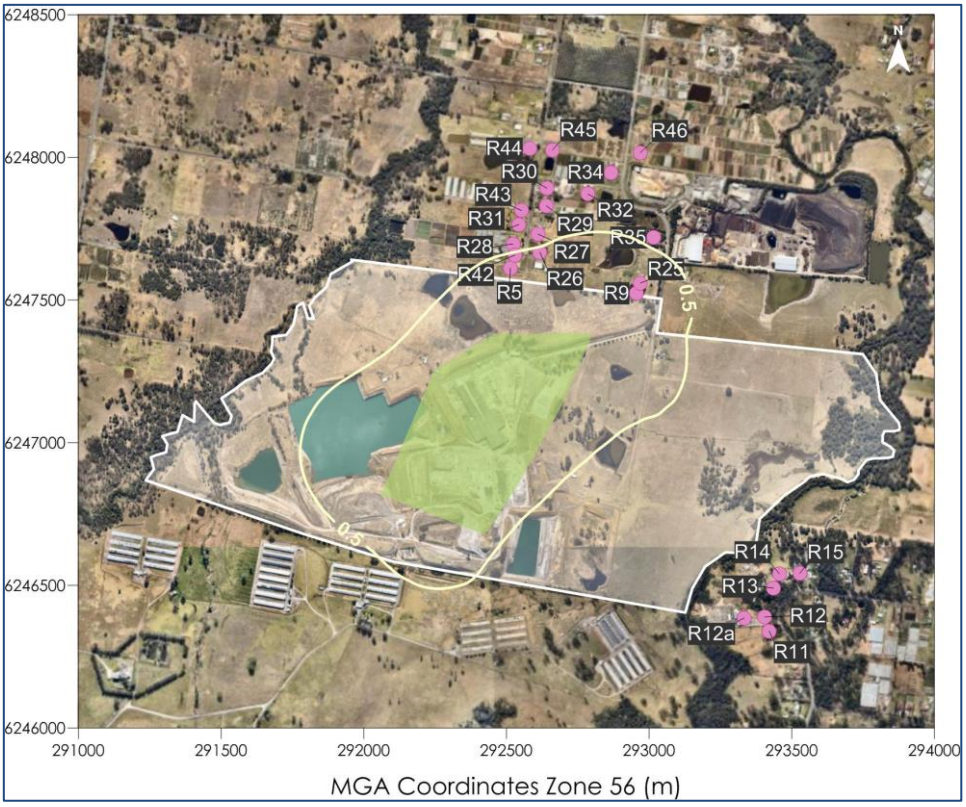


Figure C-22: Predicted incremental annual average PM_{10} concentrations – Phase 4 scenario (µg/m³)

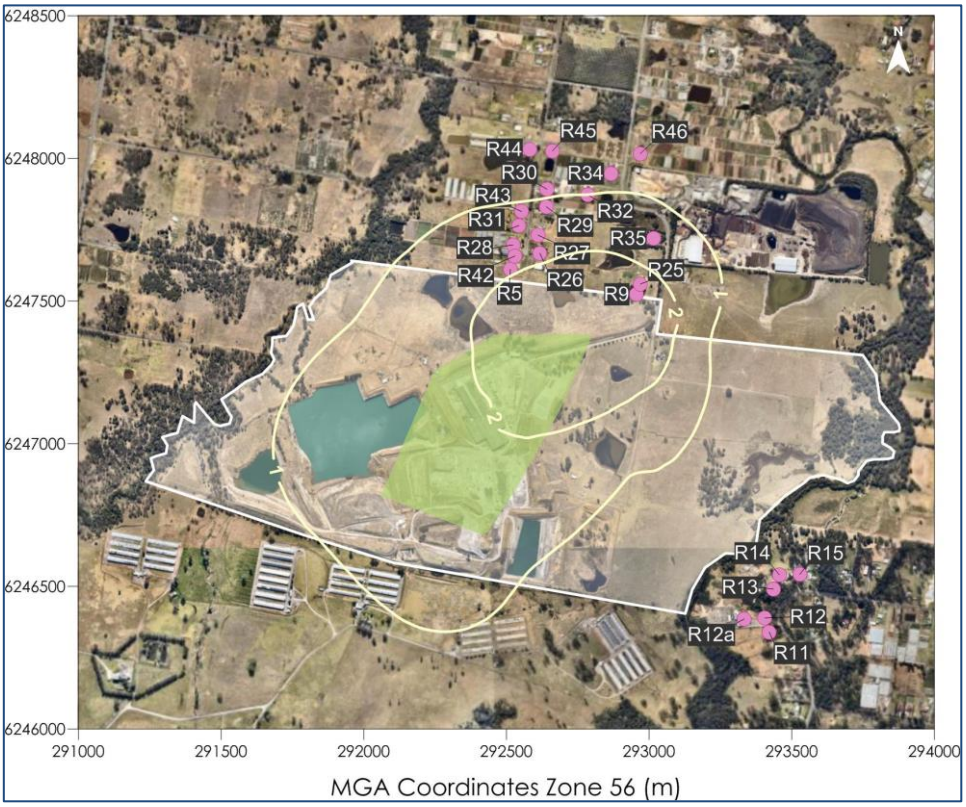


Figure C-23: Predicted incremental annual average TSP concentrations – Phase 4 scenario (µg/m³)

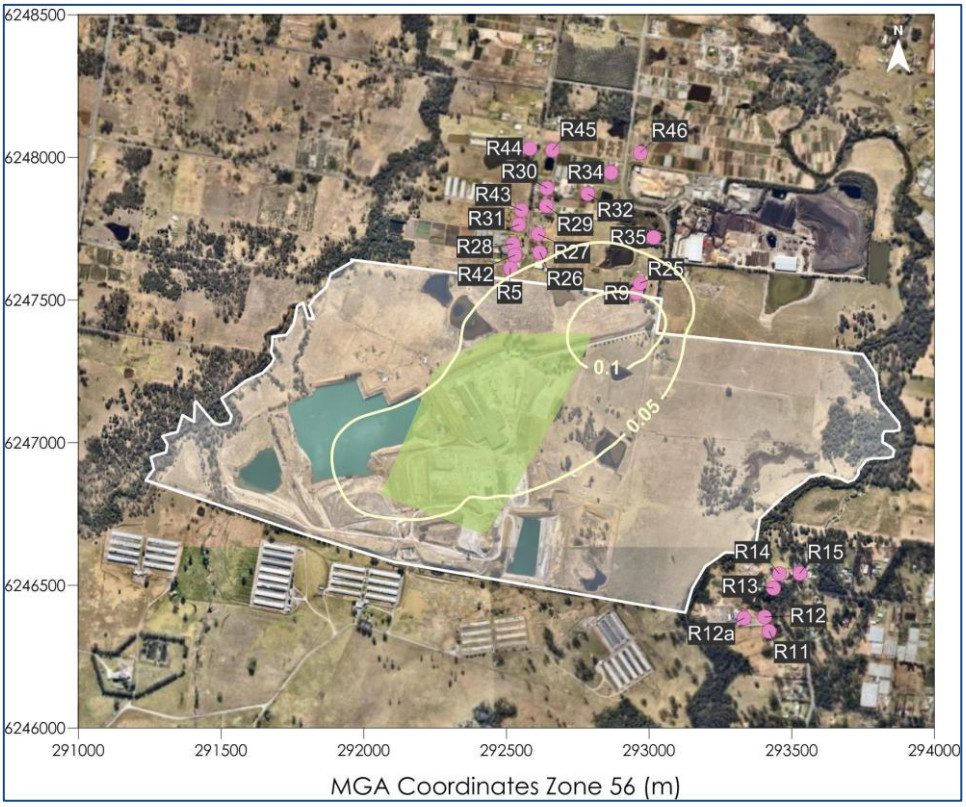


Figure C-24: Predicted incremental annual average dust deposition levels – Phase 4 scenario (g/m²/month)

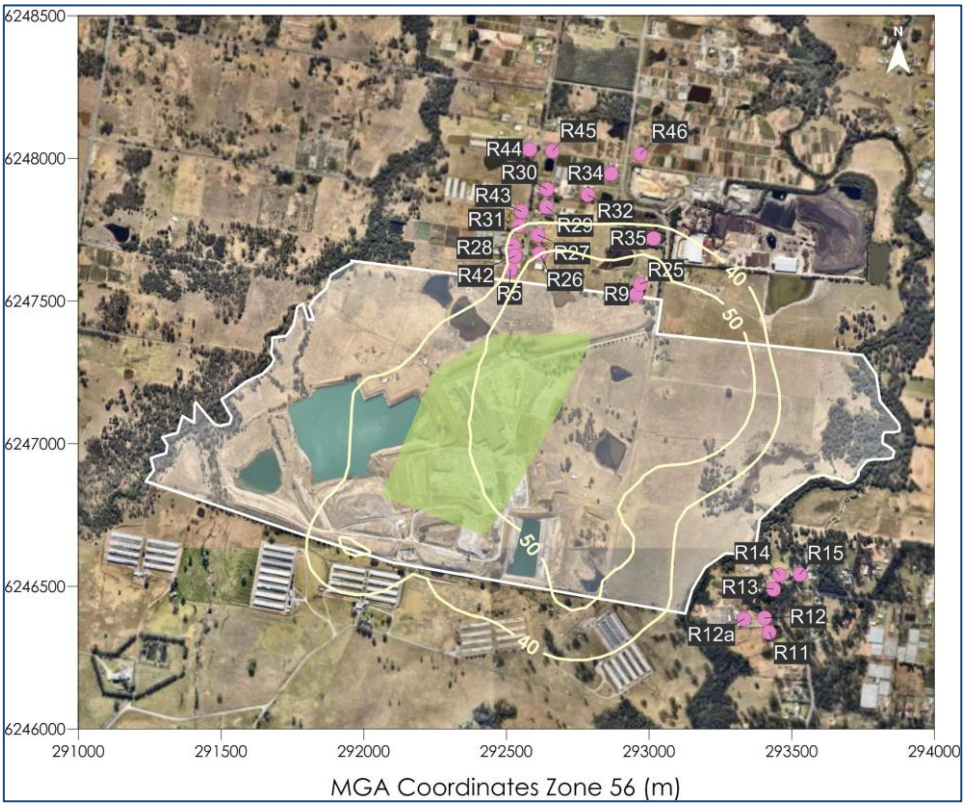


Figure C-25: Predicted incremental maximum 1-hour average SO_2 concentrations (µg/m³)

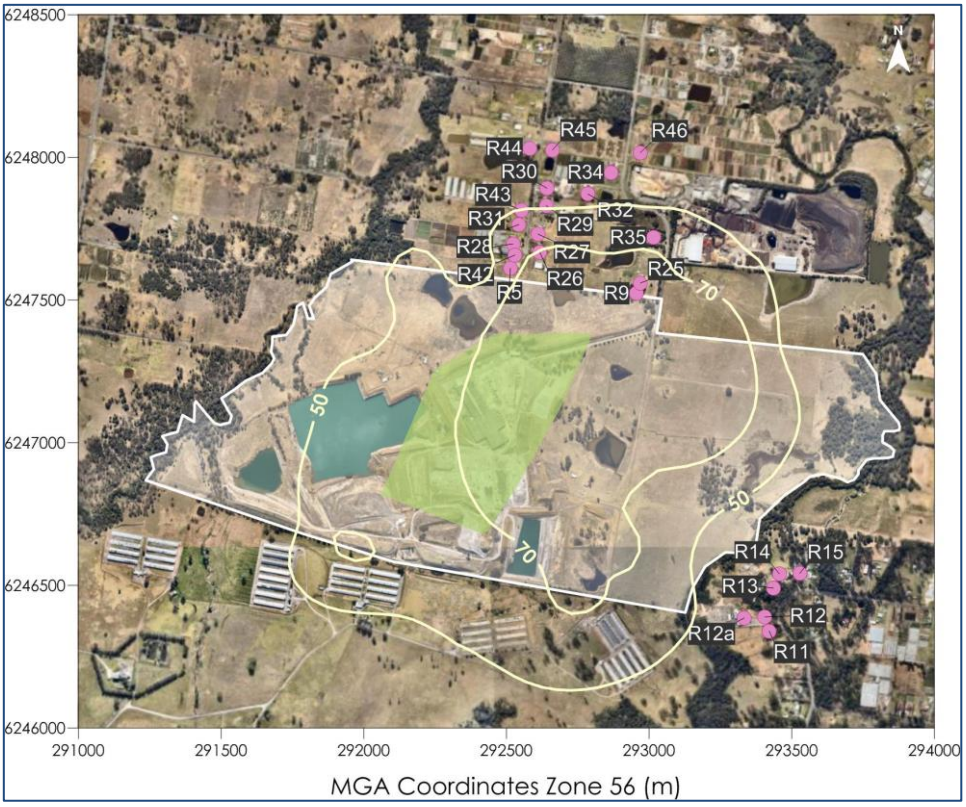


Figure C-26: Predicted incremental maximum 1-hour average NO_2 concentrations (µg/m³)

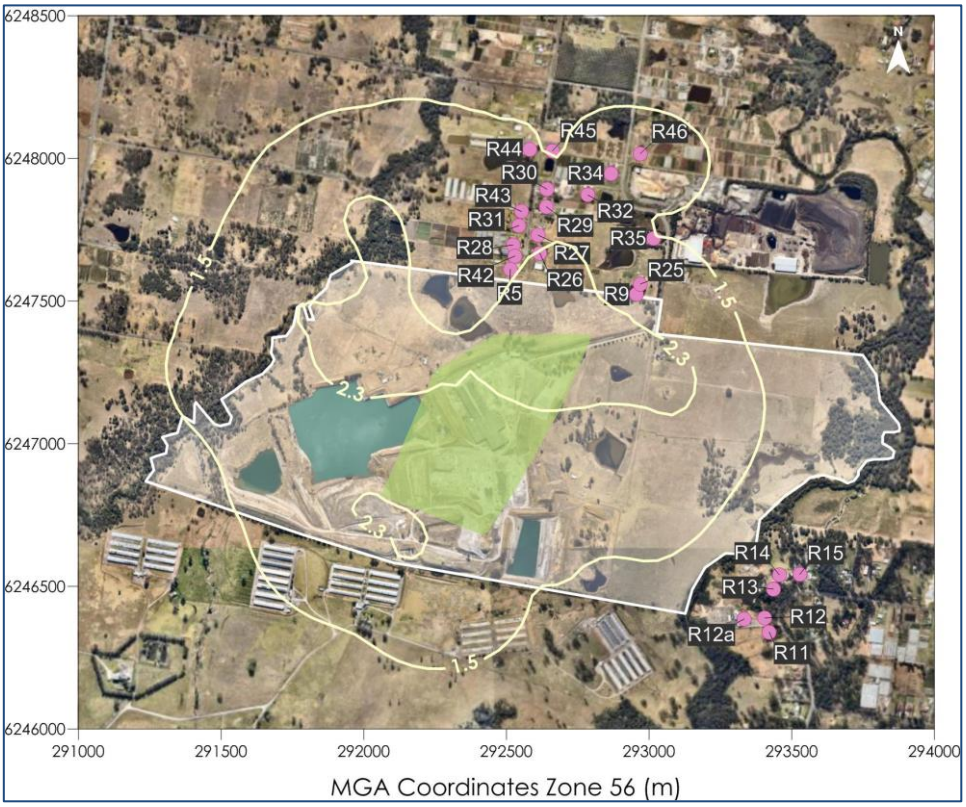


Figure C-27: Predicted incremental maximum 24-hour average hydrogen fluoride concentrations (µg/m³)

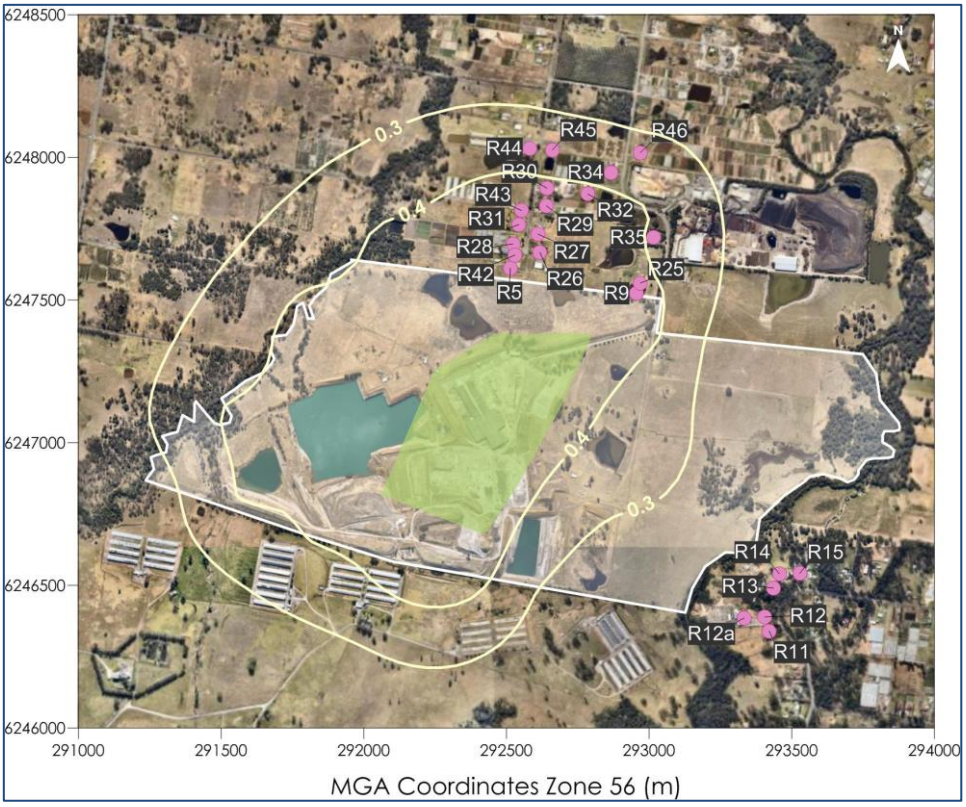


Figure C-28: Predicted incremental 99th percentile 1-hour average odour concentrations (OU)

Appendix D

Further detail regarding 24-hour $PM_{2.5}$ and PM_{10} analysis

Further detail regarding 24-hour average $PM_{2.5}$ and PM_{10} analysis

The analysis below provides a cumulative 24-hour $PM_{2.5}$ and a 24-hour PM_{10} impact assessment in accordance with the NSW EPA Approved Methods; refer to the worked example on Page 46 to 47 of the Approved Methods.

The background level is the ambient level at the OEH Liverpool monitoring station for $PM_{2.5}$ and at the Bringelly monitoring station for PM_{10}.

The predicted increment is the predicted level to occur at the receptor due to the Project.

The total is the sum of the background level and the predicted level. The totals may have minor discrepancies due to rounding.

Each table assesses one receptor. The left half of the table examines the cumulative impact during the periods of highest background levels and the right half of the table examines the cumulative impact during the periods of highest contribution from the project.

Any value above the $PM_{2.5}$ criterion of 25µg/m^3 or above the PM_{10} criterion of 50µg/m^3 is in **bold red.**

Tables D-1 to **D-32** show the predicted maximum cumulative levels at the assessed receptor locations surrounding the Project.

Table D-1: 24-hour average PM_{10} concentration (µg/m³) for Phase 1 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	1.2	43.8	13/06/2014	19.0	22.7	41.7
2/01/2014	41.8	1.1	42.9	28/03/2014	-	16.2	16.2
10/02/2014	36.8	2.5	39.3	2/07/2014	20.9	15.6	36.5
31/12/2014	36.1	0.4	36.5	10/06/2014	8.9	14.8	23.7
23/05/2014	34.2	0.0	34.2	24/05/2014	29.3	13.8	43.1
6/08/2014	33.7	6.7	40.4	1/06/2014	8.8	13.7	22.5
17/12/2014	33.4	1.8	35.2	11/06/2014	10.6	13.6	24.2
6/10/2014	33.3	1.0	34.3	10/04/2014	15.4	13.4	28.8
15/11/2014	32.7	1.5	34.2	20/06/2014	22.2	13.2	35.4
26/05/2014	32.4	0.8	33.2	21/06/2014	13.9	10.3	24.2

- No data

Table D-2: 24-hour average PM_{10} concentration (µg/m³) for Phase 1 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	1.5	44.1	13/06/2014	19.0	22.8	41.8
2/01/2014	41.8	1.4	43.2	2/07/2014	20.9	20.9	41.8
10/02/2014	36.8	1.5	38.3	10/06/2014	8.9	20.5	29.4
31/12/2014	36.1	0.1	36.2	1/06/2014	8.8	20.4	29.2
23/05/2014	34.2	0.0	34.2	28/03/2014	-	17.3	17.3
6/08/2014	33.7	8.0	41.7	24/05/2014	29.3	16.4	45.7
17/12/2014	33.4	1.0	34.4	5/06/2014	9.0	15.6	24.6
6/10/2014	33.3	0.5	33.8	4/04/2014	8.9	15.5	24.4
15/11/2014	32.7	0.7	33.4	13/07/2014	16	14.3	30.3
26/05/2014	32.4	2.8	35.2	20/06/2014	22.2	13.1	35.3

- No data

Table D-3: 24-hour average PM_{10} concentration (µg/m³) for Phase 1 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	2.2	44.8	25/05/2014	23.7	20.6	44.3
2/01/2014	41.8	0.6	42.4	14/06/2014	11.5	13.6	25.1
10/02/2014	36.8	0.0	36.8	2/06/2014	9.1	11.5	20.6
31/12/2014	36.1	0.0	36.1	24/06/2014	9.6	10.1	19.7
23/05/2014	34.2	3.1	37.3	29/06/2014	7.0	9.6	16.6
6/08/2014	33.7	1.4	35.1	20/05/2014	28.1	8.1	36.2
17/12/2014	33.4	0.0	33.4	30/07/2014	11.9	7.4	19.3
6/10/2014	33.3	0.3	33.6	2/05/2014	14.1	7.1	21.2
15/11/2014	32.7	0.0	32.7	3/05/2014	6.5	6.5	13.0
26/05/2014	32.4	0.6	33.0	17/07/2014	12.3	6.3	18.6

Table D-4: 24-hour average PM_{10} concentration (µg/m³) for Phase 1 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	1.2	43.8	13/06/2014	19.0	20.0	39.0
2/01/2014	41.8	0.9	42.7	28/03/2014	-	15.9	15.9
10/02/2014	36.8	1.9	38.7	2/07/2014	20.9	14.7	35.6
31/12/2014	36.1	0.3	36.4	10/06/2014	8.9	14.4	23.3
23/05/2014	34.2	0.0	34.2	1/06/2014	8.8	13.5	22.3
6/08/2014	33.7	6.4	40.1	20/06/2014	22.2	12.3	34.5
17/12/2014	33.4	1.2	34.6	11/06/2014	10.6	12.2	22.8
6/10/2014	33.3	0.6	33.9	24/05/2014	29.3	12.1	41.4
15/11/2014	32.7	1.0	33.7	10/04/2014	15.4	11.2	26.6
26/05/2014	32.4	0.7	33.1	4/04/2014	8.9	9.6	18.5

- No data

Table D-5: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 1 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.4	24.7	13/06/2014	16.4	3.5	19.9
12/10/2014	21.3	0.0	21.3	10/06/2014	5.9	2.8	8.7
6/08/2014	20.7	1.2	21.9	28/03/2014	4.5	2.7	7.2
8/07/2014	20.3	0.1	20.4	2/07/2014	15.9	2.7	18.6
18/05/2014	20.1	0.9	21.0	24/05/2014	11.1	2.4	13.5
9/08/2014	19.5	0.2	19.7	1/06/2014	9.2	2.4	11.6
4/07/2014	19.3	0.0	19.3	10/04/2014	8.2	2.2	10.4
26/05/2014	18.9	0.2	19.1	11/06/2014	14.0	2.1	16.1
10/05/2014	18.8	0.1	18.9	3/09/2014	5.0	2.0	7.0
5/08/2014	18.3	1.1	19.4	20/06/2014	17.2	2.0	19.2

Table D-6: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 1 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.7	25.0	13/06/2014	16.4	3.4	19.8
12/10/2014	21.3	0.3	21.6	1/06/2014	9.2	3.3	12.5
6/08/2014	20.7	1.3	22.0	10/06/2014	5.9	3.3	9.2
8/07/2014	20.3	0.8	21.1	2/07/2014	15.9	2.9	18.8
18/05/2014	20.1	1.3	21.4	28/03/2014	4.5	2.8	7.3
9/08/2014	19.5	0.3	19.8	5/06/2014	5.7	2.6	8.3
4/07/2014	19.3	0.0	19.3	4/04/2014	3.9	2.6	6.5
26/05/2014	18.9	0.9	19.8	24/05/2014	11.1	2.2	13.3
10/05/2014	18.8	0.1	18.9	21/06/2014	14.4	2.0	16.4
5/08/2014	18.3	1.0	19.3	13/07/2014	7.1	1.9	9.0

Table D-7: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 1 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.2	24.5	25/05/2014	12.9	3.1	16.0
12/10/2014	21.3	0.1	21.4	14/06/2014	13.1	2.1	15.2
6/08/2014	20.7	0.2	20.9	2/06/2014	11.9	1.8	13.7
8/07/2014	20.3	0.2	20.5	24/06/2014	3.1	1.7	4.8
18/05/2014	20.1	0.5	20.6	29/06/2014	4.2	1.6	5.8
9/08/2014	19.5	0.6	20.1	20/05/2014	12.9	1.2	14.1
4/07/2014	19.3	0.5	19.8	30/07/2014	4.6	1.2	5.8
26/05/2014	18.9	0.1	19.0	2/05/2014	8.7	1.1	9.8
10/05/2014	18.8	0.8	19.6	17/07/2014	11.4	1.1	12.5
5/08/2014	18.3	0.0	18.3	3/05/2014	6.9	1.0	7.9

Table D-8: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 1 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.4	24.7	13/06/2014	16.4	3.1	19.5
12/10/2014	21.3	0.1	21.4	10/06/2014	5.9	2.8	8.7
6/08/2014	20.7	1.1	21.8	28/03/2014	4.5	2.6	7.1
8/07/2014	20.3	0.2	20.5	2/07/2014	15.9	2.5	18.4
18/05/2014	20.1	1.0	21.1	1/06/2014	9.2	2.4	11.6
9/08/2014	19.5	0.1	19.6	24/05/2014	11.1	2.2	13.3
4/07/2014	19.3	0.0	19.3	11/06/2014	14.0	1.9	15.9
26/05/2014	18.9	0.1	19.0	15/10/2014	5.1	1.9	7.0
10/05/2014	18.8	0.1	18.9	10/04/2014	8.2	1.9	10.1
5/08/2014	18.3	0.9	19.2	20/06/2014	17.2	1.8	19.0

Table D-9: 24-hour average PM_{10} concentration (µg/m³) for Phase 2 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.8	43.4	13/06/2014	19.0	19.0	38.0
2/01/2014	41.8	0.7	42.5	2/07/2014	20.9	17.3	38.2
10/02/2014	36.8	2.4	39.2	11/06/2014	10.6	15.6	26.2
31/12/2014	36.1	0.4	36.5	20/06/2014	22.2	15.1	37.3
23/05/2014	34.2	0.0	34.2	24/05/2014	29.3	13.7	43.0
6/08/2014	33.7	1.5	35.2	10/04/2014	15.4	12.8	28.2
17/12/2014	33.4	1.7	35.1	13/07/2014	16.0	10.1	26.1
6/10/2014	33.3	0.9	34.2	11/05/2014	17.6	9.0	26.6
15/11/2014	32.7	1.0	33.7	21/06/2014	13.9	8.7	22.6
26/05/2014	32.4	0.4	32.8	11/04/2014	12.2	8.0	20.2

Table D-10: 24-hour average PM_{10} concentration (µg/m³) for Phase 2 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	1.4	44.0	13/06/2014	19.0	27.0	46.0
2/01/2014	41.8	0.9	42.7	2/07/2014	20.9	22.4	43.3
10/02/2014	36.8	1.9	38.7	24/05/2014	29.3	18.4	47.7
31/12/2014	36.1	0.1	36.2	28/03/2014	-	17.2	17.2
23/05/2014	34.2	0.0	34.2	13/07/2014	16.0	14.6	30.6
6/08/2014	33.7	4.7	38.4	11/06/2014	10.6	14.6	25.2
17/12/2014	33.4	1.1	34.5	1/06/2014	8.8	14.4	23.2
6/10/2014	33.3	0.4	33.7	21/06/2014	13.9	14.1	28.0
15/11/2014	32.7	0.7	33.4	11/04/2014	12.2	14.1	26.3
26/05/2014	32.4	2.2	34.6	10/04/2014	15.4	13.9	29.3

- No data

Table D-11: 24-hour average PM_{10} concentration (µg/m³) for Phase 2 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	2.2	44.8	25/05/2014	23.7	24.3	48.0
2/01/2014	41.8	0.8	42.6	14/06/2014	11.5	16.8	28.3
10/02/2014	36.8	0.0	36.8	2/06/2014	9.1	14.2	23.3
31/12/2014	36.1	0.0	36.1	20/05/2014	28.1	10.2	38.3
23/05/2014	34.2	3.3	37.5	24/06/2014	9.6	9.5	19.1
6/08/2014	33.7	1.5	35.2	2/05/2014	14.1	9.0	23.1
17/12/2014	33.4	0.0	33.4	29/06/2014	7.0	8.9	15.9
6/10/2014	33.3	0.3	33.6	30/07/2014	11.9	8.4	20.3
15/11/2014	32.7	0.0	32.7	26/06/2014	26.1	7.1	33.2
26/05/2014	32.4	0.7	33.1	3/05/2014	6.5	7.0	13.5

Table D-12: 24-hour average PM_{10} concentration (µg/m³) for Phase 2 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	1.0	43.6	13/06/2014	19.0	18.6	37.6
2/01/2014	41.8	0.5	42.3	2/07/2014	20.9	16.3	37.2
10/02/2014	36.8	1.9	38.7	11/06/2014	10.6	14.1	24.7
31/12/2014	36.1	0.3	36.4	20/06/2014	22.2	13.5	35.7
23/05/2014	34.2	0.0	34.2	24/05/2014	29.3	13.3	42.6
6/08/2014	33.7	1.6	35.3	10/04/2014	15.4	11.7	27.1
17/12/2014	33.4	1.1	34.5	13/07/2014	16.0	9.5	25.5
6/10/2014	33.3	0.5	33.8	21/06/2014	13.9	9.1	23.0
15/11/2014	32.7	0.6	33.3	11/04/2014	12.2	8.4	20.6
26/05/2014	32.4	0.4	32.8	11/05/2014	17.6	8.1	25.7

Table D-13: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 2 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.3	24.6	13/06/2014	16.4	3.5	19.9
12/10/2014	21.3	0.0	21.3	2/07/2014	15.9	3.3	19.2
6/08/2014	20.7	0.3	21.0	11/06/2014	14.0	2.7	16.7
8/07/2014	20.3	0.0	20.3	24/05/2014	11.1	2.7	13.8
18/05/2014	20.1	0.7	20.8	20/06/2014	17.2	2.5	19.7
9/08/2014	19.5	0.1	19.6	10/04/2014	8.2	2.4	10.6
4/07/2014	19.3	0.0	19.3	13/07/2014	7.1	2.1	9.2
26/05/2014	18.9	0.1	19.0	11/05/2014	12.4	1.9	14.3
10/05/2014	18.8	0.0	18.8	11/04/2014	5.3	1.6	6.9
5/08/2014	18.3	1.1	19.4	21/06/2014	14.4	1.6	16.0

Table D-14: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 2 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.6	24.9	13/06/2014	16.4	4.6	21.0
12/10/2014	21.3	0.3	21.6	28/03/2014	4.5	3.3	7.8
6/08/2014	20.7	0.9	21.6	2/07/2014	15.9	3.2	19.1
8/07/2014	20.3	0.6	20.9	24/05/2014	11.1	2.7	13.8
18/05/2014	20.1	1.3	21.4	1/06/2014	9.2	2.6	11.8
9/08/2014	19.5	0.3	19.8	21/06/2014	14.4	2.4	16.8
4/07/2014	19.3	0.0	19.3	11/06/2014	14.0	2.4	16.4
26/05/2014	18.9	0.8	19.7	10/04/2014	8.2	2.4	10.6
10/05/2014	18.8	0.1	18.9	11/04/2014	5.3	2.3	7.6
5/08/2014	18.3	1.1	19.4	5/06/2014	5.7	2.2	7.9

Table D-15: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 2 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.2	24.5	25/05/2014	12.9	4.6	17.5
12/10/2014	21.3	0.1	21.4	14/06/2014	13.1	3.0	16.1
6/08/2014	20.7	0.2	20.9	2/06/2014	11.9	2.8	14.7
8/07/2014	20.3	0.4	20.7	20/05/2014	12.9	1.8	14.7
18/05/2014	20.1	0.7	20.8	24/06/2014	3.1	1.7	4.8
9/08/2014	19.5	0.9	20.4	2/05/2014	8.7	1.7	10.4
4/07/2014	19.3	0.6	19.9	29/06/2014	4.2	1.6	5.8
26/05/2014	18.9	0.1	19.0	30/07/2014	4.6	1.5	6.1
10/05/2014	18.8	0.9	19.7	26/06/2014	10.2	1.3	11.5
5/08/2014	18.3	0.0	18.3	17/07/2014	11.4	1.3	12.7

Table D-16: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 2 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.4	24.7	13/06/2014	16.4	3.4	19.8
12/10/2014	21.3	0.0	21.3	2/07/2014	15.9	3.0	18.9
6/08/2014	20.7	0.3	21.0	24/05/2014	11.1	2.7	13.8
8/07/2014	20.3	0.0	20.3	11/06/2014	14.0	2.5	16.5
18/05/2014	20.1	0.8	20.9	10/04/2014	8.2	2.2	10.4
9/08/2014	19.5	0.1	19.6	20/06/2014	17.2	2.2	19.4
4/07/2014	19.3	0.0	19.3	13/07/2014	7.1	2.0	9.1
26/05/2014	18.9	0.1	19.0	11/05/2014	12.4	1.7	14.1
10/05/2014	18.8	0.0	18.8	21/06/2014	14.4	1.7	16.1
5/08/2014	18.3	0.9	19.2	11/04/2014	5.3	1.7	7.0

Table D-17: 24-hour average PM_{10} concentration (µg/m³) for Phase 3 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.4	43.0	2/07/2014	20.9	13.4	34.3
2/01/2014	41.8	0.5	42.3	20/06/2014	22.2	12.6	34.8
10/02/2014	36.8	1.9	38.7	11/06/2014	10.6	12.4	23.0
31/12/2014	36.1	0.4	36.5	13/06/2014	19.0	10.9	29.9
23/05/2014	34.2	0.0	34.2	24/05/2014	29.3	9.6	38.9
6/08/2014	33.7	0.6	34.3	10/04/2014	15.4	8.3	23.7
17/12/2014	33.4	1.4	34.8	13/07/2014	16.0	7.6	23.6
6/10/2014	33.3	0.6	33.9	11/05/2014	17.6	6.8	24.4
15/11/2014	32.7	0.9	33.6	21/06/2014	13.9	5.6	19.5
26/05/2014	32.4	0.3	32.7	28/02/2014	14.7	5.4	20.1

Table D-18: 24-hour average PM_{10} concentration (µg/m³) for Phase 3 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	1.1	43.7	13/06/2014	19.0	21.8	40.8
2/01/2014	41.8	0.7	42.5	2/07/2014	20.9	20.3	41.2
10/02/2014	36.8	1.7	38.5	24/05/2014	29.3	16.4	45.7
31/12/2014	36.1	0.1	36.2	13/07/2014	16.0	13.5	29.5
23/05/2014	34.2	0.0	34.2	11/06/2014	10.6	12.5	23.1
6/08/2014	33.7	2.5	36.2	20/06/2014	22.2	12.1	34.3
17/12/2014	33.4	1.0	34.4	21/06/2014	13.9	12.0	25.9
6/10/2014	33.3	0.3	33.6	10/04/2014	15.4	11.9	27.3
15/11/2014	32.7	0.6	33.3	11/04/2014	12.2	11.9	24.1
26/05/2014	32.4	1.8	34.2	28/03/2014	-	11.3	11.3

- No data

Table D-19: 24-hour average PM_{10} concentration (µg/m³) for Phase 3 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	1.9	44.5	25/05/2014	23.7	17.1	40.8
2/01/2014	41.8	0.6	42.4	14/06/2014	11.5	11.9	23.4
10/02/2014	36.8	0.0	36.8	2/06/2014	9.1	9.8	18.9
31/12/2014	36.1	0.0	36.1	24/06/2014	9.6	8.2	17.8
23/05/2014	34.2	2.8	37.0	20/05/2014	28.1	8.1	36.2
6/08/2014	33.7	1.2	34.9	29/06/2014	7.0	7.7	14.7
17/12/2014	33.4	0.0	33.4	2/05/2014	14.1	6.4	20.5
6/10/2014	33.3	0.2	33.5	30/07/2014	11.9	6.2	18.1
15/11/2014	32.7	0.0	32.7	28/07/2014	16.3	5.5	21.8
26/05/2014	32.4	0.5	32.9	17/07/2014	12.3	5.4	17.7

Table D-20: 24-hour average PM_{10} concentration (µg/m³) for Phase 3 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.5	43.1	2/07/2014	20.9	13.2	34.1
2/01/2014	41.8	0.3	42.1	13/06/2014	19.0	11.8	30.8
10/02/2014	36.8	1.6	38.4	20/06/2014	22.2	11.7	33.9
31/12/2014	36.1	0.3	36.4	11/06/2014	10.6	11.6	22.2
23/05/2014	34.2	0.0	34.2	24/05/2014	29.3	10.0	39.3
6/08/2014	33.7	0.5	34.2	10/04/2014	15.4	8.1	23.5
17/12/2014	33.4	0.9	34.3	13/07/2014	16.0	7.5	23.5
6/10/2014	33.3	0.3	33.6	21/06/2014	13.9	6.4	20.3
15/11/2014	32.7	0.6	33.3	11/05/2014	17.6	6.2	23.8
26/05/2014	32.4	0.3	32.7	28/02/2014	14.7	5.8	20.5

Table D-21: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 3 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.5	43.1	2/07/2014	20.9	13.2	34.1
2/01/2014	41.8	0.3	42.1	13/06/2014	19.0	11.8	30.8
10/02/2014	36.8	1.6	38.4	20/06/2014	22.2	11.7	33.9
31/12/2014	36.1	0.3	36.4	11/06/2014	10.6	11.6	22.2
23/05/2014	34.2	0.0	34.2	24/05/2014	29.3	10.0	39.3
6/08/2014	33.7	0.5	34.2	10/04/2014	15.4	8.1	23.5
17/12/2014	33.4	0.9	34.3	13/07/2014	16.0	7.5	23.5
6/10/2014	33.3	0.3	33.6	21/06/2014	13.9	6.4	20.3
15/11/2014	32.7	0.6	33.3	11/05/2014	17.6	6.2	23.8
26/05/2014	32.4	0.3	32.7	28/02/2014	14.7	5.8	20.5

Table D-22: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 3 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.6	24.9	13/06/2014	16.4	3.6	20.0
12/10/2014	21.3	0.3	21.6	2/07/2014	15.9	2.8	18.7
6/08/2014	20.7	0.5	21.2	24/05/2014	11.1	2.3	13.4
8/07/2014	20.3	0.5	20.8	28/03/2014	4.5	2.2	6.7
18/05/2014	20.1	0.9	21.0	21/06/2014	14.4	2.0	16.4
9/08/2014	19.5	0.2	19.7	11/06/2014	14.0	2.0	16.0
4/07/2014	19.3	0.0	19.3	10/04/2014	8.2	1.9	10.1
26/05/2014	18.9	0.7	19.6	11/04/2014	5.3	1.9	7.2
10/05/2014	18.8	0.0	18.8	13/07/2014	7.1	1.8	8.9
5/08/2014	18.3	0.9	19.2	1/06/2014	9.2	1.7	10.9

Table D-23: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 3 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.1	24.4	25/05/2014	12.9	3.3	16.2
12/10/2014	21.3	0.1	21.4	14/06/2014	13.1	2.2	15.3
6/08/2014	20.7	0.2	20.9	2/06/2014	11.9	2.0	13.9
8/07/2014	20.3	0.3	20.6	24/06/2014	3.1	1.5	4.6
18/05/2014	20.1	0.5	20.6	29/06/2014	4.2	1.4	5.6
9/08/2014	19.5	0.7	20.2	20/05/2014	12.9	1.4	14.3
4/07/2014	19.3	0.5	19.8	2/05/2014	8.7	1.3	10.0
26/05/2014	18.9	0.1	19.0	30/07/2014	4.6	1.1	5.7
10/05/2014	18.8	0.8	19.6	17/07/2014	11.4	1.0	12.4
5/08/2014	18.3	0.0	18.3	26/06/2014	10.2	1.0	11.2

Table D-24: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 3 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.3	24.6	2/07/2014	15.9	2.4	18.3
12/10/2014	21.3	0.0	21.3	13/06/2014	16.4	2.2	18.6
6/08/2014	20.7	0.1	20.8	24/05/2014	11.1	2.1	13.2
8/07/2014	20.3	0.0	20.3	11/06/2014	14.0	2.0	16.0
18/05/2014	20.1	0.5	20.6	20/06/2014	17.2	1.8	19.0
9/08/2014	19.5	0.0	19.5	13/07/2014	7.1	1.6	8.7
4/07/2014	19.3	0.0	19.3	10/04/2014	8.2	1.6	9.8
26/05/2014	18.9	0.1	19.0	11/05/2014	12.4	1.4	13.8
10/05/2014	18.8	0.0	18.8	21/06/2014	14.4	1.3	15.7
5/08/2014	18.3	0.7	19.0	15/10/2014	5.1	1.3	6.4

Table D-25: 24-hour average PM_{10} concentration (µg/m³) for Phase 4 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.3	42.9	2/07/2014	20.9	2.7	23.6
2/01/2014	41.8	0.3	42.1	10/04/2014	15.4	2.4	17.8
10/02/2014	36.8	1.1	37.9	24/05/2014	29.3	2.2	31.5
31/12/2014	36.1	0.2	36.3	7/09/2014	9.6	2.0	11.6
23/05/2014	34.2	0.0	34.2	3/09/2014	7.8	2.0	9.8
6/08/2014	33.7	0.4	34.1	25/05/2014	23.7	1.9	25.6
17/12/2014	33.4	0.6	34.0	21/08/2014	9.7	1.9	11.6
6/10/2014	33.3	0.6	33.9	11/05/2014	17.6	1.9	19.5
15/11/2014	32.7	0.3	33.0	19/04/2014	18.9	1.8	20.7
26/05/2014	32.4	0.1	32.5	5/08/2014	22.5	1.7	24.2

Table D-26: 24-hour average PM_{10} concentration (µg/m³) for Phase 4 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.6	43.2	10/06/2014	8.9	3.9	12.8
2/01/2014	41.8	0.4	42.2	28/03/2014	-	3.5	3.5
10/02/2014	36.8	0.2	37.0	13/06/2014	19.0	3.3	22.3
31/12/2014	36.1	0.0	36.1	1/06/2014	8.8	3.3	12.1
23/05/2014	34.2	0.0	34.2	11/06/2014	10.6	3.2	13.8
6/08/2014	33.7	1.7	35.4	15/10/2014	8.7	3.1	11.8
17/12/2014	33.4	0.3	33.7	5/06/2014	9.0	3.1	12.1
6/10/2014	33.3	0.2	33.5	1/03/2014	8.8	2.7	11.5
15/11/2014	32.7	0.5	33.2	3/09/2014	7.8	2.7	10.5
26/05/2014	32.4	1.5	33.9	2/07/2014	20.9	2.7	23.6

- No data

Table D-27: 24-hour average PM_{10} concentration (µg/m³) for Phase 4 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.4	43.0	24/06/2014	9.6	1.8	11.4
2/01/2014	41.8	0.0	41.8	29/06/2014	7.0	1.6	8.6
10/02/2014	36.8	0.0	36.8	30/09/2014	22.0	0.9	22.9
31/12/2014	36.1	0.0	36.1	29/09/2014	23.9	0.8	24.7
23/05/2014	34.2	0.5	34.7	3/05/2014	6.5	0.8	7.3
6/08/2014	33.7	0.1	33.8	30/07/2014	11.9	0.7	12.6
17/12/2014	33.4	0.0	33.4	1/08/2014	12.7	0.7	13.4
6/10/2014	33.3	0.1	33.4	17/07/2014	12.3	0.7	13.0
15/11/2014	32.7	0.0	32.7	28/07/2014	16.3	0.6	16.9
26/05/2014	32.4	0.1	32.5	27/10/2014	28.5	0.5	29.0

Table D-28: 24-hour average PM_{10} concentration (µg/m³) for Phase 4 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
19/05/2014	42.6	0.5	43.1	2/07/2014	20.9	2.4	23.3
2/01/2014	41.8	0.2	42.0	10/04/2014	15.4	2.3	17.7
10/02/2014	36.8	0.8	37.6	24/05/2014	29.3	2.0	31.3
31/12/2014	36.1	0.1	36.2	15/10/2014	8.7	1.9	10.6
23/05/2014	34.2	0.0	34.2	3/09/2014	7.8	1.9	9.7
6/08/2014	33.7	0.3	34.0	21/08/2014	9.7	1.8	11.5
17/12/2014	33.4	0.4	33.8	19/04/2014	18.9	1.7	20.6
6/10/2014	33.3	0.3	33.6	30/08/2014	6.4	1.7	8.1
15/11/2014	32.7	0.3	33.0	23/08/2014	7.4	1.7	9.1
26/05/2014	32.4	0.1	32.5	13/06/2014	19.0	1.7	20.7

Table D-29: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 4 scenario – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.2	24.5	2/07/2014	15.9	0.8	16.7
12/10/2014	21.3	0.0	21.3	3/09/2014	5.0	0.7	5.7
6/08/2014	20.7	0.1	20.8	24/05/2014	11.1	0.7	11.8
8/07/2014	20.3	0.0	20.3	7/09/2014	4.0	0.7	4.7
18/05/2014	20.1	0.2	20.3	30/08/2014	3.8	0.7	4.5
9/08/2014	19.5	0.0	19.5	19/08/2014	6.1	0.7	6.8
4/07/2014	19.3	0.0	19.3	12/04/2014	5.6	0.7	6.3
26/05/2014	18.9	0.1	19.0	18/08/2014	3.0	0.6	3.6
10/05/2014	18.8	0.0	18.8	29/03/2014	6.1	0.6	6.7
5/08/2014	18.3	0.6	18.9	17/04/2014	6.7	0.6	7.3

Table D-30: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 4 scenario – R9

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.4	24.7	5/05/2014	4.9	0.9	5.8
12/10/2014	21.3	0.3	21.6	28/03/2014	4.5	0.9	5.4
6/08/2014	20.7	0.4	21.1	10/06/2014	5.9	0.8	6.7
8/07/2014	20.3	0.5	20.8	13/06/2014	16.4	0.8	17.2
18/05/2014	20.1	0.6	20.7	1/06/2014	9.2	0.8	10.0
9/08/2014	19.5	0.1	19.6	18/07/2014	8.1	0.8	8.9
4/07/2014	19.3	0.0	19.3	5/06/2014	5.7	0.8	6.5
26/05/2014	18.9	0.7	19.6	2/11/2014	4.7	0.8	5.5
10/05/2014	18.8	0.0	18.8	6/05/2014	6.6	0.7	7.3
5/08/2014	18.3	0.5	18.8	14/07/2014	4.4	0.7	5.1

Table D-31: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 4 scenario – R12a

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.1	24.4	24/06/2014	3.1	0.4	3.5
12/10/2014	21.3	0.1	21.4	29/06/2014	4.2	0.4	4.6
6/08/2014	20.7	0.0	20.7	29/09/2014	8.9	0.3	9.2
8/07/2014	20.3	0.0	20.3	24/04/2014	13	0.3	13.3
18/05/2014	20.1	0.1	20.2	27/10/2014	11.5	0.3	11.8
9/08/2014	19.5	0.1	19.6	28/07/2014	12.6	0.2	12.8
4/07/2014	19.3	0.2	19.5	30/09/2014	10.8	0.2	11.0
26/05/2014	18.9	0.0	18.9	5/03/2014	8.0	0.2	8.2
10/05/2014	18.8	0.1	18.9	31/07/2014	4.2	0.2	4.4
5/08/2014	18.3	0.0	18.3	28/06/2014	4.1	0.2	4.3

Table D-32: 24-hour average $PM_{2.5}$ concentration (µg/m³) for Phase 4 scenario – R26

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
3/07/2014	24.3	0.2	24.5	15/10/2014	5.1	0.9	6.0
12/10/2014	21.3	0.0	21.3	2/07/2014	15.9	0.8	16.7
6/08/2014	20.7	0.1	20.8	24/05/2014	11.1	0.8	11.9
8/07/2014	20.3	0.0	20.3	12/04/2014	5.6	0.7	6.3
18/05/2014	20.1	0.3	20.4	30/08/2014	3.8	0.7	4.5
9/08/2014	19.5	0.0	19.5	3/09/2014	5.0	0.6	5.6
4/07/2014	19.3	0.0	19.3	20/07/2014	7.5	0.6	8.1
26/05/2014	18.9	0.1	19.0	7/09/2014	4.0	0.6	4.6
10/05/2014	18.8	0.0	18.8	17/04/2014	6.7	0.6	7.3
5/08/2014	18.3	0.4	18.7	10/04/2014	8.2	0.6	8.8



APPENDIX C

CSR ADVANCED MANUFACTURING HUB NOISE IMPACT ASSESSMENT PREFERRED PROJECT

ACOUSTICS AND AIR

CSR ADVANCED MANUFACTURING HUB

NOISE IMPACT ASSESSMENT - PREFERRED PROJECT

REPORT NO. 17199-AD
VERSION A

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PREPARED FOR

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GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

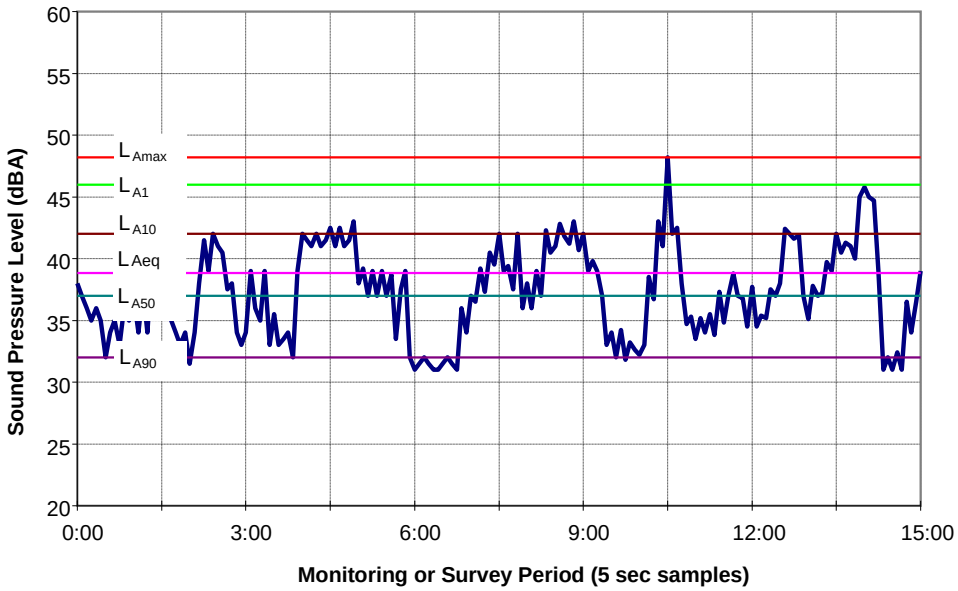
L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

Typical Graph of Sound Pressure Level vs Time



1 INTRODUCTION

1.1 Background

The Western Sydney Planning Partnership (WSPP) provided a submission to both CSR's Advanced Manufacturing Hub modification applications (3 and 4), raising concern that the proposed modifications were inconsistent with the *Western Sydney Aerotropolis Land Use and Infrastructure Plan – Stage 1: Initial Precincts* (LUIIP).

CSR met with DPIE and WSPP on 3 July 2019 to discuss concerns raised in WSPPs submission on the consistency of the modification with the LUIIP. It was agreed in this meeting that the modifications would need to:

- discuss how and when parts of the site could be made available for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- that a 40m wide easement for the future realignment and extension of Martin Road through the site can be accommodated.

Following the 3 July meeting, CSR revisited their proposed modifications and developed a 'preferred project' which:

- reduces the extent and duration of quarrying on the site, thereby reducing the volume of virgin excavated natural material (VENM) and the duration of VENM importation required to backfill quarry pits on the site;
- removes the proposed Monier roof products manufacturing facility and solar farm;
- frees up all but a 30 hectare (Ha) portion of the 200 Ha site for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- accommodates a six lane road within a 40m wide easement for the future realignment and extension of Martin Road through the site.

CSR had an additional meeting with DPIE on 3 September 2019 to present the preferred project. DPIE requested that the response to submissions reports for modification 3 and 4 should include:

- a description of the preferred project and changes to the modification 3 and 4 project descriptions;
- a description of the changes to the impacts associated with the preferred project; and
- a response to all submissions received on the modification 3 and 4 EAs from government agencies and neighbouring landowners that are relevant to the preferred project.

The description of the preferred project in Section 1.3 is based on the outcomes of this meeting.

1.2 Purpose

Wilkinson Murray has been engaged by Element Environment, on behalf of CSR, to prepare a Noise and Vibration Impact Assessment (NVIA) for the preferred project.

1.3 Preferred Project Description

The key components of the preferred project include:

- construction and operation of the brick making facility comprising (the same as existing Modification 3):
  - removal of most of the existing brick manufacturing equipment and replacement with new brick manufacturing equipment in the existing brick making facility.
  - increase in the building footprint of the existing brick making facility.
  - increase in the building footprint of the existing administration building.
  - a National Association of Testing Authorities (NATA) accredited advanced testing laboratory.
  - extension to the existing visitor's carpark.
  - an innovation centre.
  - a weighbridge.
  - factory staff parking.
  - a new access road to the factory staff parking area and for bulk material deliveries and dispatch.
  - new rainwater tanks.
- extraction of the remaining clay from Pit 3 for up to a maximum of 10 years;
- dewatering of Pit 1 with use of water for onsite processes and irrigation, transfer offsite for use by other parties (e.g. Western Sydney Airport (WSA) and Australian Native Landscapes) or discharge to local creeks.
- importation of VENM to backfill quarry pits 1, 2 and 3 to allow for future development consistent with the objectives of the Western Sydney Aerotropolis.
- upgrade of the existing Martin Road-Elizabeth Drive intersection to a signalised intersection.

The following aspects, previously included in the modification 3 and 4 applications will not form part of the preferred project:

- Monier roof products manufacturing facility.
- solar farm.
- quarry pits 4 and 5 (extraction or backfilling with VENM).
- extraction of the remaining clay from Pit 1.

Below is a summary of the four different phases of the preferred project and the key activities that will take place during these phases. Table 1 presents a comparison of the approved project parameters against the proposed preferred project parameters as well as the variance between the proposed preferred project parameters and the combined modification 3 and 4 parameters. Table 2 presents a comparison of the approved project operating hours against the proposed preferred project operating hours. Table 3 presents the changes to the number of heavy vehicle movements associated with the preferred project.

NOTE: All activities associated with the previously proposed Monier roof products manufacturing facility, the solar farm, pits 4 and 5 and further extraction in Pit 1, have been removed from the four preferred project phases described below.

Phase 1: Year 1 – 6 (approx. end of 2019 to end of 2025) – Refer to Figure 1

- Pits 2 and 3 are dewatered into Pit 1 over a period of seven weeks and three weeks respectively. Pit 1 is then dewatered over a period of 1 – 3 years by pumping water to the Western Sydney Airport site or alternative water disposal options or a combination (it will take a minimum of 1 year if pumping directly to Badgerys Creek at a rate of 100,000 L/hr 24hrs/7days a week, but is likely to take longer if pumping to WSA);
- Possible noise bunds along northern property boundary/realigned VENM haul road need to be constructed to attenuate VENM truck noise and potentially some other brick manufacturing and quarrying activities (additional noise modelling to confirm). **The aim is to demonstrate through noise modelling that without mining of Pits 1, 4 and 5 and rerouting the VENM haul road, that no noise bunds will be required**;
- Pit 1 and Pit 2 are backfilled (engineered fill) with a combination of existing fill material in Pit 2 (405,000 m^3), unusable/burden stockpiles located in the southern part of the site (500,000 m^3), burden yet to be extracted from Pit 3 (115,000 m^3) and imported VENM.
- It is estimated that it will take approximately 2 years to extract and re-emplace the existing fill in Pit 2 as an engineered fill and approximately 5 - 6 months to backfill the remainder of Pit 2.
- It is estimated to take approximately 2 – 2.5 years to backfill Pit 1 with imported VENM at the maximum rate of VENM importation;
- 420,000 tonnes of clay is extracted from Pit 3 per calendar year;
- 275,000 tonnes of clay is exported from site to other PGH brick making facilities per calendar year;
- 215,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year;
- 330,000 tonnes of bricks are dispatched from site per calendar year; and
- VENM is imported to backfill Pit 1 and 2 at 200 trucks per weekday (Mon – Fri), 130 trucks per Saturday and 100 trucks per Sunday.
- landscaped earth bund constructed around the western, southern and eastern sides of the brick making facility's raw material stockpile area by end of year 6;
- landscaping (including screening plants) completed around the northern and eastern sides of the brick making facility by end of year 6;
- landscaping (including screening plants) completed around the western and part of the northern and southern sides of Pit 3 by end of year 6.

At the start of this first six year period, the approved Pit 4 and 5 areas, and previously proposed Monier roof products manufacturing facility and solar farm areas (totalling 65.07 Ha) (Figure 1) are available for progressing development applications for activities aligned with the LUIIP.

By the end of year 6 (end of 2025) (Figure 2), the Pit 1 and 2 areas as well as some land between the site's southern boundary and the raw material stockpile area (totalling 37.15 Ha), is also available for progressing development applications for activities aligned with the LUIIP. A total of 102.95 is available for development from the end of 2025 onwards.

It is assumed that Transport for NSW (TfNSW) would realign and extend Martin Road southwards through the site within the first six years i.e. by end of 2025. In the early years of Phase 1 the VENM haul route traverses the proposed future Martin Road corridor.

However, pits 1 and 2 should be backfilled within the first four years after which this VENM haul route will only need to continue to Pit 3 and will not need to traverse the future Martin Road corridor. If the construction of the extended Martin Road needs to commence prior to the completion of backfilling of pits 1 and 2 then an underpass or alternative temporary intersection can be constructed under/across the extended Martin Road. This underpass/intersection will facilitate both VENM importation for backfilling pits 1 and 2 and for the haulage of extracted clay from Pit 3 to the raw material stockpile area.

Phase 2: Year 7 – 10 (approx. end of 2029) – Refer to Figure 2

- 420,000 tonnes of clay is extracted from Pit 3 per calendar year;
- 275,000 tonnes of clay is exported from site to other PGH brick making facilities per calendar year;
- 215,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year;
- 330,000 tonnes of bricks are dispatched from site per calendar year; and
- VENM is imported to backfill Pit 3 (engineered fill) at 200 trucks per weekday (Mon – Fri), 130 trucks per Saturday and 100 per Sunday. This is to allow flexibility that during the final stages of clay extraction in the east of Pit 3, VENM can be imported to start to backfill the western part of Pit 3.

Phase 3: Year 11 – 13 (approx. end of 2032) – Refer to Figure 3

- 360,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year;
- 330,000 tonnes of bricks are dispatched from site per calendar year; and
- VENM is imported to backfill Pit 3 (engineered fill) at 200 trucks per weekday (Mon – Fri), 130 trucks per Saturday and 100 per Sunday.

Phase 4: Year 14 onwards (approx. end of 2032 onwards) – Refer to Figure 4

- 360,000 tonnes of clay is imported to site for manufacturing bricks per calendar year;
- 300,000 tonnes of bricks are manufactured per calendar year; and
- 330,000 tonnes of bricks are dispatched from site per calendar year.

From approximately year 14 (end of 2032) onwards, the Pit 3 area (totalling 12.83 Ha) is also available for progressing development applications for activities aligned with the LUIIP and approximately 30 hectares of the 200 hectare site will be used for ongoing brick manufacturing. A total of 115.78 Ha is available for development from approximately year 14 onwards.

Figure 1
Preferred Project: Phase 1 - Years 1 to 6 (End 2019 to end 2025)

CSR ADVANCED MANUFACTURING HUB
Response to Submissions Report

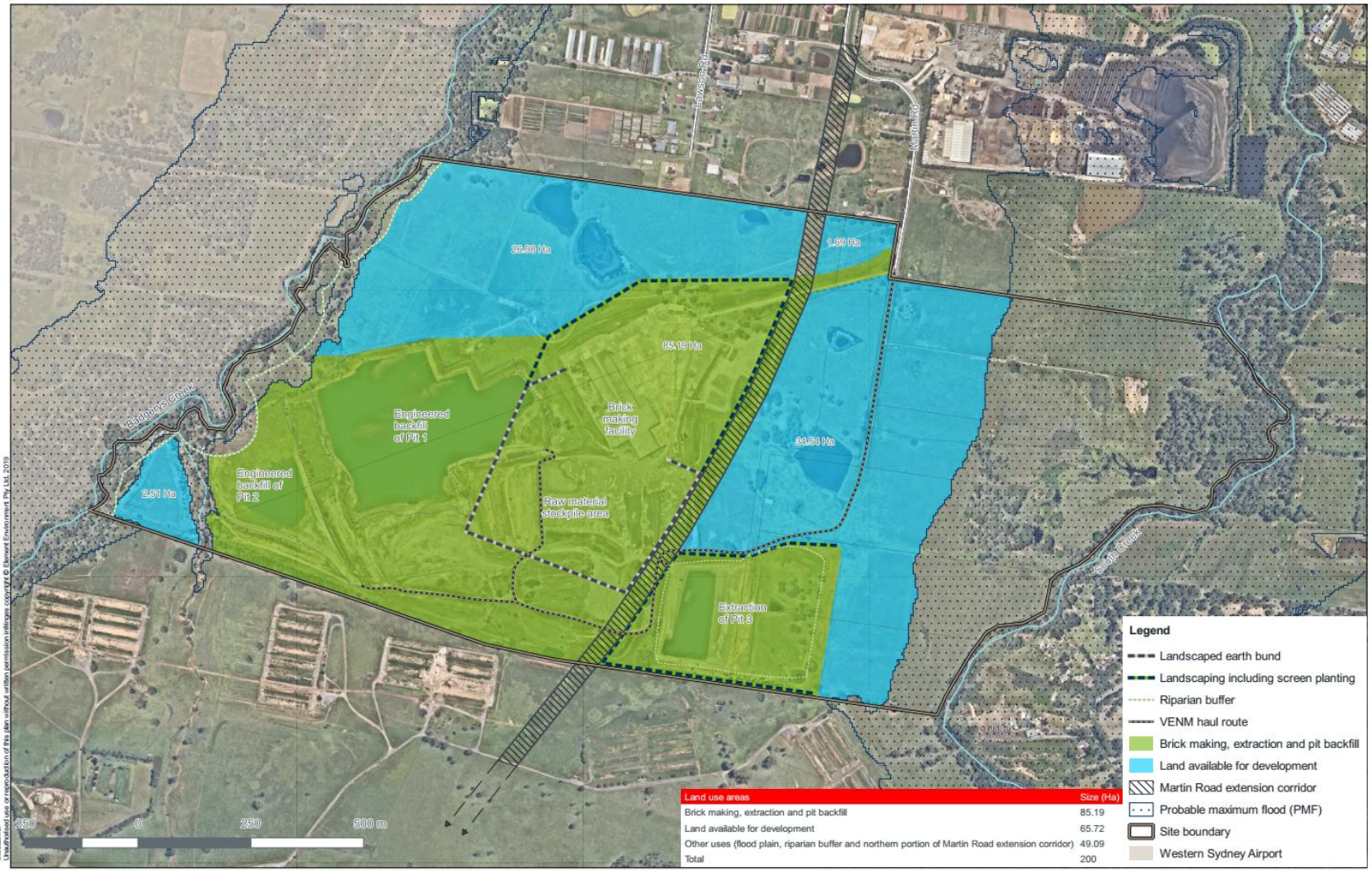


Figure 2
Preferred Project: Phase 2 Year 7 to 10 (end of 2025 to end of 2029)

CSR ADVANCED MANUFACTURING HUB
Response to Submissions Report

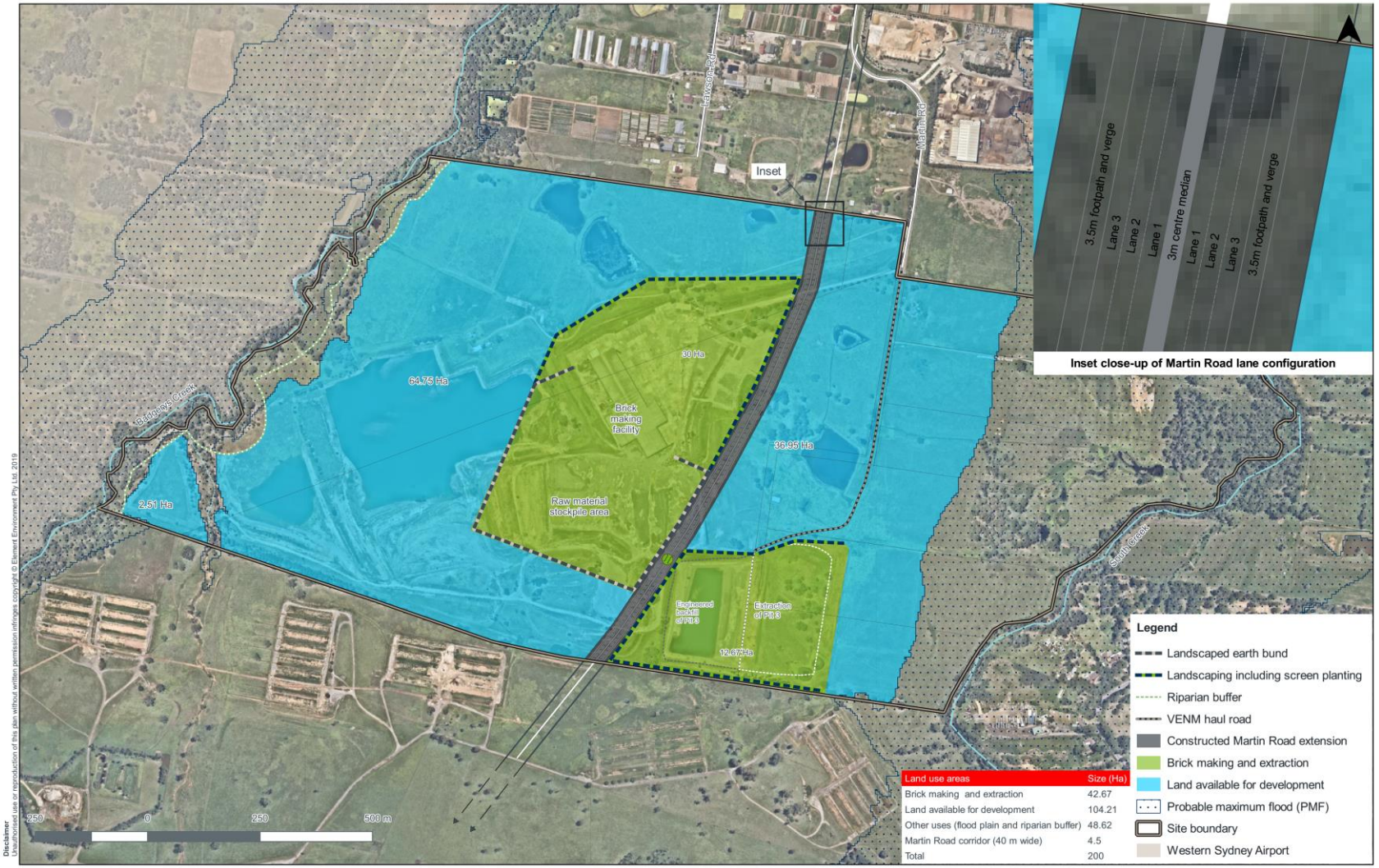


Figure 3
Preferred Project: Phase 3 - Year 11 to 13 (end of 2029 to end of 2032)

CSR ADVANCED MANUFACTURING HUB
Response to Submissions Report

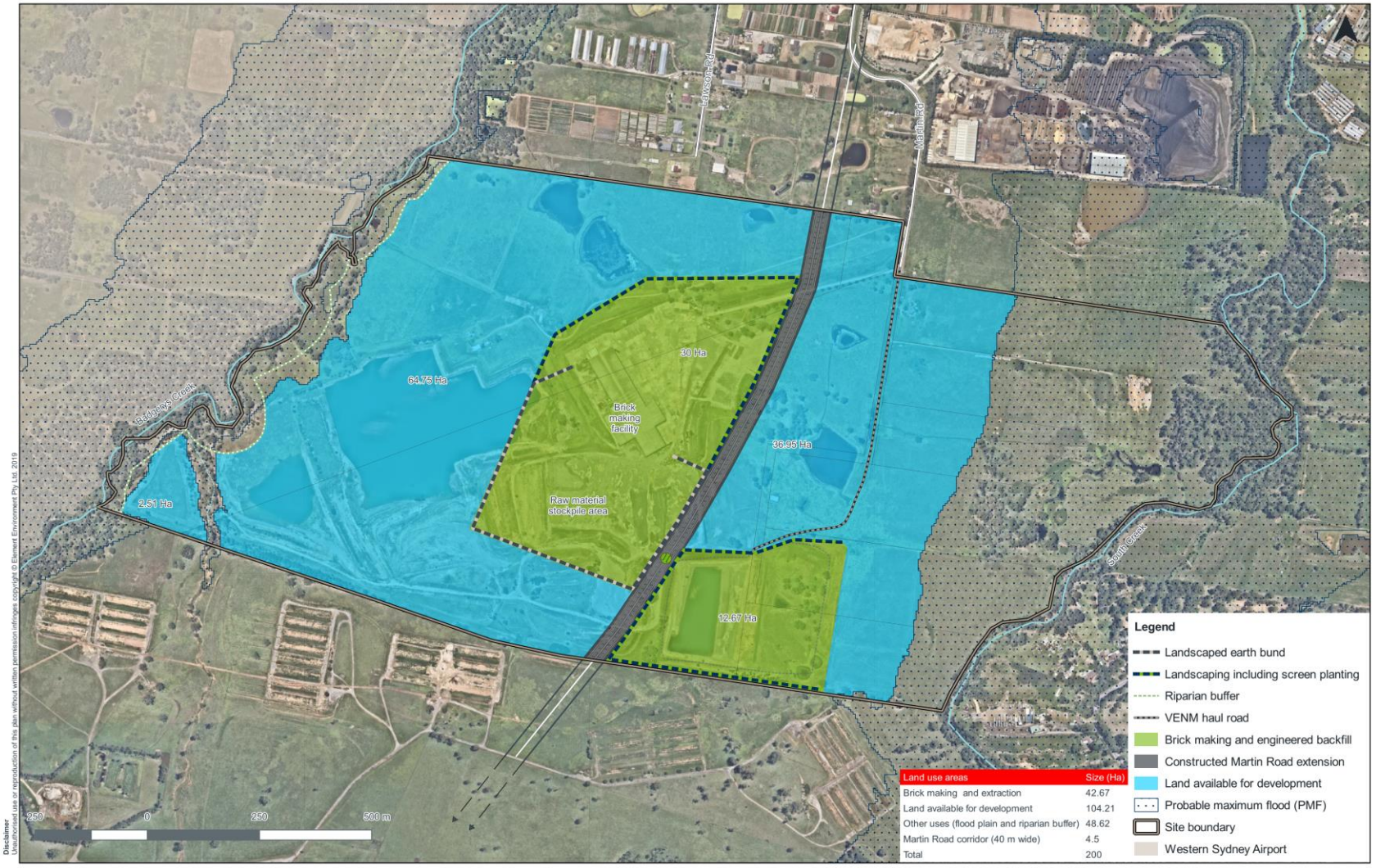


Figure 4
Preferred Project: Phase 4 - Year 14 onwards (approximately end of 2032 onwards)

CSR ADVANCED MANUFACTURING HUB
Response to Submissions Report

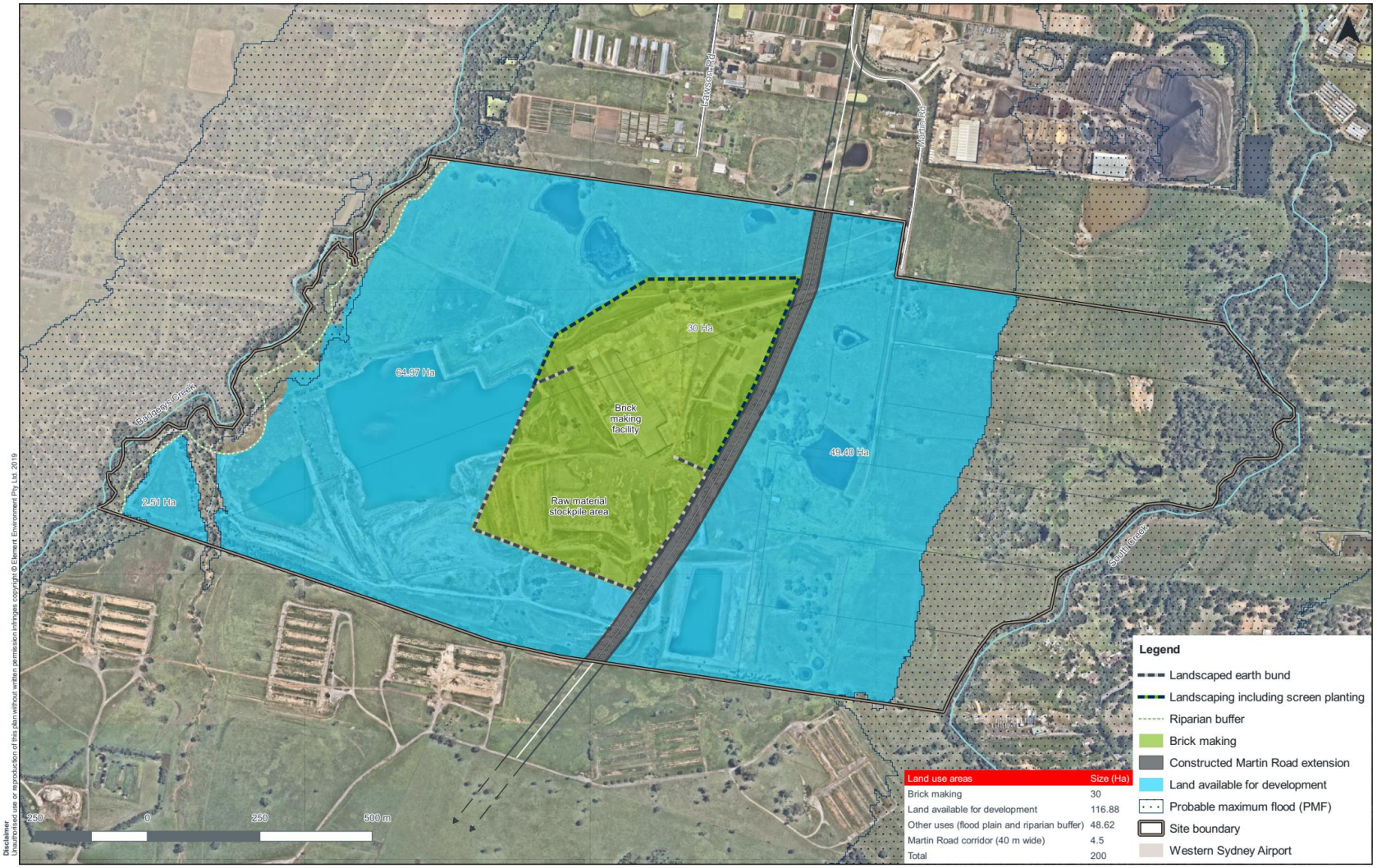


Table 1-1 Comparison of Approved Project and Proposed Preferred Project

Aspect	Existing Project Approval	Preferred Project	Variance between Approved Project and Preferred Project	Variance to Proposed Modification 3 & 4
Brick Production	252,000 tonnes of bricks per calendar year	300,000 tonnes of bricks per calendar year	Increased production of 48,000 tonnes of bricks per calendar year	Nil
Quarrying (approx. year 1 - 10)	Extract 420,000 tonnes of clay shale per calendar year	No change	Nil	Nil
Quarrying (approx. year 11 onwards)	Extract 420,000 tonnes of clay shale per calendar year	Cease extraction of clay shale by end of year 10 (approx. end of 2029)	Current approval allows quarrying until 27 September 2031	Decrease of 420,000 tonnes of clay shale extracted per calendar year for 20 years
Receival of raw materials (approx. year 1 – 10)	Receive 20,000 tonnes of raw materials for brick production per calendar year	Importation of 215,000 tonnes of raw materials for brick production per calendar year	Increase of 195,000 tonnes of imported raw materials for brick production per calendar year until end of year 10 (approx. 2029)	Nil
Receival of raw materials (approx. year 11 onwards)	Receive 20,000 tonnes of raw materials for brick production per calendar year	Receive 360,000 tonnes of raw materials for brick production per calendar year	Increase of 340,000 tonnes of imported raw materials for brick production per calendar year from approx. year 11 onwards	Increase of 145,000 tonnes of imported raw materials for brick production compared to Modification 3 and 4
Dispatching of raw materials (approx. year 1 – 10)	Dispatch 275,000 tonnes of raw materials from the site per calendar year	No change	Nil	Nil
Dispatching of raw materials (approx. year 11 onwards)	Dispatch 275,000 tonnes of raw materials from the site per calendar year	Cease dispatching of raw material by end of year 10 (approx. 2029)	275,000 tonne reduction in dispatched raw material per calendar year	Decrease of 275,000 tonnes of exported raw materials from the site from year 11 onwards compared to Modification 3 and 4

Aspect	Existing Project Approval	Preferred Project	Variance between Approved Project and Preferred Project	Variance to Proposed Modification 3 & 4
Truck Movements (approx. year 1 – 6) including receival of 215,000 tonnes of raw material, dispatch of 275,000 tonnes of raw materials, dispatch of 330,000 tonnes of finished brick products and importation of VENM to backfill Pits 1 and 2	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 400 trucks entering and exiting the site per day Monday – Friday (i.e. 800 vehicle movements). 200 truckloads are associated with the brick making facility and 200 truckloads are associated with VENM importation.	This is a combined increase of 340 trucks entering and exiting the site per day Monday to Friday (i.e. 680 vehicle movements).	Decrease of 72 trucks entering and exiting the site per day Monday – Friday compared to Modification 3 and 4
	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday	Maximum of 179 trucks entering and exiting the site per day on Saturday (i.e. 358 vehicle movements). 49 truckloads are associated with the brick making facility and 130 truckloads are associated with VENM importation.	This is a combined increase of 159 trucks entering and exiting the site per day on Saturday (i.e. 318 vehicle movements).	No change in the number of trucks entering and exiting the site per day on Saturday compared to Modification 3 and 4. The 30 trucks that were associated with the Monier roof products manufacturing facility will be used to facilitate an additional 30 VENM importation trucks on a Saturday.
	Nil	Maximum of 100 trucks entering and existing the site per day on Sunday	Increase of 100 trucks (VENM only) entering and exiting the site per day on Sunday (i.e. 200 vehicle movements)	Nil
Truck Movements (approx. year 7 – 10) including receival of 215,000 tonnes of raw material, dispatch of 275,000 tonnes of raw materials, dispatch of 330,000 tonnes of finished brick products and importation of VENM for staged	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 400 trucks entering and exiting the site per day Monday – Friday (i.e. 800 vehicle movements). 200 truckloads are associated with the brick making facility and 200 truckloads are associated with VENM importation.	This is a combined increase of 340 trucks entering and exiting the site per day Monday to Friday (i.e. 680 vehicle movements).	Decrease of 72 trucks entering and exiting the site per day Monday – Friday compared to Modification 3 and 4

Aspect	Existing Project Approval	Preferred Project	Variance between Approved Project and Preferred Project	Variance to Proposed Modification 3 & 4
backfill of Pit 3	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday	Maximum of 179 trucks entering and exiting the site per day on Saturday (i.e. 358 vehicle movements). 49 truckloads are associated with the brick making facility and 130 truckloads are associated with VENM importation.	This is a combined increase of 159 trucks entering and exiting the site per day on Saturday (i.e. 318 vehicle movements).	No change in the number of trucks entering and exiting the site per day on Saturday compared to Modification 3 and 4. The 30 trucks that were associated with the Monier roof products manufacturing facility will be used to facilitate an additional 30 VENM importation trucks on a Saturday.
	Nil	Maximum of 100 trucks entering and existing the site per day on Sunday	Increase of 100 trucks (VENM only) entering and exiting the site per day on Sunday (i.e. 200 vehicle movements)	Nil
Truck Movements (approx. year 11 – 13) including receival of 360,000 tonnes of raw material, dispatch of 330,000 tonnes of finished brick products and importation of VENM to backfill Pit 3	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 383 trucks entering and exiting the site per day Monday – Friday (i.e. 766 vehicle movements). 183 truckloads are associated with the brick making facility and 200 truckloads are associated with VENM importation.	This is a combined increase of 323 trucks entering and exiting the site per day Monday to Friday (i.e. 646 vehicle movements).	Decrease of 89 trucks entering and exiting the site per day Monday – Friday compared to Modification 3 and 4
	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday	Maximum of 179 trucks entering and exiting the site per day on Saturday (i.e. 358 vehicle movements). 49 truckloads are associated with the brick making facility and 130 truckloads are associated with VENM importation.	This is a combined increase of 159 trucks entering and exiting the site per day on Saturday (i.e. 318 vehicle movements).	No change in the number of trucks entering and exiting the site per day on Saturday compared to Modification 3 and 4. The 30 trucks that were associated with the Monier roof products manufacturing facility will be used to facilitate an additional 30 VENM importation trucks on a Saturday.

Aspect	Existing Project Approval	Preferred Project	Variance between Approved Project and Preferred Project	Variance to Proposed Modification 3 & 4
	Nil	Maximum of 100 trucks entering and existing the site per day on Sunday	Increase of 100 trucks (VENM only) entering and exiting the site per day on Sunday (i.e. 200 vehicle movements)	Nil
Truck Movements (approx. year 14 onwards) including receival of 360,000 tonnes of raw material and dispatch of 330,000 tonnes of finished brick products	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 183 trucks entering and exiting the site per day Monday – Friday (i.e. 366 vehicle movements). 183 truckloads are associated with the brick making facility.	This is a combined increase of 123 trucks entering and exiting the site per day Monday to Friday (i.e. 246 vehicle movements).	Decrease of 289 trucks entering and exiting the site per day Monday – Friday compared to Modification 3 and 4
	Maximum of 20 laden brick trucks (i.e. 40 vehicle movements) exiting the site per day on Saturday	Maximum of 49 trucks entering and exiting the site per day on Saturday (i.e. 98 vehicle movements). 49 truckloads are associated with the brick making facility.	This is an increase of 29 trucks entering and exiting the site per day on Saturday (i.e. 58 vehicle movements).	Decrease of 130 trucks entering and exiting the site per day on Saturday compared to Modification 3 and 4
	Maximum of 60 laden brick trucks (i.e. 120 vehicle movements) exiting the site per day Monday to Friday	Maximum of 183 trucks entering and exiting the site per day Monday – Friday (i.e. 366 vehicle movements). 183 truckloads are associated with the brick making facility.	This is a combined increase of 123 trucks entering and exiting the site per day Monday to Friday (i.e. 246 vehicle movements).	Decrease of 289 trucks entering and exiting the site per day Monday – Friday compared to Modification 3 and 4

Aspect	Existing Project Approval	Preferred Project	Variance between Approved Project and Preferred Project	Variance to Proposed Modification 3 & 4
Duration of Project Approval	27 September 2031	Brick making: Conditions of approval to be amended to have no project lifespan/sunset clause for brick making.	Brick making: Approved project limited to 27 Sept 2031, while proposed preferred project will have no project lifespan/sunset clause for brick making.	Nil. Modification 3 and 4 also requested no project lifespan/sunset clause for brick making
		Quarrying (Pit 3): Conditions of approval to be amended to allow quarrying (extraction from Pit 3) for 10 years from the date of modification approval.	Quarrying: Approved project limited to 27 Sept 2031, while proposed preferred project limited to quarrying only in Pit 3 for 10 years. Assuming approval granted in December 2019, quarrying of Pit 3 would cease in December 2019.	Modification 3 and 4 allowed for quarrying for 30 years from date of approval i.e. 20 years longer than the preferred project.
		VENM importation: At peak VENM importation of 200 trucks per day Mon-Fri and 100 per day Sat and Sun, Pit 3 could be filled within 2.5 years, However due to uncertainty on the rate at which suitable VENM will be available, it is to be requested that VENM importation does not have a lifespan/sunset clause.	No VENM importation allowed in the approved project.	Modification 4 allowed for VENM importation for 30 years.

Table 1-2 Comparison of Approved Hours of Operation and Proposed Preferred Project

Activity	Existing Project Approval	Preferred project	Proposed Modification 3	Proposed Modification 4	Variance to Approved Project
Quarrying operations (excluding removal of overburden, truck arrival, loading and dispatch)	Monday-Saturday 7:00 am to 6:00 pm Sunday and public holidays None	No change	No change	No change	Nil
Removal of overburden and construction of noise bunds	Monday-Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm Sunday and public holidays None	No change	No change	No change	Nil
Brick making facility and storage yard	Monday-Sunday 24 hours	No change	No change	No change	Nil
Truck arrival and dispatch (excluding finished building products i.e. raw materials)	Monday-Friday 6:00am to 10:00pm Saturday 6:00am to 6:00pm Sunday and public holidays None	No change	No change	No change	Nil

Activity	Existing Project Approval	Preferred project	Proposed Modification 3	Proposed Modification 4	Variance to Approved Project
Truck arrival and dispatch (finished building products only)	Monday-Saturday 7:00am to 10:00pm Sunday and public holidays None	Monday-Friday 5:00 am to 10:00 pm Saturday 6:00 am to 6:00 pm Sunday and public holidays None	Monday-Friday 5:00 am to 10:00 pm Saturday 6:00 am to 6:00 pm Sunday and public holidays None	N/A	Deliveries and dispatch to be extended by two hours earlier in the morning on a week day (Monday to Friday) and one hour earlier in the morning on a Saturday to allow finished product trucks (Modification 3 and preferred project) to arrive at site, load, and dispatch between 5:00 am and 6:00 am
Truck arrival and dispatch (VENM Importation)	Nil	Monday - Sunday 7:00 am – 6:00 pm	N/A	Monday - Sunday 7:00 am – 6:00 pm	Importation of VENM to backfill open voids (Modification 4 and preferred project)
Sales Selection / Cash Sales	Nil	Monday-Saturday 6:00 am to 6:00 pm Sunday and public holidays None	Monday-Saturday 6:00 am to 6:00 pm Sunday and public holidays None	N/A	Additional operating hours for sales selection and cash sales activities for finished brick products (Modification 3 and preferred project)
Customer Display Centre	Nil	Monday-Sunday 8:00 am to 5:00 pm Public Holidays None	Monday-Sunday 8:00 am to 5:00 pm Public Holidays None	N/A	Additional operating hours for customer display centre for finished brick products (Modification 3 and preferred project)

Table 1-3 Heavy Vehicle Calculations

Aspect	Monier	PGH	VENM Importation
Heavy Vehicle Movements for Modification 3 and 4 (per business) (taken from Modification 3 and 4 RFI Rev 32 dated 10 Oct 2018).	Dispatch of Finished Roof Products: 42 laden (84 movements) per day Mon to Fri 15 laden (30 movements) per day Sat Incoming Raw Materials and misc.: 27 laden (54 movements) per day Mon to Fri 14 laden (28 movements) per day Sat Incoming (Finished Roof Products): 3 laden (6 movements) per day Mon to Fri 1 laden (2 movements) per day Sat Total Heavy Vehicles per day (Mon – Fri): 42 + 27 + 3 = 72 Total Heavy Vehicles per day (Sat): 15 + 14 + 1 = 30 Total Heavy Vehicles per average hour: I have assumed 72 / 12hrs (6am – 6pm) = 6 Total Heavy Vehicles per busiest hour: Monier have advised that	Despatch of Bricks & Pavers: 123 laden brick trucks per day Mon to Fri (252 days/annum) 49 laden brick trucks per day Sat 12 services/maintenance trucks per day Mon to Fri (The above truck numbers have been changed to reflect the increase in brick production i.e. 2.44 x previous)(see PGH trucks tab) Import of Raw Material: 29 trucks per day (252 days/annum) Mon to Fri (manganese trucks and liquid delivery trucks listed in Point 13 are included). (The above truck numbers are calculated as: 215,000 tonnes pa/252 days pa/30 tonnes per truck = 29 trucks per day) Export of Raw Material: Export of raw material - 36 trucks per day (252 days/annum) Mon to Fri Total Heavy Vehicles per day (Mon – Fri): 123 + 12 + 29 + 36 = 200 Total Heavy Vehicles per day (Sat): 49 Total Heavy Vehicles per average hour: I have assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: Within the 1 hour morning period of 5am - 6am (Monier's busiest hour - see column J) there is likely to be a maximum of 15 brick trucks arriving on site, loaded and dispatched	VENM Importation: STAGE 1 - Aiming to complete by December 2026 Pit 1 Volume - 2,050,000 m3 (in situ quantity) / 4,305,000 tonnes (loose quantity) - used 2.2 conversion rate Pit 2 Volume 747,330m3 (in situ) / 1,644,126 tonnes (loose quantity) Total STAGE 1 Volume = 5,949,126 tonnes (loose) - divide by 31 Trucks in total = 191,907.29 - divide by 7 years Year = 27,415.3272 trucks per year Per week = 571.15 trucks (based on 48 week year) Typical VENM Importation Per Day (Mon - Fri) = 115 truck loads (rounded up from 114.23) Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 100 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm) Assumptions: - Truck and Dog carries 31 tonnes - Based on a 48 week year

Aspect	Monier	PGH	VENM Importation
	up to 14 trucks could arrive, load and dispatch within the 1 hour morning period of 5am - 6am and 10 Monier trucks could arrive and depart during PGH's busiest 1 hour period from 8am - 9am (see column K).	within the 5am - 6am period (two way heavy vehicle movement). The busiest hour for the PGH operations is likely to be from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour.	- 5 days per week (Mon - Fri) (conservative) used to calculate the likely VENM importation volumes per year. Worst case scenario from a traffic modelling perspective is 200 truckloads per day Mon - Fri and 100 truckloads per day on a Sat - Assume trucks are specific for VENM campaign, arriving fully laden to site and departing empty
Heavy Vehicle Movements (total from site) (taken from Modification 3 and 4 RFI Rev 32 dated 10 Oct 2018).	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 72 + 200 + 200 = 472 TOTAL HEAVY VEHICLES PER DAY (SAT): 30 + 49 + 100 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 6 + 17 + 18 = 41 TOTAL HEAVY VEHICLES PER MONIER BUSY HOUR (5am - 6am): 14 + 15 + 0 = 29 TOTAL HEAVY VEHICLES PER PGH BUSY HOUR (8am - 9am): 10 + 23 + 18 = 51		
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 29 (raw material import trucks) + 36 (raw material export trucks) = 200 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: 23 heavy vehicle loads (46 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour.	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)

Aspect	Monier	PGH	VENM Importation
Preferred Project: Phase 1 (approx. year 1 – 6) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 200 + 200 = 400 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 + 130 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 17 + 18 = 35 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 23 + 18 = 41		
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 29 (raw material import trucks) + 36 (raw material export trucks) = 200 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 200 / 12hrs (6am – 6pm) = 17 (round up from 16.6) Total Heavy Vehicles per busiest hour: 23 heavy vehicle loads (46 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 6 raw material trucks arrive and depart totalling 23 heavy vehicle loads (46 movements) in the busiest hour.	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm) Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)
Preferred Project: Phase 2 (approx. year 7 – 10) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 200 + 200 = 400 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 + 130 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 17 + 18 = 35 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 23 + 18 = 41		
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 48 (raw material import trucks)(360,000 tonnes pa/252 days pa/30 tonnes per truck) = 183 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks)	Max VENM Importation Per Day (Mon - Fri) = 200 truckloads per day (7am - 6pm) VENM Importation Per Average/Typical and Busy Hour = 18 truckloads (200/11hrs = 18.18 truckloads/hr) Max VENM Importation (Sat) = 130 trucks per day (7am - 6pm)

Aspect	Monier	PGH	VENM Importation
		Total Heavy Vehicles per average hour: Assumed 183 / 12hrs (6am – 6pm) = 15 (round down from 15.25) Total Heavy Vehicles per busiest hour: 21 heavy vehicle loads (42 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 4 raw material trucks arrive totalling 21 heavy vehicle loads (42 movements) in the busiest hour.	Max VENM Importation (Sun) = 100 Trucks per day (7am - 6pm)
Preferred Project: Phase 3 (approx. year 11 – 13) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 183 + 200 = 383 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 + 130 = 179 TOTAL HEAVY VEHICLES PER DAY (SUN) = 100 (VENM Importation Only) TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 15 + 18 = 33 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 21 + 18 = 39		
Preferred Project: Phase 4 (approx. year 14 onwards) Heavy Vehicle Movements	Nil (Monier operations removed from Preferred Project)	Total Heavy Vehicles per day (Mon – Fri): 123 (laden brick trucks) + 12 (service/maintenance trucks) + 48 (raw material import trucks)(300,000 tonnes pa/252 days pa/30 tonnes per truck) = 183 Total Heavy Vehicles per day (Sat): 49 (only laden brick trucks) Total Heavy Vehicles per average hour: Assumed 183 / 12hrs (6am – 6pm) = 15 (round down from 15.25) Total Heavy Vehicles per busiest hour: 21 heavy vehicle loads (42 movements) in the busiest hour from 8am - 9am where 17 brick trucks arrive and depart and 4 raw material trucks arrive totalling 21 heavy vehicle loads (42 movements) in the busiest hour.	Nil (Pit 3 backfill complete)

Aspect	Monier	PGH	VENM Importation
Preferred Project: Phase 4 (approx. year 14 onwards) Heavy Vehicle Movements – Total.	TOTAL HEAVY VEHICLES PER DAY (MON - FRI): 175 = 183 TOTAL HEAVY VEHICLES PER DAY (SAT): 49 = 49 TOTAL HEAVY VEHICLES PER AVERAGE HOUR: 15 TOTAL HEAVY VEHICLES PER BUSY HOUR (8am - 9am): 21		

2 EXISTING ENVIRONMENT

2.1 Sensitive Receivers

The nearest and most potentially affected receivers are a number of rural residential properties surrounding the site. These receivers have previously been identified in the *Noise Assessment Addendum Report* included in the *Responses to Submissions Report* for the original Project Approval, prepared by AECOM and dated 31 May 2011 and subsequently in the Modification 2 Environmental Assessment (Element Environment, 2018) and the Modification 3 and 4 Environmental Assessments (Element Environment, 2019). These receivers are shown on Figure 2-1 and summarised in Table 2-1.

Identified receivers to the west of the Project site, on the opposite side of Badgerys Creek are situated on the Western Sydney Airport site. The majority of these dwellings have been demolished, and it is understood that none of these buildings would be used as residential dwellings in the future. These receivers are identified on Figure 2-1; however, operational noise levels associated with the Proposal are not assessed at these receiver locations.

Receiver R10 is situated on land owned by CSR. Therefore, operational noise levels at R10 have not been assessed.

Review of aerial photography indicates that a second dwelling may be situated on property of receiver R12. This dwelling has been identified as receiver R12a and included in this assessment.

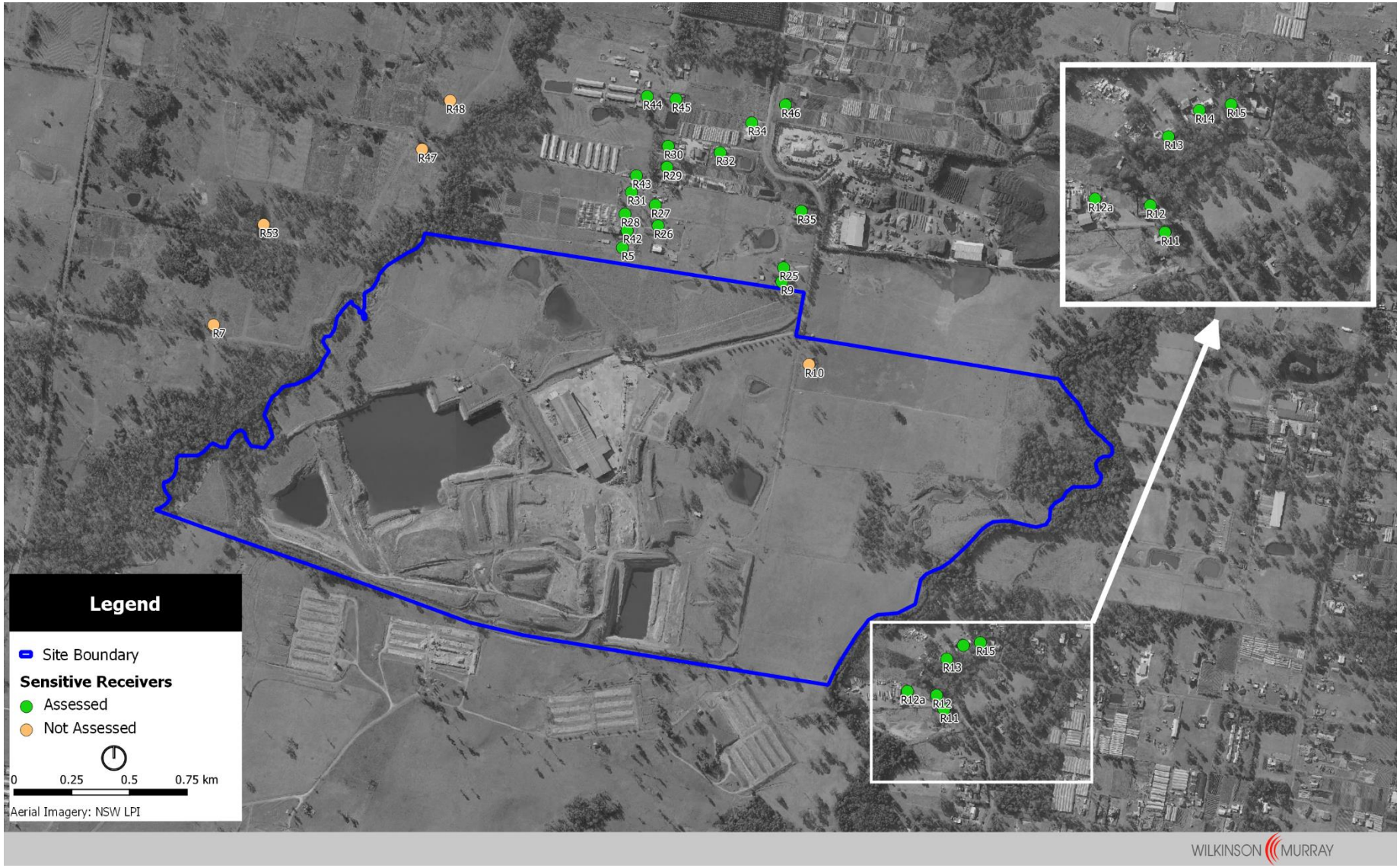
Table 2-1 Sensitive Receivers

Receiver	Address	Lot/DP Number
R5	255 Lawson Road, Badgerys Creek	19 DP 3050
R7 [a]	Lot 77 Fuller Street, Badgerys Creek	1 DP 838361
R9	217 Martin Road, Badgerys Creek	3 DP 589918
R10 [b]	225 Martin Road, Badgerys Creek	16 DP 28050
R11	22 Victor Avenue, Kemps Creek	17 DP 28050
R12	50 Victor Avenue, Kemps Creek	19 DP 28050
R12a	50 Victor Avenue, Kemps Creek	19 DP 28050
R13	70 Victor Avenue, Kemps Creek	20 DP 28050
R14	80 Victor Avenue, Kemps Creek	21 DP 28050
R15	82 Victor Avenue, Kemps Creek	3 DP 589918
R25	211 Martin Road, Badgerys Creek	2 DP 589918
R26	210 Lawson Rd, Badgerys Creek	1 DP 589918
R27	200 Lawson Road, Badgerys Creek	18 DP 3050
R28	245 Lawson Road, Badgerys Creek	1 DP 237229
R29	190 Lawson Road, Badgerys Creek	2 DP 237229
R30	180 Lawson Road, Badgerys Creek	2 DP 237229
R31	235 Lawson Road, Badgerys Creek	17 DP 3050
R32	180 Martin Road, Badgerys Creek	2 DP 237229
R34	170 Lawson Road, Badgerys Creek	3 DP 237229

Receiver	Address	Lot/DP Number
R35	195 Martin Road, Badgerys Creek	4 DP 589918
R42	245 Lawson Road, Badgerys Creek	18 DP 3050
R43	225 Lawson Road, Badgerys Creek	16 DP 3050
R44	205 Lawson Road, Badgerys Creek	14 DP 3050
R45	160 Lawson Road, Badgerys Creek	4 DP 237229
R46	170 Martin Road, Badgerys Creek	1 DP 567860
R47 [a]	255 (Lot 60) Longleys Road, Badgerys Creek	1 DP 838361
R48 [a]	42 Longleys Road, Badgerys Creek	1 DP 838361
R53 [a]	65 Leggo St, Badgerys Creek	1 DP 838361

a. Dwelling within Western Sydney Airport site and not assessed.
b. Residence on CSR owned land.

Figure 2-1 Sensitive Receivers



2.1 Existing Ambient Noise Levels

In order to quantify the existing ambient noise environment of the area, noise monitoring was conducted. Unattended noise monitoring was conducted between 16 June and 2 August 2017 to determine the existing ambient noise levels at the most potentially affected residential receivers in the area surrounding the site. The monitoring was undertaken at three locations, each considered representative of nearby residential receivers, as shown in Figure 2-2 and described in Table 2-2.

Table 2-2 Noise Monitoring Locations

Location	Address
L1	217 Martin Road, Badgerys Creek
L2	245 Lawson Road, Badgerys Creek
L3	48 Victor Avenue, Kemps Creek

2.1.1 Ambient Noise Monitoring Results

The noise monitoring equipment used for these measurements consisted of an environmental noise logger set to A-weighted, fast response. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

From the background noise levels (L_{A90}) the Rating Background Levels (RBLs) were determined using the methodology recommended in the NSW *Noise Policy for Industry* (NPfI). In addition to RBLs being established for the day, evening and night assessment periods, as defined in the NPfI, a "morning shoulder" period has been established to appropriately assess potential noise impacts between 5:00am and 7:00am when finished building products are proposed to be transported off-site.

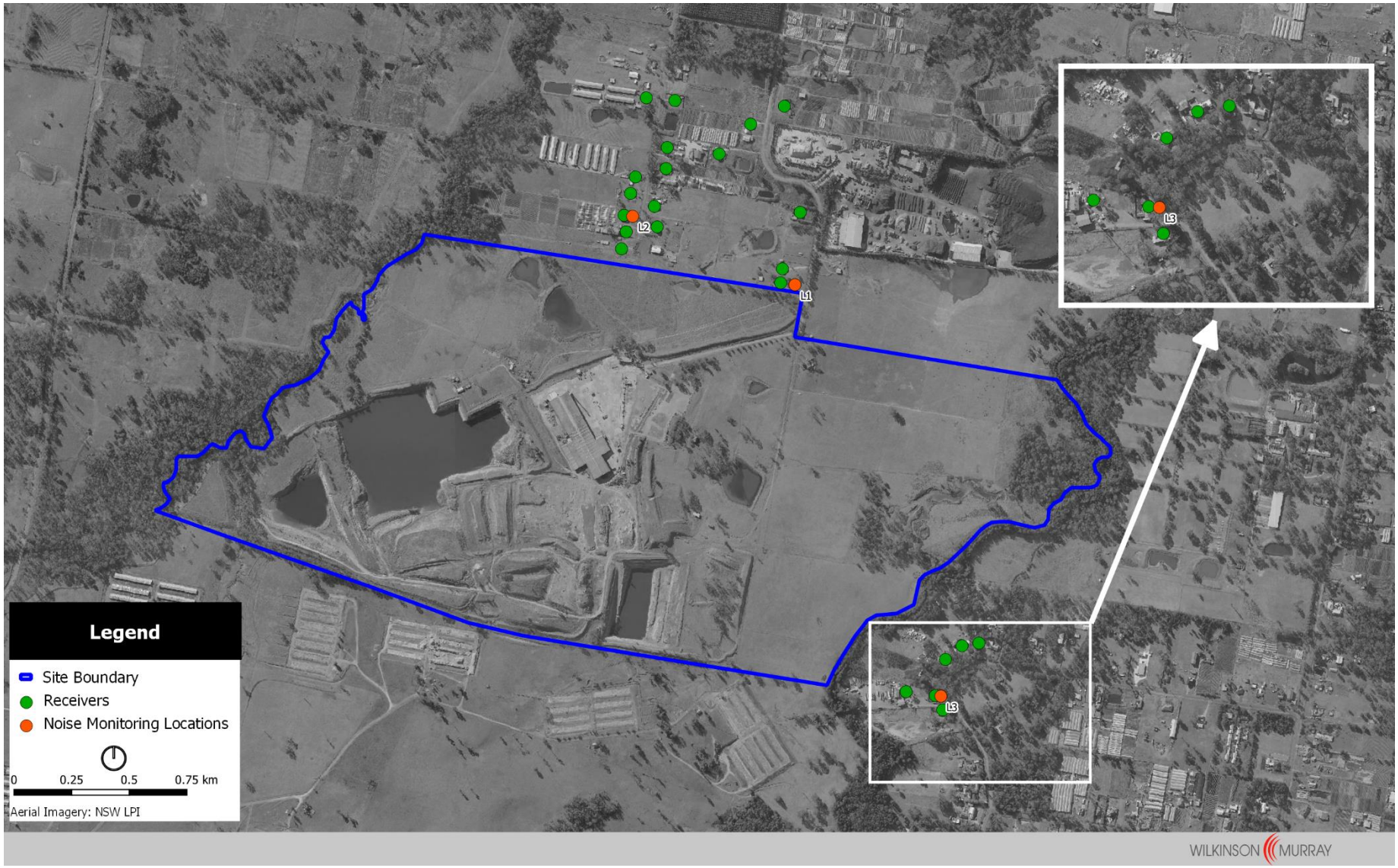
The existing ambient noise levels are presented in Table 2-3 below. Daily plots of the noise logger data are presented in Appendix A.

Table 2-3 Existing Ambient Noise Levels

Monitoring location	Represented Receivers	Time of Day [a]	Noise Levels (dBA)	
			RBL	L_{Aeq}
L1	R9, R25, R35	Morning shoulder	38	47
		Day	40	50
		Evening	35	43
		Night	34	43
L2	R5, R26-R32, R34, R42-46	Morning shoulder	38	45
		Day	37	51
		Evening	36	43
		Night	34	42
L3	R11-R15	Morning shoulder	41	47
		Day	38	47
		Evening	38	43
		Night	37	45

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.

Figure 2-2 Noise Monitoring Locations



3 OPERATIONAL NOISE ASSESSMENT

3.1 Operational Noise Trigger Levels

The *Noise Policy for Industry* (NPfI) (EPA, 2017) provides a framework for assessing environmental noise impacts from industrial premises and industrial development proposals in New South Wales.

The NPfI recommends the development of project noise trigger levels, which provide a benchmark for assessing a proposal or site. The project noise trigger levels should not be interpreted as mandatory noise criteria but, rather, as noise levels that, if exceeded, would indicate a potential noise impact on the community.

The project noise trigger level is the lower value of the project intrusiveness noise level and the project amenity noise level. The project intrusiveness noise level assesses the likelihood of noise being intrusive above the ambient noise level and is applied to residential receivers only. The project amenity noise level ensures the total industrial noise from all sources in the area does not rise above a maximum acceptable level.

3.1.1 Project Intrusiveness Noise Levels

The intrusiveness noise level is the noise level 5 dBA above the background noise level for each time period (daytime, evening or night time) of interest at a residential receiver. The background noise level is derived from the measured L_{A90} noise levels.

The NPfI stipulates that project intrusiveness noise levels should not be set below 40 dBA during the daytime and 35 dBA in the evening and night time. Additionally, the NPfI recommends that the project intrusiveness noise level for evening is set at no greater than that for the daytime, and that the project intrusiveness level for night time is set at no greater than that for the evening and daytime. Although not explicitly stated in the NPfI, Wilkinson Murray considers that limiting the intrusiveness noise level in the morning shoulder to no greater than that during the daytime is an approach consistent with the intent of the NPfI.

Intrusiveness noise levels for the project are calculated from the RBLs in Section 2.1 of this report and are presented in Table 3-1.

Table 3-1 Project Intrusiveness Noise Levels

Receiver	Time of Day [a]	RBL	Project Intrusiveness Noise Level ($L_{Aeq,15min}$ dBA)
R9, R25, R35	Morning shoulder	38	43
	Day	40	45
	Evening	35	40
	Night	34	39
R5, R26-R32, R34, R42-46	Morning shoulder	38	42
	Day	37	42
	Evening	36	41
	Night	34	39

Receiver	Time of Day [a]	RBL	Project Intrusiveness Noise Level ($L_{Aeq,15min}$ dBA)
R11-R15	Morning shoulder	41	43
	Day	38	43
	Evening	38	43
	Night	37	42

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.

3.1.2 Project Amenity Noise Levels

Project amenity noise levels aim to set a limit on continuing increases in noise levels from all industrial noise sources affecting a variety of receiver types; that is, the ambient noise level in an area from all industrial noise sources remains below recommended amenity noise levels.

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include transportation noise (when on public transport corridors), noise from motor sport, construction noise, community noise, blasting, shooting ranges, occupational workplace noise, wind farms, amplified music/patron noise.

The amenity noise level aims to limit continuing increases in noise levels which may occur if the intrusiveness level alone is applied to successive development within an area.

The recommended amenity noise level represents the objective for total industrial noise at a receiver location. The project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To prevent increases in industrial noise due to the cumulative effect of several developments, the project amenity noise level for each new source of industrial noise is set at 5dBA below the recommended amenity noise level.

The following exceptions apply to determining the project amenity noise level:

- For high-traffic areas the amenity criterion for industrial noise becomes the $L_{Aeq,period(traffic)}$ minus 15dBA.
- In proposed developments in major industrial clusters.
- If the resulting project amenity noise level is 10dB or more lower than the existing industrial noise level, the project amenity noise level can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.
- Where cumulative industrial noise is not a consideration because no other industries are present in, or likely to be introduced into the area, the relevant amenity noise level is assigned as the project amenity noise level for the development.

Amenity noise levels are not used directly as regulatory limits. They are used in combination with the project intrusiveness noise level to assess the potential impact of noise, assess mitigation options and determine achievable noise requirements.

The project amenity noise levels are calculated from the recommended amenity noise levels presented in Table 3-2.

Table 3-2 Recommended Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day [a]	Recommended Amenity Noise Level (dBA $L_{Aeq,period}$)
Residential	Rural	Day	50
		Evening	45
		Night	40
	Suburban	Day	55
		Evening	45
		Night	40
	Urban	Day	60
		Evening	50
		Night	45
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks	See column 4	See column 4	5dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day.
School classroom-internal	All	Noisiest 1-hour period when in use	35
Hospital ward internal external	All	Noisiest 1-hour	35
	All	Noisiest 1-hour	50
Place of worship-internal	All	When in use	40
Area specifically reserved for passive recreation (e.g. national park)	All	When in use	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65
Industrial premises	All	When in use	65
Industrial interface (applicable only to residential noise amenity areas)	All	All	Add 5dB(A) to recommended noise amenity area

a. Day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 7:00am.

Recommended amenity noise levels presented in Table 3-2 above represent the objective for total industrial noise at a receiver location. In the case of a single new noise source being proposed, the project amenity noise level represents the objective for noise from a single industrial development at the receiver location. This is calculated as the recommended amenity noise level minus 5dBA.

Due to different averaging periods for the $L_{Aeq,15min}$ and $L_{Aeq,period}$ noise descriptors, the values of project intrusiveness and amenity noise levels cannot be compared directly when identifying noise trigger levels i.e.; the most stringent values of each category. In order to make a comparison between descriptors, the NPfI assumes that the $L_{Aeq,15min}$ equivalent of an $L_{Aeq,period}$ noise level is equal to the $L_{Aeq,15min}$ level plus 3dB.

Table 3-3 Project Amenity Noise Levels

Noise Amenity Area	Time of Day [a]	Recommended Amenity Noise Level ($L_{Aeq,period}$)	Project Amenity Noise Level ($L_{Aeq,15min}$ dBA)
Rural	Day	50	48
	Evening	45	43
	Night	40	38

b. Day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 7:00am.

3.1.3 Project Noise Trigger Levels

Table 3-4 below shows the project noise levels for sensitive receivers, with the project noise trigger levels shown in bold.

Table 3-4 Project Noise Trigger Levels

Receiver	Time of Day [a]	Project Intrusiveness Noise Levels ($L_{Aeq,15min}$ dBA)	Project Amenity Noise Levels ($L_{Aeq,15min}$ dBA)
R9, R25, R35	Morning shoulder	**43**	n/a
	Day	**45**	48
	Evening	**40**	43
	Night	39	**38**
R5, R26-R32, R34, R42-46	Morning shoulder	**42**	n/a
	Day	**42**	48
	Evening	**41**	43
	Night	39	**38**
R11-R15	Morning shoulder	**43**	n/a
	Day	**43**	48
	Evening	**43**	43
	Night	42	**38**

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.

3.1.4 Maximum Noise Trigger Levels

Noise sources at night occurring over a short duration have the potential to cause sleep disturbance despite complying with project noise trigger levels. The manufacturing facilities are intended to operate on a 24-hour basis as required. Therefore, the maximum noise level events need to be considered for potential sleep disturbance.

The NPfI recommends that, where the night time L_{Amax} receiver noise levels from a development exceeds 52 dBA or the RBL plus 15 dBA, whichever is the greater, then a more detailed assessment of potential sleep disturbance impacts is warranted. Table 3-5 presents the maximum noise trigger levels for the receivers identified in this assessment. These noise levels are typically addressed at the façade of potentially affected dwellings and should consider multiple storey dwellings.

Table 3-5 Maximum Noise Trigger Levels

Receiver	RBL (dBA)	RBL + 15 dBA	Maximum Noise Trigger Level (dBA)
R9, R25, R35	34	49	52
R5, R26-R32, R34, R42-46	34	49	52
R11-R15	37	52	52

Additionally, in instances where night time $L_{Aeq,15min}$ noise levels exceed 40 dBA or the prevailing RBL plus 5 dBA, whichever is the greater, then a detailed assessment of potential sleep disturbance impacts is warranted. Since the night time project noise trigger level is less than 40 dBA for all nearby receivers, compliance with these noise trigger levels will ensure that no further assessment of night time $L_{Aeq,15min}$ noise levels, with regard to sleep disturbance, would be required.

3.2 Operational Noise Modelling Methodology

3.2.1 Computer Noise Model

Operational noise emissions associated with the Proposal were modelled using the CadnaA acoustic noise prediction software and the CONCAWE noise prediction algorithm. The CONCAWE noise propagation model is used around the world and is widely accepted as an appropriate model for predicting noise over significant distances. Factors that were addressed in the noise modelling are:

- Equipment noise level emissions and locations;
- Shielding from ground topography and structures;
- Noise attenuation due to geometric spreading;
- Ground absorption;
- Atmospheric absorption; and,
- Noise enhancing meteorology.

3.2.2 Ground Topography and Structures

Within the site, topographical data has been provided by CSR at 1 metre height intervals. Beyond the site boundary, 2 metre ground contours from NSW Land and Property Information (LPI) have been incorporated in the model.

The existing topography within the site includes a noise bund along the main driveway, and also a partially constructed noise bund in the south eastern corner of the site, near Pit 3.

A 3 metre landscaped visual bund, to the east, south and west of the brick making facility raw material stockpile area, is proposed to be constructed by the end of phase 1. This would be an earthen bund and would attenuate noise levels to the east, south and west of the brick making facility. However, as a conservative measure, this bund has not been included in the noise modelling.

The existing and proposed structures associated with the brick making facility are also included in the noise model.

3.2.3 Ground Absorption

A ground absorption factor of 0.75 has been applied to the entire model. This global ground absorption value conservatively represents the mix of hard ground (absorption = 0) and soft ground (absorption = 1) on and around the site.

3.2.4 Meteorological Effects

At relatively large distances from a source, the resultant noise levels at receivers can be influenced by meteorological conditions, particularly temperature inversions and gradient winds. Where these factors are a feature of an area their effect on resultant noise levels should be taken into account.

Noise enhancing meteorology adopted in this assessment, denoted as "NE" in results tables, are described below.

Temperature Inversions

Temperature inversions are considered likely to be a feature of the area, particularly during winter nights. Therefore, the following default temperature inversion parameters recommended in the NPfI have been included in the assessment:

- Stability category F with 2 m/s winds.

These parameters have been applied during night time and the morning shoulder period.

The CadnaA noise modelling software includes a feature that allows the model to be run with the "worst-case wind direction". This option produces the highest noise level for each receiver due to noise-enhancing winds and has been used in the modelling.

Wind

Prevailing winds have been identified in general accordance with "Fact Sheet D" of the NPfI, based on hourly wind speed and direction observations taken during 2017 at the Bringelly Air Quality Monitoring Station (AQMS), operated by the NSW Office of Environment and Heritage (OEH).

Table 3-6 presents the percentage of time where light winds up to 3.0 m/s are blowing from a particular direction, plus or minus 45 degrees, during the day, evening and night time in each season. Where the percentage is 30% or more, denoted in bold text, the winds are considered a feature of the area, and should be included in the assessment.

Table 3-6 Identification of Prevailing Winds

Direction	Percentage of Time											
	Summer			Autumn			Winter			Night		
	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night	Day	Eve	Night
N	21	9	7	16	3	1	18	4	4	21	3	2
NNE	24	16	7	17	3	2	17	2	4	23	7	2
NE	25	22	6	16	7	2	11	2	2	24	16	2
ENE	21	29	4	12	10	4	5	2	2	19	23	3
E	21	**38**	5	18	12	5	7	2	2	19	32	3
ESE	20	**45**	7	20	13	6	8	4	1	18	34	4
SE	19	**43**	10	22	10	6	10	3	1	14	27	5
SSE	18	**41**	28	28	24	17	17	14	14	12	29	17
S	16	**35**	**48**	**34**	**46**	**40**	26	**40**	**36**	11	**32**	**38**
SSW	13	22	**48**	**35**	**48**	**45**	**33**	**43**	**43**	10	28	**42**
SW	12	14	**45**	**31**	**46**	**45**	**33**	**46**	**43**	10	26	**41**
WSW	7	8	27	23	**32**	**32**	28	**38**	**31**	9	20	29
W	6	3	5	10	8	7	17	15	10	7	8	7
WNW	7	3	3	7	5	2	11	12	3	6	6	3
NW	8	5	4	9	5	1	14	9	5	10	5	2
NNW	17	7	6	16	4	1	18	6	4	17	3	2

Table 3-6 indicates the potential for prevailing winds in the area surrounding the Proposal. Therefore, in accordance with the NPfI, the following meteorological conditions have been incorporated into the noise model during the daytime and evening:

- D-class stability; and,
- 3 m/s wind.

Similar to the modelling of drainage winds during temperature inversions, winds during the daytime and evening are modelled to result in the highest noise levels at each receiver. However, it is noted that winds from westerly to east-north-easterly are not prevalent in any period during any season. Therefore, noise enhancement due to prevailing winds is unlikely to occur at receivers located in an arc from easterly to west-south-westerly of the site. This arc includes receivers on Victor Avenue. Therefore, noise-enhanced predicted noise levels during the daytime and evening at receivers R11 – R15 will be ignored.

3.2.5 Modifying Factors

Consideration has been given to modifying factors which account for annoying noise characteristics, and such factors have been deemed not applicable. Low frequency noise is often associated with quarrying activities and, in the context of the Proposal, low frequency noise impacts are considered unlikely for the following reasons:

- Operational noise sources are not identified as having "unbalanced" source spectra, that is the C-A noise level difference would not be greater than 15dB; and,
- Sensitive receivers are located relatively close to the noise sources, thereby limiting the potential for the C weighted level being 15dB above the A weighted level via differential noise attenuation – where, over large distances, attenuation of mid and high frequencies is significantly larger than for low frequencies;

Notwithstanding the above, during detailed design, plant and machinery will be selected carefully to minimise potential annoying noise characteristics. Finally, it is expected that the provisions in the Noise Policy for Industry 2017 (NPfI) for annoying noise characteristics would apply to any noise monitoring conducted under the consent.

3.3 Operational Noise Sources

3.3.1 Source Sound Power Levels

Major fixed sources of operational noise emissions from the existing brick making facility were previously measured by AECOM and presented in previous noise assessments, most notably the assessments accompanying the 2010 EIS and RtS. CSR advises that any new fixed plant to be installed at the brick making facility is anticipated to have similar noise emissions to the existing equipment.

A small number of fixed plant items at the brick making facility, specifically the box feed and primary crusher, were not identified as noise sources in previous assessments. This is most likely due to these items being located at the southern end of the brick making facility and having a small contribution to receiver noise levels. Notwithstanding, sound power levels measured by Wilkinson Murray at another brick making facility in Western Sydney have been applied to these items.

VENM would be imported into the site via truck-and-dogs along the public road network. Up to 200 truck loads of VENM would be imported to the site, during daytime (7:00am – 6:00pm) hours only.

Source sound power levels for most items of mobile plant have been taken from previous measurements of similar equipment conducted by Wilkinson Murray on similar sites.

Table 3-7 summarises the operational noise sources associated with the various elements of the Proposal and their respective SWL.

Table 3-7 Operational Noise Sources and Sound Power Levels

Item	Description	Quantity	SWL (dBA) per item	Reference
Brick Making Facility				
Kiln Stack	Northern end	2	92	Previous EIS/RtS
Vent	Western side	1	98	Previous EIS/RtS
Exhaust	Middle of roof	3	96	Previous EIS/RtS
Hydraulics	Western side	1	102	Previous EIS/RtS
Compressor	Western side	1	96	Previous EIS/RtS
Primary Crusher	Southern side	1	94	WM database
Box Feeder	Southern side	1	94	WM database
Mobile Jaw Crusher	Sandvik QJ341	1	115	WM database
Forklift	5 tonne	7 [a]	99	WM database
Road Truck	e.g. Semi	See Table 3-8	103	WM database
Front End Loader	Komatsu WA500	2	107	Previous EIS/RtS
Quarrying				
Grader	Cat 140H	1	108	WM database
Dozer	Komatsu D375A-5	1	116	WM database
Excavator (45t)	Komatsu PC450	1	113	Previous EIS/RtS
Excavator (30t)	Komatsu PC300	1	104	WM database
Compactor	Cat 825	1	112	WM database
Dump Truck	Cat 740	5 [b]	110	WM database
Water Cart	Cat 740	1	110	WM database
VENM Importation				
Road Trucks	Truck and dog	200 per day	103	WM database

a. One forklift to remain inside at all times.
b. 3 dump trucks used during normal quarrying operations, 2 additional dump trucks used for engineered fill of Pit 2.

3.4 Modelled Activities and Assessment Scenarios

Receiver noise levels associated with the operation of the Proposal have been predicted for a range of scenarios. These scenarios include times when quarrying activities are being conducted, and times where only the brick making facility is operating.

3.4.1 Brick Making Facility

Operating parameters for the brick making facility and associated storage yards were described in the NIA for Modification 3, and are summarised below in Table 3-8. The modelled locations of these sources are shown in Figure 3-1.

Table 3-8 Operational Noise Sources – Brick Making Facility

Item	Modelled Source Description			
	Morning shoulder [a]	Day [a]	Evening [a]	Night [a]
Kiln Stack	Continuous operations			
Vent				
Exhaust				
Hydraulics				
Compressor				
Forklift	6 units operating in yard	6 units operating in yard	6 units operating in yard	3 units operating in yard
Road Truck	15 brick trucks per hour	17 brick trucks and 6 raw material trucks per hour	13 brick trucks and 4 raw material trucks per hour	Nil
Front End Loader	1 unit in continuous operation	2 units in continuous operation	2 units in continuous operation	1 unit in continuous operation

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.

Figure 3-1 Modelled Noise Sources – Brick Making Facility



3.4.2 Quarrying, VENM Importation and Engineered Fill

Noise impacts associated with quarrying activities would vary as the nature and location of the works change over phases 1, 2 and 3. For assessment purposes, quarrying activities in Pit 3 have been modelled in the eastern part of the pit as this is likely to result in the highest noise levels at sensitive receivers. Within Pit 3, both overburden removal (OB) and raw material extraction (RM) activities have been modelled. Additionally, during the removal of overburden from Pit 3, engineered filling activities have been modelled in both Pit 1 and Pit 2.

These activities are described below. Figures showing the locations of modelled noise sources for each quarrying scenario are included in Appendix B.

Overburden Removal

Overburden removal involves the use of a grader and an excavator to strip material and transfer it into dump trucks. The dump trucks would then transfer the material to other areas of the site as may be needed to back-fill previously quarried areas.

Overburden removal would commence at the existing ground level and would continue downwards to a level approximately 4 metres below the existing ground level. The highest receiver noise levels during overburden removal would coincide with activities occurring at the existing ground level, where shielding from nearby topography is at a minimum. Accordingly, the noise modelling assumes that overburden removal is conducted at the existing ground level.

At the location where the overburden is placed, it will be spread with a compactor to fill a previously extracted area.

Raw Material Extraction

Once the overburden has been removed, and desirable material has been exposed, a dozer would be used to rip this material and an excavator would load the material into dump trucks. The dump trucks would haul the material from the pit to the raw material stockpiles.

As described previously, overburden would be removed down to approximately 4 metres below the existing ground level. Therefore, noise modelling assumes that raw material extraction would begin at approximately 4 metres below existing ground level.

VENM Importation and Engineered Fill

Road trucks importing VENM onto the site would haul to the appropriate pit and dump material in the pit. A compactor and a water cart would be used to achieve the required compaction.

Additionally, during the engineering fill of Pit 2, a single excavator would be used to strip previously emplaced overburden from the northern third of Pit 2. This material would be loaded into one of 2 dump trucks and hauled to the central and southern sections of Pit 2 for compaction.

3.5 Predicted $L_{Aeq,15min}$ Operational Noise Levels

The predicted $L_{Aeq,15min}$ operational noise levels at sensitive receivers for the proposed site activities outlined in the preceding sections are presented in Table 3-9 through Table 3-12. Contour plots of predicted operational noise levels are presented in Appendix C.

Table 3-9 Predicted Operational Noise Levels – Phase 1

Receiver	AM Shoulder [a]				Day [a]						Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level				Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b] OB [e]	Calm [b] RM [e]	NE [c] OB [e]	NE [c] RM [e]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R5	34	38	42	Yes	36	36	41	41	42	Yes	36	41	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	35	36	39	40	45	Yes	35	39	40	Yes	27	31	38	Yes
R11	22	27	43	Yes	39	35	- [d]	- [d]	43	Yes	39	- [d]	43	Yes	19	25	38	Yes
R12	22	28	43	Yes	41	36	- [d]	- [d]	43	Yes	41	- [d]	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	41	37	- [d]	- [d]	43	Yes	41	- [d]	43	Yes	21	26	38	Yes
R13	22	28	43	Yes	39	36	- [d]	- [d]	43	Yes	39	- [d]	43	Yes	19	24	38	Yes
R14	22	27	43	Yes	39	35	- [d]	- [d]	43	Yes	39	- [d]	43	Yes	18	23	38	Yes
R15	22	27	43	Yes	38	34	- [d]	- [d]	43	Yes	38	- [d]	43	Yes	18	23	38	Yes
R25	31	34	43	Yes	35	35	39	39	45	Yes	35	39	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	34	34	39	39	42	Yes	34	39	41	Yes	30	35	38	Yes
R27	30	34	42	Yes	33	33	38	39	42	Yes	33	38	41	Yes	29	33	38	Yes
R28	30	35	42	Yes	34	34	39	39	42	Yes	34	39	41	Yes	29	34	38	Yes
R29	27	32	42	Yes	32	32	37	37	42	Yes	32	37	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	31	31	36	36	42	Yes	31	36	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	33	33	38	38	42	Yes	33	38	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	31	31	36	36	42	Yes	31	36	41	Yes	25	30	38	Yes
R34	24	29	42	Yes	29	29	34	35	42	Yes	29	34	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	32	33	37	37	45	Yes	32	37	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	34	35	39	40	42	Yes	34	39	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	32	32	37	37	42	Yes	32	37	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	29	29	34	35	42	Yes	29	34	41	Yes	23	28	38	Yes

Receiver	AM Shoulder [a]				Day [a]						Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level				Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b] OB [e]	Calm [b] RM [e]	NE [c] OB [e]	NE [c] RM [e]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R45	24	29	42	Yes	29	30	35	35	42	Yes	29	35	41	Yes	23	28	38	Yes
R46	22	27	42	Yes	27	28	33	33	42	Yes	27	33	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.
e. OB = overburden removal; RM = raw material extraction.

Table 3-10 Predicted Operational Noise Levels – Phase 2

Receiver	AM Shoulder [a]				Day [a]				Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R5	34	38	42	Yes	36	40	42	Yes	34	39	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	35	39	45	Yes	31	35	40	Yes	27	31	38	Yes
R11	22	27	43	Yes	35	- [d]	43	Yes	22	- [d]	43	Yes	<20	25	38	Yes
R12	22	28	43	Yes	36	- [d]	43	Yes	22	- [d]	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	37	- [d]	43	Yes	23	- [d]	43	Yes	21	26	38	Yes
R13	22	28	43	Yes	36	- [d]	43	Yes	23	- [d]	43	Yes	<20	24	38	Yes
R14	22	27	43	Yes	35	- [d]	43	Yes	22	- [d]	43	Yes	<20	23	38	Yes
R15	22	27	43	Yes	34	- [d]	43	Yes	22	- [d]	43	Yes	<20	23	38	Yes
R25	31	34	43	Yes	35	39	45	Yes	31	34	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	34	39	42	Yes	32	36	41	Yes	30	35	38	Yes
R27	30	34	42	Yes	33	38	42	Yes	30	35	41	Yes	29	33	38	Yes

Receiver	AM Shoulder [a]				Day [a]				Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R28	30	35	42	Yes	33	38	42	Yes	31	36	41	Yes	29	34	38	Yes
R29	27	32	42	Yes	31	36	42	Yes	28	33	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	30	35	42	Yes	27	32	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	32	37	42	Yes	30	35	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	30	35	42	Yes	27	32	41	Yes	25	30	38	Yes
R34	24	29	42	Yes	28	34	42	Yes	24	29	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	32	37	45	Yes	26	31	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	34	39	42	Yes	32	37	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	31	36	42	Yes	29	34	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	28	33	42	Yes	25	30	41	Yes	23	28	38	Yes
R45	24	29	42	Yes	28	33	42	Yes	25	30	41	Yes	23	28	38	Yes
R46	22	27	42	Yes	27	33	42	Yes	23	28	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

Table 3-11 Predicted Operational Noise Levels – Phase 3

Receiver	AM Shoulder [a]				Day [a]				Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R5	33	38	42	Yes	35	39	42	Yes	34	39	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	34	38	45	Yes	31	35	40	Yes	27	31	38	Yes

Receiver	AM Shoulder [a]				Day [a]				Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R11	22	27	43	Yes	37	- [d]	43	Yes	22	- [d]	43	Yes	<20	25	38	Yes
R12	22	27	43	Yes	39	- [d]	43	Yes	22	- [d]	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	40	- [d]	43	Yes	23	- [d]	43	Yes	21	26	38	Yes
R13	22	27	43	Yes	38	- [d]	43	Yes	23	- [d]	43	Yes	<20	24	38	Yes
R14	22	27	43	Yes	37	- [d]	43	Yes	22	- [d]	43	Yes	<20	23	38	Yes
R15	21	26	43	Yes	36	- [d]	43	Yes	22	- [d]	43	Yes	<20	23	38	Yes
R25	30	34	43	Yes	34	38	45	Yes	31	34	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	32	37	42	Yes	32	36	41	Yes	30	35	38	Yes
R27	29	34	42	Yes	31	36	42	Yes	30	35	41	Yes	29	33	38	Yes
R28	30	35	42	Yes	32	37	42	Yes	31	36	41	Yes	29	34	38	Yes
R29	27	32	42	Yes	29	34	42	Yes	28	33	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	28	33	42	Yes	27	32	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	31	35	42	Yes	30	35	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	28	33	42	Yes	27	32	41	Yes	25	30	38	Yes
R34	23	28	42	Yes	26	31	42	Yes	24	29	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	31	35	45	Yes	26	31	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	33	38	42	Yes	32	37	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	30	34	42	Yes	29	34	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	26	31	42	Yes	25	30	41	Yes	23	28	38	Yes
R45	24	29	42	Yes	26	31	42	Yes	25	30	41	Yes	23	28	38	Yes
R46	22	27	42	Yes	25	30	42	Yes	23	28	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

Table 3-12 Predicted Operational Noise Levels – Phase 4

Receiver	AM Shoulder [a]				Day [a]				Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R5	33	38	42	Yes	34	39	42	Yes	34	39	41	Yes	32	37	38	Yes
R9	31	35	43	Yes	32	35	45	Yes	31	35	40	Yes	27	31	38	Yes
R11	22	27	43	Yes	22	- [d]	43	Yes	22	- [d]	43	Yes	<20	25	38	Yes
R12	22	27	43	Yes	23	- [d]	43	Yes	22	- [d]	43	Yes	20	25	38	Yes
R12a	23	28	43	Yes	24	- [d]	43	Yes	23	- [d]	43	Yes	21	26	38	Yes
R13	22	27	43	Yes	23	- [d]	43	Yes	23	- [d]	43	Yes	<20	24	38	Yes
R14	22	27	43	Yes	23	- [d]	43	Yes	22	- [d]	43	Yes	<20	23	38	Yes
R15	21	26	43	Yes	22	- [d]	43	Yes	22	- [d]	43	Yes	<20	23	38	Yes
R25	30	34	43	Yes	31	35	45	Yes	31	34	40	Yes	26	31	38	Yes
R26	31	36	42	Yes	32	37	42	Yes	32	36	41	Yes	30	35	38	Yes
R27	29	34	42	Yes	30	35	42	Yes	30	35	41	Yes	29	33	38	Yes
R28	30	35	42	Yes	31	36	42	Yes	31	36	41	Yes	29	34	38	Yes
R29	27	32	42	Yes	28	33	42	Yes	28	33	41	Yes	26	31	38	Yes
R30	26	31	42	Yes	27	32	42	Yes	27	32	41	Yes	25	30	38	Yes
R31	29	34	42	Yes	30	35	42	Yes	30	35	41	Yes	28	33	38	Yes
R32	26	31	42	Yes	27	32	42	Yes	27	32	41	Yes	25	30	38	Yes
R34	23	28	42	Yes	25	30	42	Yes	24	29	41	Yes	22	27	38	Yes
R35	26	31	43	Yes	27	31	45	Yes	26	31	40	Yes	24	29	38	Yes
R42	32	36	42	Yes	33	37	42	Yes	32	37	41	Yes	31	35	38	Yes
R43	28	33	42	Yes	29	34	42	Yes	29	34	41	Yes	27	32	38	Yes
R44	24	29	42	Yes	25	30	42	Yes	25	30	41	Yes	23	28	38	Yes
R45	24	29	42	Yes	25	30	42	Yes	25	30	41	Yes	23	28	38	Yes

Receiver	AM Shoulder [a]				Day [a]				Evening [a]				Night [a]			
	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?	Predicted Level		Trigger Level	Complies?
	Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]			Calm [b]	NE [c]		
R46	22	27	42	Yes	23	28	42	Yes	23	28	41	Yes	21	26	38	Yes

a. Morning shoulder = 5:00am – 7:00am; day = 7:00am – 6:00pm; evening = 6:00pm – 10:00pm; night = 10:00pm – 5:00am.
b. D-class stability, no wind
c. 3 m/s source to receiver wind during day & evening; F-class stability and 2 m/s source to receiver wind during night & AM shoulder.
d. Noise enhancement due to wind is not a feature of the area for receivers to the south-east of the site.

Review of Table 3-9 through Table 3-12 indicates that the predicted operational $L_{Aeq,15min}$ noise levels at sensitive receivers comply with the project noise trigger levels during all phases of the Proposal.

3.5.1 Voluntary Land Acquisition and Mitigation Policy

The Proposal is classified as a State significant mining/extractive industry development and therefore, the Voluntary Land Acquisition and Mitigation Policy (VLAMP) must be considered.

The predicted noise levels associated with the operation of the Proposal comply with the established noise trigger levels at all sensitive receivers. Additionally, the predicted noise levels associated with the operation of the Proposal do not exceed the acceptable noise level plus 5 dB in Table 2.2 of the NPfI on more than 25% of any privately owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Therefore, no voluntary mitigation or land acquisition rights, as prescribed by the VLAMP, would be applicable to the Proposal.

3.6 Predicted L_{Amax} Operational Noise Levels

Pneumatic parking brakes on trucks are considered the most likely potential source of maximum noise levels during site operations. Based on measurements previously conducted by Wilkinson Murray, the L_{Amax} sound power level of pneumatic parking brakes is typically up to 122 dBA.

The predicted L_{Amax} noise levels at sensitive receivers due to the operation of truck parking brakes on the site are presented in Table 3-13.

Table 3-13 Predicted L_{Amax} Noise Levels

Receiver	Predicted Level		Maximum Noise Trigger Level	Complies?
	Calm [a]	NE [b]		
R5	37	42	52	Yes
R9	39	44	52	Yes
R11	35	40	52	Yes
R12	36	40	52	Yes
R12a	37	42	52	Yes
R13	37	41	52	Yes
R14	37	41	52	Yes
R15	36	41	52	Yes
R25	37	42	52	Yes
R26	37	42	52	Yes
R27	35	40	52	Yes
R28	35	40	52	Yes
R29	33	38	52	Yes
R30	31	36	52	Yes
R31	34	39	52	Yes

Receiver	Predicted Level		Maximum Noise Trigger Level	Complies?
	Calm [a]	NE [b]		
R32	33	38	52	Yes
R34	32	37	52	Yes
R35	33	38	52	Yes
R42	36	42	52	Yes
R43	33	37	52	Yes
R44	28	33	52	Yes
R45	29	34	52	Yes
R46	29	34	52	Yes

a. D-class stability, no wind
b. F-class stability and 2 m/s source to receiver wind.

Table 3-13 indicates that the predicted L_{Amax} operational noise levels comply with the maximum noise trigger level at all receivers. Therefore, no further assessment of potential sleep disturbance impacts is warranted.

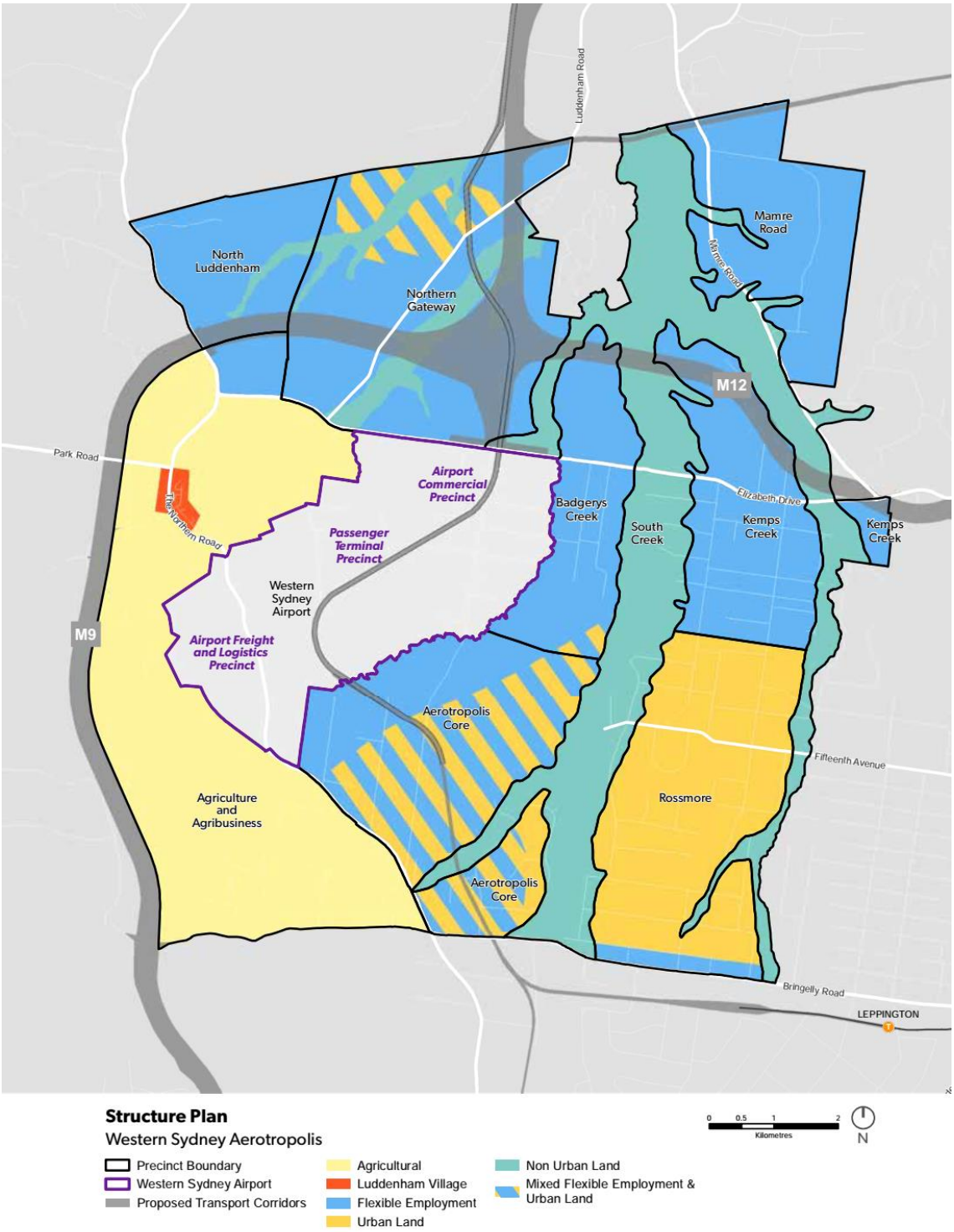
3.7 Operational Noise Impacts on Western Sydney Aerotropolis

The LUIIP for the Western Sydney Aerotropolis identifies the Proposal site and surrounding land for future flexible employment (including commercial and industrial) and urban development. The LUIIP Structure Plan is shown in Figure 3-2. From phase 4 onwards, the Proposal would confine brick making operations to an approximately 30 Ha area in the centre of CSR's 200 Ha site, while land within the site boundary beyond this 30 Ha area is made available for development in accordance with the LUIIP.

With respect to the LUIIP, operational noise levels from the Proposal would:

- Comply with NPfI-derived noise trigger levels for commercial and industrial land uses on all land beyond the site boundary during all phases;
- Comply with NPfI-derived noise trigger levels for commercial and industrial land uses to the north and west of the final 30 Ha brick making site from phase 2 onwards;
- Comply with NPfI-derived noise trigger levels for commercial and industrial land uses to the south and east of the final 30 Ha brick making site from phase 4 onwards; and,
- Comply with NPfI-derived noise trigger levels for residential land uses to the south and east of the final 30 Ha brick making site from phase 4 onwards.

Figure 3-2 Western Sydney Aerotropolis LUIIP Structure Plan



4 ROAD NOISE ASSESSMENT

The Proposal will generate additional traffic along the surrounding public road network. The increase will be most prominent along Martin Road and will largely be due to heavy vehicles hauling VENM to the Proposal site. The traffic generated by the Proposal is significant when compared to the existing flows along Martin Road. Accordingly, a detailed assessment of potential road noise impact at all sensitive receivers along Martin Road has been conducted.

Additionally, the Proposal will generate additional traffic on Elizabeth Drive. However, these movements will be relatively minor compared to the existing traffic flows on Elizabeth Drive. Therefore, a high-level assessment of potential impacts at the most potentially affected receivers along Elizabeth Drive has been conducted.

The highest level of traffic generation from the Proposal would occur within phase 1. Accordingly, the road noise assessments presented herein are based on phase 1 traffic generation.

4.1 Martin Road – Elizabeth Drive Intersection Upgrade

The traffic impact assessment for the proposal has found that the Martin Road – Elizabeth Drive intersection would need to be signalised. In addition to the introduction of traffic signals, turning lanes at the intersection would be revised.

The changes to the horizontal alignment of the "through lanes" at the intersection are not significant when compared to the setback distance to nearby receivers. Therefore, the intersection upgrade would have a negligible effect on road noise from traffic continuing straight on Elizabeth Drive.

CoRTN (Calculation of Road Traffic Noise) is the road noise model approved for use in NSW. This model does not account for noise associated with vehicles accelerating and decelerating at intersections. These effects are considered unlikely to cause unacceptable road noise impacts at nearby receivers but are not able to be predicted using the approved model. To protect the acoustic amenity of receivers potentially affected by road noise impacts associated with the intersection upgrade, it is recommended that the existing levels of road noise are quantified prior to the upgrade works. In the event that receivers near the intersection complain of increased road noise after the upgrade, road noise levels at these receivers should be re-measured. If the measurements indicate that the intersection upgrade has caused exceedances of applicable road noise criteria, then appropriate architectural treatments should be offered to affected receivers.

4.2 Road Noise Criteria

The *NSW Road Noise Policy* (RNP) (DECCW, 2011) sets out criteria for assessment of noise from traffic on public roads. The RNP sets out noise assessment criteria for "freeways", "arterial", "sub-arterial" and "local roads".

Martin Road would typically be classified as a local road. However, in addition to standard road classifications, the RNP also identifies "principal haulage routes" whereby some local public roads servicing industries such as mines and extractive industries carry a different level and mix of traffic to typical local roads in residential areas. The RNP advises that the noise criteria for principal haulage routes should match those for arterial/sub-arterial roads, noting that they carry a different level and mix of traffic to most local roads.

Martin Road is an approved B-Double route and, in addition to the CSR site, services other heavy traffic generating activities such as the Australian Native Landscapes (ANL) site at 210 Martin Road and resource recovery facilities at 25 and 55 Martin Road. As discussed further in Section 4.3.2, heavy vehicles contribute approximately 43% of the existing traffic flows on Martin Road. Therefore, the use of Martin Road is consistent with that of a principal haulage route and has been assessed as such in accordance with the RNP.

In accordance with the RNP, Elizabeth Drive is considered a sub-arterial road.

The RNP impact assessment criteria for residential land uses impacted by additional traffic on arterial/sub-arterial roads are presented in Table 4-1

Table 4-1 RNP Impact Assessment Criteria

Road	Category	Assessment Criteria - dBA	
		Day [a]	Night [a]
Martin Road	Principal haulage route (arterial/sub-arterial)	$L_{Aeq,\ 15\ hour}$ 60 (external)	$L_{Aeq,\ 9\ hour}$ 55 (external)

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am

With regard to the permissible increase in road traffic noise from a land use development the *RNP* states:

> "*For existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option'.*"

4.3 Road Noise Impacts Along Martin Road

4.3.1 Sensitive Receivers Potentially Affected by Road Noise

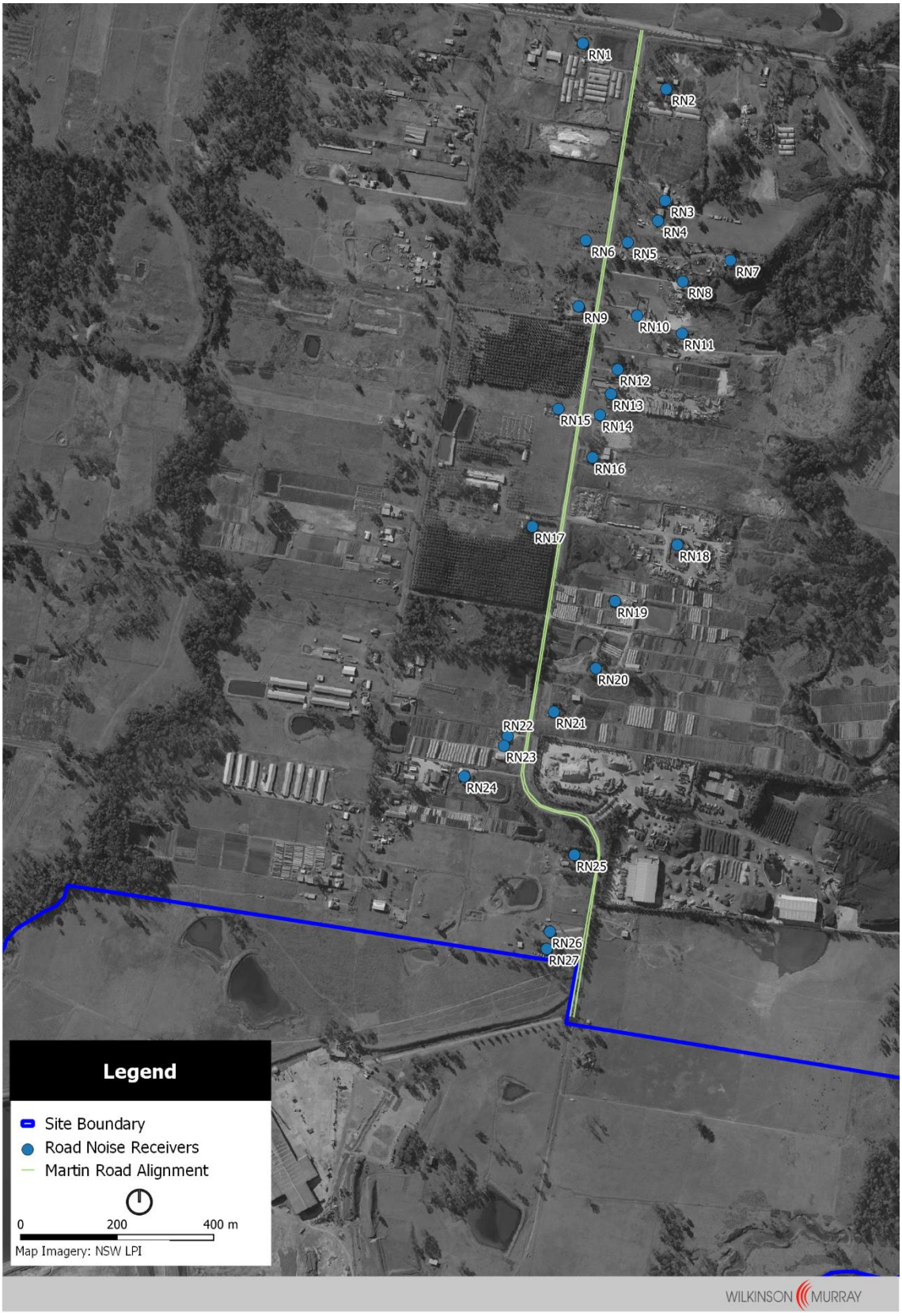
Road noise impacts associated with traffic generated by the Proposal are assessed at all residences adjacent to Martin Road. These receivers are summarised in Table 4-2 and shown in Figure 4-1.

Table 4-2 Road Noise Receivers

Receiver ID [a]	Address
RN1	1970 Elizabeth Drive Badgerys Creek
RN2	10 Martin Road Badgerys Creek
RN3	30 Martin Road Badgerys Creek
RN4	40 Martin Road Badgerys Creek
RN5	50 Martin Road Badgerys Creek
RN6	55 Martin Road Badgerys Creek
RN7	50a Martin Road Badgerys Creek
RN8	60 Martin Road Badgerys Creek
RN9	65 Martin Road Badgerys Creek
RN10	70 Martin Road Badgerys Creek
RN11	80 Martin Road Badgerys Creek
RN12	90 Martin Road Badgerys Creek
RN13	100 Martin Road Badgerys Creek
RN14	110 Martin Road Badgerys Creek
RN15	75 Martin Road Badgerys Creek
RN16	120 Martin Road Badgerys Creek
RN17	85 Martin Road Badgerys Creek
RN18	140 Martin Road Badgerys Creek
RN19	150 Martin Road Badgerys Creek
RN20	160 Martin Road Badgerys Creek
RN21	170 Martin Road Badgerys Creek
RN22 (R34)	165 Martin Road Badgerys Creek
RN23	165A Martin Road Badgerys Creek
RN24 (R32)	180 Lawson Road Badgerys Creek
RN25 (R35)	195 Martin Road Badgerys Creek
RN26 (R25)	211 Martin Road Badgerys Creek
RN27 (R9)	211a Martin Road Badgerys Creek

a. Receiver labels in brackets denote receivers identified in construction and operational noise assessments.

Figure 4-1 Road Noise Receivers



4.3.2 Existing Road Noise Levels and Traffic Volumes

Wilkinson Murray has undertaken noise monitoring along Martin Road to establish the existing traffic noise levels at sensitive receivers and to facilitate validation/calibration of the noise model. Unattended noise monitoring, accompanied by contemporaneous traffic counting conducted by Austraffic Pty Ltd, was undertaken at two locations along Martin Road between Thursday 16 August and Thursday 30 August 2018. The noise monitoring and traffic counting locations are shown in Figure 4-2. The noise loggers were placed in "free-field" locations.

The results of the noise monitoring and traffic count surveys are summarised in Table 4-4 and Table 4-4, respectively.

Table 4-3 Existing Traffic Noise Levels

Monitoring Location	Façade/Free-Field	Day [a] $L_{Aeq, 15\ hour}$	Night [a] $L_{Aeq, 9\ hour}$
L1	Free-field	53.1	47.9
L2	Free-field	54.1	48.4

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am.

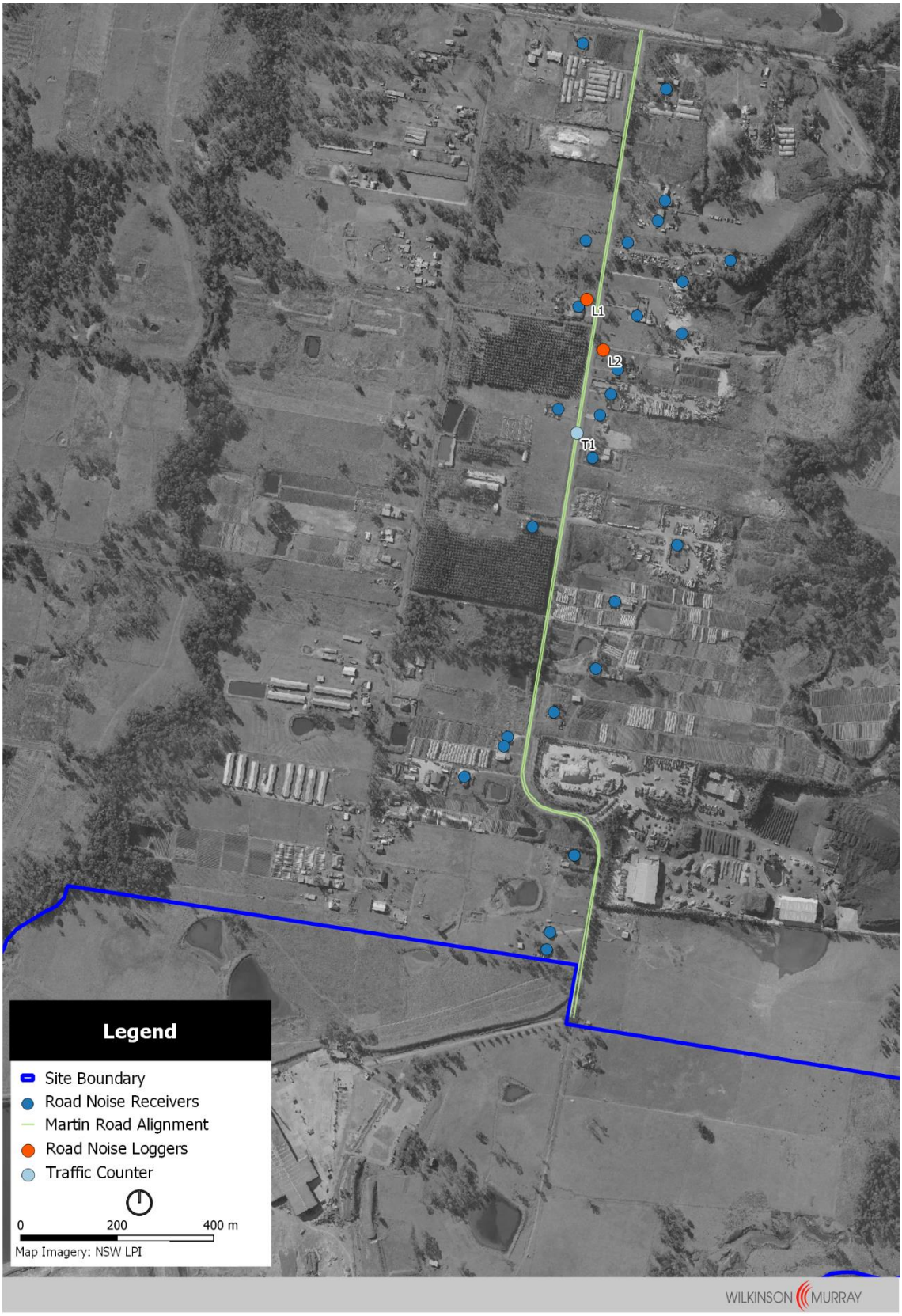
Table 4-4 Existing Traffic Volumes

Location	Direction	Day [a]		Night [a]	
		Light [b]	Heavy [b]	Light [b]	Heavy [b]
T1	Northbound	212	144	11	21
	Southbound	143	152	74	20
	Total	355	296	85	41

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am.
b. Light = Austroads vehicle classifications 1 & 2; heavy = Austroads vehicle classifications 3-12.

The traffic volumes measured during the survey are considered representative of the existing conditions along Martin Road, north of the Australian Native Landscapes (ANL) site at 210 Martin Road. South of the ANL site, the only potential sources of traffic on Martin Road are three residential properties. Therefore, the existing traffic flows and associated road noise levels at Martin Road residences south of ANL are assumed to be negligible.

Figure 4-2 Traffic Noise and Volume Monitoring Locations



4.3.3 Road Noise Modelling Methodology

The following factors have been considered during the assessment process:

- Traffic volume and proportions of heavy vehicles;
- Vehicle speed;
- Road surface type;
- Road gradient;
- Different noise emission levels and source heights;
- Ground topography;
- Location of potentially affected receivers; and,
- Allocation of traffic to different lanes

Noise levels from the introduced traffic movements were calculated using procedures based on the *CoRTN (Calculation of Road Traffic Noise)* (UK Department of Transport, 1988) prediction algorithms. The standard prediction procedures were modified as follows:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the *CoRTN* algorithms using the well-validated approximation $L_{Aeq,1hour} = L_{A10,1hr} - 3$ (NSW RTA, 2001). It is worth noting the predicted $L_{Aeq,1hr}$ is equivalent to the $L_{Aeq,period}$ as required by the noise criteria since the input is the "average" traffic flow per hour over the given daytime and night time periods.
- Noise source heights were set at 0.5m for cars, 1.5m for heavy vehicle engines and 3.6m for heavy vehicle exhausts, representative of typical values for Australian vehicles (*Road Traffic Noise: Interim Traffic Noise Policy*, 1992).
- Noise from a heavy vehicle exhaust is 8dBA lower than the (steady continuous) noise from the engine.

The model was implemented using SoundPLAN v8.0 using CoRTN Australia (NSW). Table 4-5 summarises other variables used in the noise model.

Table 4-5 Variables used for modelling

Parameter	Comment
Roads	Manually generated
Traffic Speed	60 km/h
Road surfaces	+0dB DGA
Traffic Volume	Current traffic volumes have been provided by Austraffic traffic consultants
Terrain	2m Contours
Road Alignment	Manually generated
Noise Barriers	Not applicable
Buildings	Manually generated
Receivers	Generated in SoundPLAN at each façade of each noise-sensitive building
Ground Absorption	Ground absorption factor was set to 75% for the entire area
Façade Correction	+2.5 dB in accordance with CoRTN

Table 4-6 shows the measured and predicted road noise levels at both road noise monitoring locations.

Table 4-6 Model Validation Results

Location	$L_{Aeq,15hr}$ dBA			$L_{Aeq,9hr}$ dBA		
	Measured	Predicted	Difference	Measured	Predicted	Difference
Logger 1	53.1	53.9	-0.8	47.9	48.7	-0.8
Logger 2	54.1	53.2	0.9	48.4	48	0.4

If the difference between measured and predicted results are within 2 dB, they are generally considered acceptable given the expected accuracy of standard noise monitoring and modelling procedures in conjunction with variability in traffic speeds and variability in pavement wear along the whole alignment. Therefore, the model validation results for both locations are considered satisfactory.

4.3.4 Traffic Generated by the Development

The anticipated traffic movements generated by the development have been provided by CSR and are summarised in Table 4-7. It should be noted that these traffic movements represent the total traffic generated by the Project as it would operate under the Proposal and are not incremental to movements allowed under any existing consent.

Table 4-7 Traffic Movements Generated by the Proposal

Direction	Day [a]		Night [a]	
	Light [b]	Heavy [b]	Light [b]	Heavy [b]
Northbound	143	381	15	19
Southbound	118	381	40	19

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am.
b. Light = Austroads vehicle classifications 1 & 2; heavy = Austroads vehicle classifications 3-12.

4.3.5 Predicted Road Noise Levels

The predicted road noise levels at sensitive receivers are summarised in Table 4-8. Noise levels are presented for the existing traffic volumes along Martin Road and for future traffic volumes which include traffic generated by the Proposal. These scenarios are termed the "no-build" and "build" scenarios, respectively.

Table 4-8 identifies those receivers where, based on the most affected façade on the property, the predicted "build" noise levels exceed the impact assessment criteria, and the increase in road noise levels due to the Proposal are greater than 2 dB. When these conditions are met, all reasonable and feasible mitigation measures should be implemented to reduce noise levels down to the impact assessment criteria.

Table 4-8 Predicted Road Noise Levels at the Most Affected Residential Facades

Receiver		Predicted $L_{Aeq,period}$ Noise Levels				Criteria		Increase		Exceed Criteria?		Increase > 2dB?		Mitigate?	Treatment Package
		No Build		Build											
ID	Address	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night		
RN1	1970 Elizabeth Drive	46	40	51	43	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN2	10 Martin Road	50	44	55	46	60	55	5.4	2.7	N	N	Y	Y	N	Nil
RN3	30 Martin Road	47	41	53	44	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN4	40 Martin Road	48	42	53	45	60	55	5.4	2.7	N	N	Y	Y	N	Nil
RN5	50 Martin Road	56	50	**61**	53	60	55	5.4	2.8	Y	N	Y	Y	**Y**	**1**
RN6	55 Martin Road	54	48	60	51	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN7	50a Martin Road	39	33	45	36	60	55	5.6	2.9	N	N	Y	Y	N	Nil
RN8	60 Martin Road	43	37	48	39	60	55	5.5	2.9	N	N	Y	Y	N	Nil
RN9	65 Martin Road	57	51	**62**	53	60	55	5.3	2.7	Y	N	Y	Y	**Y**	**1**
RN10	70 Martin Road	49	43	55	46	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN11	80 Martin Road	42	36	48	39	60	55	5.5	2.9	N	N	Y	Y	N	Nil
RN12	90 Martin Road	51	45	57	48	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN13	100 Martin Road	52	46	58	49	60	55	5.4	2.8	N	N	Y	Y	N	Nil
RN14	110 Martin Road	58	52	**63**	55	60	55	5.3	2.8	Y	N	Y	Y	**Y**	**1**
RN15	75 Martin Road	55	49	60	51	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN16	120 Martin Road	58	52	**64**	55	60	55	5.2	2.8	Y	N	Y	Y	**Y**	**1**
RN17	85 Martin Road	53	47	58	50	60	55	5.3	2.7	N	N	Y	Y	N	Nil
RN18	140 Martin Road	42	36	48	39	60	55	5.5	2.9	N	N	Y	Y	N	Nil
RN19	150 Martin Road	46	40	51	43	60	55	5.3	2.7	N	N	Y	Y	N	Nil

Receiver		Predicted $L_{Aeq,period}$ Noise Levels				Criteria		Increase		Exceed Criteria?		Increase > 2dB?		Mitigate?	Treatment Package
		No Build		Build											
ID	Address	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night		
RN20	160 Martin Road	48	42	53	45	60	55	5.3	2.8	N	N	Y	Y	N	Nil
RN21	170 Martin Road	56	50	**62**	53	60	55	5.4	2.7	Y	N	Y	Y	**Y**	**1**
RN22 (R34)	165 Martin Road	58	52	**63**	55	60	55	5.3	2.8	Y	N	Y	Y	**Y**	**1**
RN23	165A Martin Road	55	49	60	51	60	55	5.4	2.7	N	N	Y	Y	N	Nil
RN24 (R32)	180 Lawson Road	45	39	51	42	60	55	5.7	3.1	N	N	Y	Y	N	Nil
RN25 (R35)	195 Martin Road	40	34	58	47	60	55	17.6	13.6	N	N	Y	Y	N	Nil
RN26 (R25)	211 Martin Road	36	29	54	44	60	55	18.8	14.6	N	N	Y	Y	N	Nil
RN27 (R9)	211a Martin Road	31	25	54	44	60	55	22.8	18.7	N	N	Y	Y	N	Nil

4.3.6 Mitigation of Road Noise

The preceding assessment of road noise impacts associated with additional traffic on Martin Road has identified six receivers as qualifying for mitigation of the increases in noise levels due to the operation of the Proposal.

The RNP recommends that noise control is applied to road noise impacts in a hierarchical manner, as follows:

- Road design and traffic management;
- Quieter pavement surfaces;
- In-corridor noise barriers/mounds; and,
- At-property treatments.

Noise control via road design and traffic management are typically only available to road infrastructure projects and are generally not reasonable or feasible for traffic generating development such as the Proposal.

Due to the relatively low traffic speeds on Martin Road and the high proportion of heavy vehicles due to the Proposal, quieter pavement surfaces would not lead to a significant reduction in road traffic noise levels.

In corridor noise barriers/mounds are not feasible as the barrier(s) would need to be terminated at many locations to accommodate the driveways to properties on Martin Road and to ensure appropriate visibility.

Since all higher priority mitigation measures are not feasible and reasonable, at-receiver mitigation is recommended.

There are six receivers identified as qualifying for mitigation of the increases in noise levels due to the operation of the Proposal. For each of these receivers, the exceedance of the impact assessment criteria is less than 5 dB and the increase in road noise levels due to the operation of the Proposal is less than 6 dB.

Architectural treatments to properties are considered the most appropriate means of achieving the required reductions in road noise levels at receivers qualifying for mitigation. The RMS *Draft At-Receiver Treatment Guideline* provides deemed-to-comply construction solutions for a range of "treatment package types". All receivers qualifying for mitigation would require the "Type 1" treatment package, outlined in Table 4-9.

It is noted that, where truck movements generated by the Proposal are not greater than those allowed under the current Project Approval, no architectural treatments would be warranted at receivers on Martin Road. Moreover, noise modelling results indicate that the Proposal could generate up to 180 truck movements in the daytime period without requiring architectural treatments to receivers on Martin Road.

Table 4-9 Deemed to Comply Mitigation Packages

Construction	Treatment Package Type				
	1	2	3	4	5
Exceedance, dBA	**1-5**	**6-8**	**9-11**	**12-14**	**>14**
All	• Optional ceiling fans[1] • Mechanical ventilation (MV) • New acoustic seals for windows • Seal around window architraves / door jambs • Seal all vents and openings	• As per Category 1 treatments • External solid core door (40mm) with perimeter acoustic seals, drop seals and threshold seals			
Brick veneer or double brick Window area less than or equal to 20% floor area		For 6 dBA exceedance: • 6.38mm laminate and roof insulation (R4.0 215mm thick) or 6.5mm lam with acoustic interlayer For 7 dBA exceedance: • 8.5mm lam with acoustic interlayer or 10.38mm lam For 8 dBA exceedance: • 8.5mm lam with acoustic interlayer or 10.5mm lam with acoustic interlayer or 10mm acrylic panel with nominally 100mm gap or >5mm secondary window with 100mm gap, or equivalent	• Roof insulation (R4.0 215mm thick) For 9 dBA exceedance: • 8.5mm lam with acoustic interlayer or 10.38mm lam Otherwise: • 10.5mm lam with acoustic interlayer or 10mm acrylic panel with nominally 10mm gap, or >4mm secondary window with 100mm gap, or equivalent	• >4mm secondary window with 100mm gap, or equivalent • Roof insulation (R4.0 215mm thick)	
Brick veneer or double brick Sliding door area less than or equal to 50% wall area	• 6.38mm lam, or equivalent	• 6.5mm lam with acoustic interlayer, or equivalent • Roof insulation (R4.0 215mm thick) Or • 8.5mm lam with acoustic interlayer, or equivalent	• 8.5mm lam with acoustic interlayer or >4mm secondary window with nominally 100mm gap, or equivalent • Roof insulation (R4.0 215mm thick)	• >6mm secondary window with nominally 100mm gap, or equivalent • Roof insulation (R4.0 215mm thick)	
Lightweight Window area less than or equal to 20% floor area	• Sealed subfloor • Roof insulation (R4.0 215mm thick)	• As per Category 1 treatments For 8 dBA exceedance: • 10mm acrylic panel with nominally 100mm gap, or equivalent • Re-sheet wall lining (1x 6mm fibre cement sheeting with nominal board weight of 11 kg/m^2 and 1x 13mm plasterboard with nominal board weight of 10.5 kg/m^2 to finish, or equivalent) • Wall insulation (R2.7 90mm thick) Otherwise: • 10mm acrylic panel with 100mm gap, or equivalent • Additional wall lining (1x 13mm plasterboard with nominal board weight of 10.5 kg/m^2 to finish, or equivalent)	As per Category 1 treatments For 8 dBA exceedance: • 10mm acrylic panel with nominally 100mm gap, or equivalent • Re-sheet wall lining (1x 6mm fibre cement sheeting with nominal board weight of 11 kg/m^2 and 1x 13mm plasterboard with nominal board weight of 10.5 kg/m^2 to finish, or equivalent) • Wall insulation (R2.7 90mm thick) • Resilient mount to isolate wall lining and stud	As per Category 1 treatments • 4mm secondary window with nominally 100mm gap, or equivalent • Re-sheet wall lining (1x 6mm fibre cement sheeting with nominal board weight of 11 kg/m^2 and 1x 13mm plasterboard with nominal board weight of 10.5 kg/m^2 to finish, or equivalent) • Wall insulation (R2.7 90mm thick) • Resilient mount to isolate wall lining and stud	As per Category 1 treatments • 6mm secondary window with nominally 100mm gap, or equivalent • Re-sheet wall lining (1x 6mm fibre cement sheeting with nominal board weight of 11 kg/m^2 and 1x 13mm plasterboard with nominal board weight of 10.5 kg/m^2 to finish, or equivalent) • Wall insulation (R2.7 90mm thick) • Resilient mount to isolate wall lining and stud •

Note 1: Ceiling fans should have Direct Current (DC) electric motors to minimise noise.
Note 2: Mechanical ventilation (MV) should be installed so that fresh air is ducted from an unaffected building façade. Mechanical fan noise should meet the recommended noise levels in AS2107.

4.4 Road Noise Impacts Along Elizabeth Drive

The traffic impact assessment for the Proposal advises that approximately 75% of the traffic movements to and from the site will travel along the section of Elizabeth Drive that is east of Martin Road. Therefore, the assessment of potential road noise impacts will focus on this section of Elizabeth Drive.

4.4.1 Traffic Volume and Percent Heavy Vehicles

The traffic impact assessment advises that the existing peak hour traffic volume along Elizabeth Drive is approximately 1200 vehicles, with heavy vehicles contributing 12% of the total traffic flow. To assess 15-hour daytime and 9-hour night time road traffic noise levels, it assumed that the peak hourly traffic volume accounts for 10% of the average daily traffic volume and that the night time traffic volume accounts for 10% of the average daily traffic volume.

Table 4-10 presents the existing ("no build") and future ("build") traffic volumes and percent heavy vehicles ("mix") along Elizabeth Drive, east of Martin Road.

Table 4-10 Traffic Volume and Mix – Elizabeth Drive

Road	Time [a]	Existing (no build)		Future (build)	
		Volume	Mix	Volume	Mix
Elizabeth Drive – East of Martin Road	Day	10,800	12%	11,568	16%
	Night	1,200	12%	1,270	14%

a. Day = 7:00am – 10:00pm; night = 10:00pm – 7:00am

Using the traffic data in Table 4-10, the no-build and build road traffic noise levels have been predicted at the front façade of potentially affected receivers along Elizabeth Drive. These noise levels have been predicted using the CoRTN model and are based on the following additional inputs:

- The posted speed limit along Elizabeth Drive is 80 km/h;
- The front façade of the most potentially affected receivers is approximately 90 metres from the nearest edge of Elizabeth Drive; and,
- A +2.5 dBA façade correction has been applied.

Table 4-11 presents the predicted road noise levels at the most potentially affected receiver locations along Elizabeth Drive with and without the Proposal.

Table 4-11 Predicted $L_{Aeq,period}$ Road Noise Levels – Elizabeth Drive

Road	No Build		Build		Criteria		Difference	
	Day [a]	Night [a]	Day [a]	Night [a]	Day [a]	Night [a]	Day [a]	Night [a]
Elizabeth Drive – East of Martin Road	57.7	50.4	58.6	50.9	60	55	0.9	0.5

Review of Table 4-11 indicates that the predicted $L_{Aeq,period}$ road noise levels at the façade of the most potentially affected receivers along Elizabeth Drive comply with the RNP impact assessment criteria and that the increase in traffic noise levels due to the Proposal is less than 2 dBA.

5 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

The following section presents an assessment of potential noise impacts associated with the construction of the Proposal.

The construction of the Proposal would likely begin in June 2020 and the works would take approximately 18 months to complete.

In addition to the construction works proposed to be undertaken within the Proposal site, potential noise impacts associated with the construction of the proposed signalised intersection have also been assessed. The most potentially affected sensitive receivers near the intersection works are 1970 Elizabeth Drive and 10 Martin Road. These receivers were identified in the detailed road noise assessment as receivers RN1 and RN2, respectively. These receiver designations will be used in this construction noise assessment.

5.1 Construction Noise Management Levels

The *Interim Construction Noise Guideline* (ICNG) (DECC, 2009) recommends noise management levels (NML) to reduce the likelihood of noise impacts arising from construction activities. The ICNG NML for residential receivers are shown in Table 5-1.

Table 5-1 Construction NMLs at Residences

Time of Day	Management Level $L_{Aeq,15min}$ (dBA)	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2.

It is expected that all construction activities will be conducted within standard construction hours.

Based on the established RBLs, construction noise management levels for residential receivers near the Proposal site are presented in Table 5-2.

Table 5-2 Project-specific construction NML

Receiver	Acceptable $L_{Aeq,15min}$ Noise Level (Standard daytime construction hours)	Highly Affected Noise Level (dBA)
R9, R25, R35	50	75
R5, R26-R32, R34, R42-46	47	75
R11-R15	48	75

Background noise monitoring location L1 (see Section 2.1) is considered most representative of the existing ambient noise environment at receivers RN1 and RN2, located near the intersection works. Therefore, the applicable construction NML at these receivers is 50 dBA.

5.2 Construction Noise Modelling Methodology

Site-related noise emissions were modelled with the "CadnaA" noise prediction software using the CONCAWE noise prediction algorithms. Factors that are addressed in the noise model are:

- equipment sound level emissions and location;
- screening effects from barriers;
- receiver locations;
- ground topography;
- noise attenuation due to geometric spreading;
- ground absorption; and
- atmospheric absorption.

Noise predictions have been made based on the likely worst-case impacts taking into consideration the anticipated construction scenarios. This has been made based on Wilkinson Murray's previous experience with similar scale construction projects. As a worst-case scenario, this assumes that most of the relevant plant would be operating during most of the 15-minute assessment period.

5.3 Assessment of Construction Activities within the Proposal Site

5.3.1 Construction Plant, Activities and Sound Power Levels

The main activities and noisiest plant items to be used for construction are listed in Table 5-3. The table also provides typical sound power levels of the equipment, based on measurements previously conducted by Wilkinson Murray, and the resultant total sound power for each construction activity.

Table 5-3 Sound Power Levels for Construction Plant

Construction Activity	Plant	Individual Sound Power Level (dBA)	Activity Sound Power Level (dBA)
Construction of New Buildings	Compressor	100	116
	Generator	95	
	Concrete pump	103	
	Agitators	105	
	Concrete saw	112	
	Mobile crane	110	
	Forklift	100	
	Trucks	105	
	Welder	90	
Additions to Existing Buildings	Compressor	100	112
	Generator	95	
	Mobile crane	110	
	Forklift	100	
	Trucks	105	
	Welder	90	
VENM Haul Road Construction	Excavator	110	119
	Dozer	116	
	Trucks	105	
	Vibratory Roller	114	
	Water cart	105	
Visual Bund Construction	Excavator	110	118
	Dozer	116	
	Trucks	105	

The activity sound power is considered to represent the typical worst-case level in a given 15-minute period. It is important to note that this sound power level is unlikely to be sustained at such a level for the duration of the activity. As a result, many 15-minute periods will be at lower levels.

Construction of new buildings was modelled within the brick making site where the new admin buildings are to be located. Alterations to existing buildings were modelled at the main building within the brick making site.

The plant associated with constructing the VENM haul road was modelled at various stages along the proposed VENM haul road alignment. The construction of the visual bund was modelled in a similar way.

5.3.2 Predicted Construction Noise Levels

The predicted $L_{Aeq,15min}$ construction noise levels at sensitive receivers are presented in Table 5-4. Exceedances of the NML are highlighted in bold text, and the range of predicted exceedances is presented for each receiver.

Table 5-4 Predicted $L_{Aeq,15min}$ Construction Noise Levels

Receiver	Predicted Level				NML	Exceedance
	New Buildings	Building Alterations	VENM Haul Road	Visual Bund		
R5	**51**	37	37	42	47	**4 dB**
R9	37	27	**52**	33	50	**2 dB**
R11	23	<20	43	29	48	**-**
R12	23	<20	44	29	48	**-**
R12a	24	<20	45	30	48	**-**
R13	24	21	45	29	48	**-**
R14	26	21	44	29	48	**-**
R15	27	21	43	29	48	**-**
R25	37	27	**51**	34	50	**1 dB**
R26	46	36	39	39	47	**-**
R27	44	34	38	39	47	**-**
R28	46	34	36	41	47	**-**
R29	39	31	37	36	47	**-**
R30	37	29	36	35	47	**-**
R31	43	33	36	40	47	**-**
R32	40	34	40	34	47	**-**
R34	34	27	39	32	47	**-**
R35	36	25	49	30	50	**-**
R42	**48**	35	37	42	47	**1 dB**
R43	39	32	36	37	47	**-**
R44	34	28	34	34	47	-
R45	35	28	36	34	47	-
R46	32	25	38	30	47	-

The results in Table 5-4 indicate the potential for construction noise levels to exceed the NML at receivers R5, R9, R25 and R42. The predicted exceedances range from 1 dB to 4 dB. No exceedances of the 75 dBA highly affected level are predicted.

5.4 Assessment of Construction Noise from Intersection Works

5.4.1 Construction Plant, Activities and Sound Power Levels

The main activities and noisiest plant items likely to be used for the intersection works are listed in Table 5-5. The table also provides typical sound power levels of the equipment, as published by RMS, and the resultant total sound power for each construction activity.

Table 5-5 Sound Power Levels for Construction Plant

Construction Activity	Description	Plant	Individual Sound Power Level (dBA)	Activity Sound Power Level (dBA)
Bulk Earthworks	Formation of road alignment. Excavation of soil and rock, loading, haulage, compaction of fill areas, grading	Dozer	116	118
		Scraper	110	
		Excavator	110	
		Grader	113	
		Dump truck	110	
		Compactor	106	
		Roller	109	
		Water cart	107	
Paving/asphalting	Delivery of raw materials, placement of surface material, saw cutting.	Pavement laying machine	114	118
		Dump truck	110	
		Asphalt truck and sprayer	103	
		Concrete truck	109	
		Smooth drum roller	107	
		Concrete saw	118	
Road furniture installation	Signposting and line marking	Road truck	108	111
		Scissor lift	98	
		Franna crane	98	
		Line marking truck	108	

The activity sound power is considered to represent the typical worst-case level in a given 15-minute period. It is important to note that this sound power level is unlikely to be sustained at such a level for the duration of the activity. As a result, many 15-minute periods will be at lower levels.

Construction plant were modelled as operating within the construction footprint shown in Figure 5-1.

Figure 5-1 Intersection Works Footprint



5.4.2 Predicted Construction Noise Levels

The predicted $L_{Aeq,15min}$ noise levels at sensitive receivers associated with the proposed intersection works are presented in Table 5-6. Exceedances of the NML are highlighted in bold text, and the range of predicted exceedances is presented for each receiver.

Table 5-6 Predicted $L_{Aeq,15min}$ Construction Noise Levels

Receiver	NML	Predicted Level			Exceedance
		Bulk Earthworks	Paving/Asphalting	Furniture Installation	
RN1	50	73	71	65	23 dB
RN2	50	71	69	63	21 dB

The results in Table 5-6 indicate the potential for construction noise levels to exceed the NML by up to 23 dBA at nearby receivers during the proposed intersection works. No exceedances of the 75 dBA highly affected level are predicted.

5.5 Construction Noise Mitigation

As outlined above, there is potential for noise levels associated with the construction of the Proposal to exceed the established NML. Therefore, all reasonable and feasible measures should be applied to manage noise levels down to the NML. These measures should be documented in a *Construction Noise Management Plan* (CNMP) and should include:

- Identification of nearby residences and other sensitive land uses;
- Description of approved hours of work;
- Description and identification of construction activities, including work areas, equipment and duration;
- Description of what work practices (generic and specific) will be applied to minimise noise and vibration;
- Consider the selection of plant and processes with reduced noise emissions;
- A complaints handling process;
- Noise monitoring procedures;
- Overview of community consultation required for identified high impact works;
- Induction and training will be provided to relevant staff and sub- contractors outlining their responsibilities with regard to noise; and,
- Procedures for approval of any works undertaken outside of the following hours:
    - Standard hours of 7:00 am to 6:00 pm Monday to Friday, and 8:00am to 1:00 pm Saturday

Examples of typical construction noise mitigation measures are provided in Table 5-7, along with the likely reduction in noise levels. Where reasonable and feasible, these measures should be employed during the construction of the Proposal.

Table 5-7 Indicative Construction Noise Mitigation Measures

Mitigation Measure	Anticipated Noise Reduction, dBA
Administrative Controls	
Operate during approved hours	N/A
Undertake regular noise monitoring to determine the impact of operating plant on sensitive receivers	N/A
Appropriate training of onsite staff	N/A
Undertake community consultation and respond to complaints in accordance with established project procedures	N/A
Turning off machinery when not in use	0-5
Respite periods for pile drivers and rock breakers	N/A
Engineering Controls	
Portable temporary screens	5-10
Screen or enclosure for stationary equipment	10-15
Maximising the offset distance between noisy plant items and sensitive receivers	3-6

Mitigation Measure	Anticipated Noise Reduction, dBA
Avoiding using noisy plant simultaneously and / or close together, adjacent to sensitive receivers	2-3
Orienting equipment away from sensitive receivers	3-5
Carrying out loading and unloading away from sensitive receivers	3-5
Using dampened tips on rock breakers	3-6
Using noise source controls, such as the use of residential class mufflers, to reduce noise from all plant and equipment including bulldozers, cranes, graders, excavators and trucks	5-10
Selecting site access points and roads as far as reasonably practicable away from sensitive receivers	3-6
Using spotters, closed circuit television monitors, "smart" reversing alarms, or "squawker" type reversing alarms in place of traditional reversing alarms	2-5
Employ non noise-generating structures such as site offices, storage sheds, stockpiles and tanks as noise barriers	5-10

5.6 Construction Vibration Criteria

When assessing vibration there are two components that require consideration:

- Human exposure to vibration; and
- The potential for building damage from vibration.

Construction work is generally considered an intermittent source of vibration.

5.6.1 Human Exposure to Vibration

The DECCW's *Assessing Vibration: A Technical Guideline* provides guidance for assessing human exposure to vibration. The publication is based on British Standard BS6472:1992. Intermittent vibration is best assessed by the Vibration Dose Value (VDV) which is based on the *weighted* root mean quartic (rmq) acceleration. However, for simplicity of assessment and monitoring, a peak particle velocity (PPV) goal is preferred.

Table 5-8 sets out PPV values for continuous and impulsive vibration as specified by *Assessing Vibration: A Technical Guideline.* The impulsive vibration goals are shown in brackets.

Table 5-8 Human Comfort Vibration Goals – PPV (mm/s)

Place	Day (7.00am-10.00pm)	
	Preferred	Maximum
Residences	0.28 (8.6)	0.56 (17.0)
Offices	0.56 (18.0)	1.1 (36.0)
Workshops	1.1 (18.0)	2.2 (36.0)

Note: Impulsive goals are shown in brackets – These are most relevant to activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.

5.6.2 Building Damage from Vibration

There are currently no Australian Standards or guidelines to provide guidance on assessing the potential for building damage from vibration. It is common practice to derive goal levels from international standards such as British Standard BS7385:1993

The recommended limits (guide values from BS7385) for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 5-9.

Table 5-9 Transient Vibration Guide Values - Minimal Risk of Cosmetic Damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures Industrial and heavy commercial buildings	50mm/s at 4 Hz and above	N/A
Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4 Hz increasing to 20mm/s at 15 Hz	20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above

For general construction vibration, the dominant frequency of vibration is typically in the range 31.5 – 100 Hz. Because the dominant frequency of vibration cannot be determined with certainty, conservative goals of 20 mm/s for residential buildings and 50 mm/s for commercial and industrial buildings have been adopted.

5.7 Safe Working Distances

The recommended safe working distances for vibration intensive plant suggested in the Transport Construction Authority's *Construction Noise Strategy* have been adopted in this assessment to evaluate the potential for vibration impacts from the proposed works. Table 5-10 sets out the recommended safe working distances for various vibration intensive plant relevant to the proposed works.

Table 5-10 Recommended Safe Working Distances for Vibration Intensive Plant

Item	Description	Safe Working Distance	
		Cosmetic Damage	Human Response
Vibratory Roller	<50 kN (typically 1-2 tonnes)	5 m	15 m to 20 m
	<100 kN (typically 2-4 tonnes)	6 m	20 m
	<200 kN (typically 4-6 tonnes)	12 m	40 m
	<300 kN (typically 7-13 tonnes)	15 m	100 m
	>300 kN (typically 13-18 tonnes)	20 m	100 m
	>300 kN (>18 tonnes)	25 m	100 m

Source: Construction Noise Strategy, 2012, Transportation Construction Authority

Review of the information in Table 5-10 indicates that the safe working distances for building damage and human comfort applicable to the largest foreseeable vibratory roller are 25 metres and 100 metres, respectively. During construction of the VENM haul road (the closest construction activity to sensitive receivers), vibratory rollers are not anticipated to be used within 100 m of a sensitive receptor. Therefore, vibration impacts during construction are considered unlikely.

6 CONCLUSION

Wilkinson Murray has been engaged by Element Environment, on behalf of CSR, to prepare a Noise and Vibration Impact Assessment (NVIA) for the Preferred Project Proposal including the upgrade, expansion and operation of the Badgerys Creek brick making facility, continued quarrying of Pit 3, and VENM importation for the engineered filling of pits 1, 2 and 3.

Existing ambient noise levels have been established at nearby sensitive receivers via long-term unattended noise monitoring. The noise monitoring data has been processed in accordance with the NPfI to establish the RBLs at sensitive receivers.

Noise impacts associated with the operation of the Proposal have been assessed in accordance with the NPfI. Project noise trigger levels have been established for the morning shoulder, day, evening and night time periods.

A computer noise model has been developed to predict the $L_{Aeq,15min}$ operational noise levels at sensitive receivers. Meteorological data from the nearby Bringelly AQMS has been analysed to identify the potential for noise-enhancing meteorology. Both temperature inversions and gradient winds are considered to be a feature of the area and have been incorporated into the noise model.

Based on information from CSR and previous noise assessments of the site, operating parameters, equipment and source sound power levels have been developed to describe several noise assessment scenarios for the Proposal.

$L_{Aeq,15min}$ operational noise levels have been predicted at sensitive receivers for each assessment scenario, for both calm and noise-enhancing meteorological conditions. The predicted noise levels comply with the established project noise trigger levels during all phases of the Proposal during both calm and noise-enhancing meteorological conditions.

The Proposal will generate additional traffic along the surrounding public road network. The increase will be most prominent along Martin Road and will largely be due to heavy vehicles transporting goods to and from the Proposal site.

Road noise impacts associated with the operation of the Proposal have been assessed in accordance with the RNP.

Martin Road services a number of industrial sites and has significantly more heavy-vehicle traffic than a typical local road. Therefore, as recommended in the RNP, Martin Road is considered a principal haul route and is to be assessed using impact assessment criteria for arterial/sub-arterial roads.

Existing traffic volumes and road noise levels along Martin road have been established using long-term unattended noise logging and contemporaneous traffic counting. A computer noise model has been developed and calibrated using the monitoring data.

Traffic noise levels during the operation of the Proposal have been predicted, and at six receivers, have been found to exceed the impact assessment criteria and increase by more than 2 dB compared to the 'no-build' noise levels.

Appropriate architectural treatments to reduce road noise levels have been recommended for receivers qualifying for mitigation.

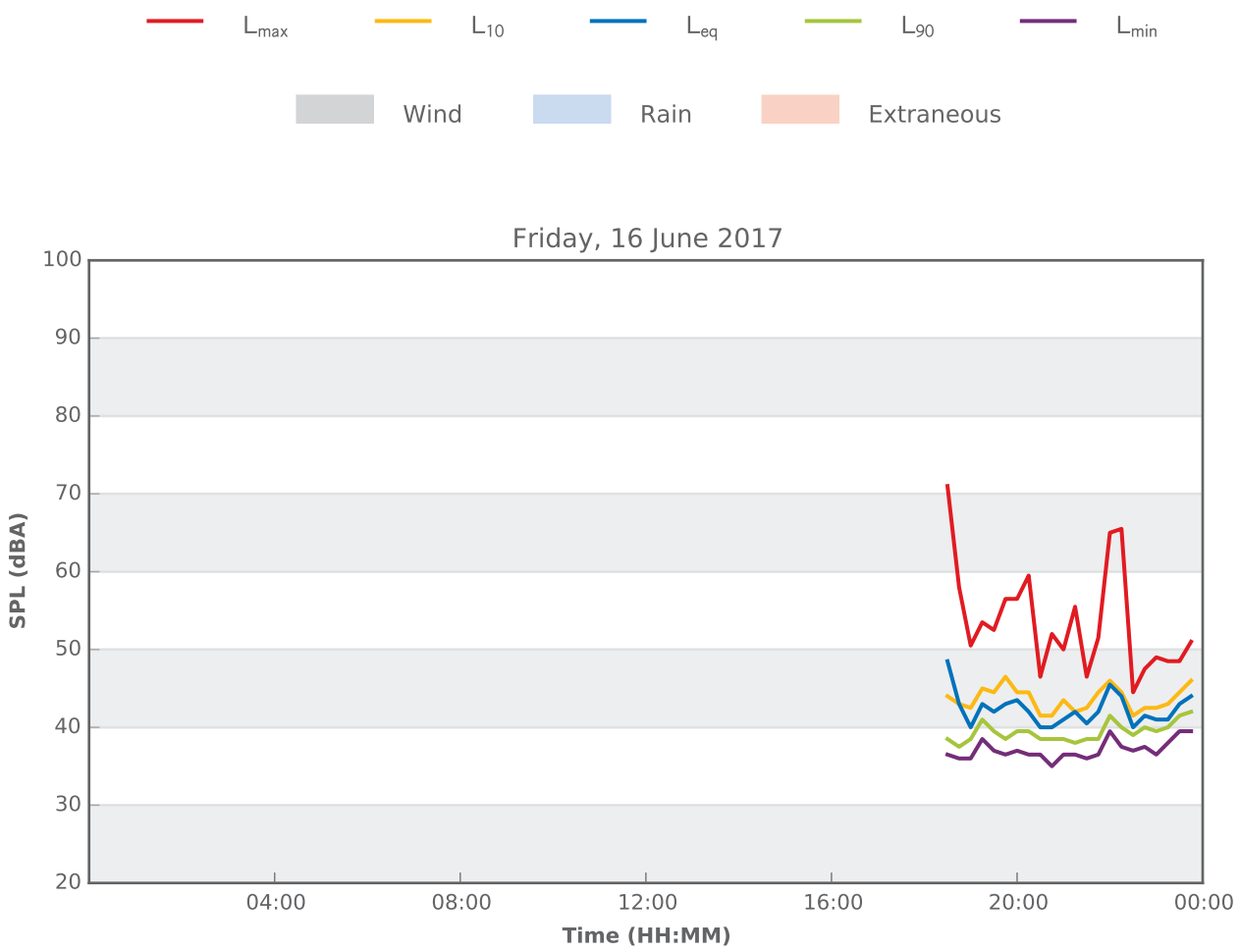
Noise impacts from the construction of the Proposal have been assessed in accordance with the

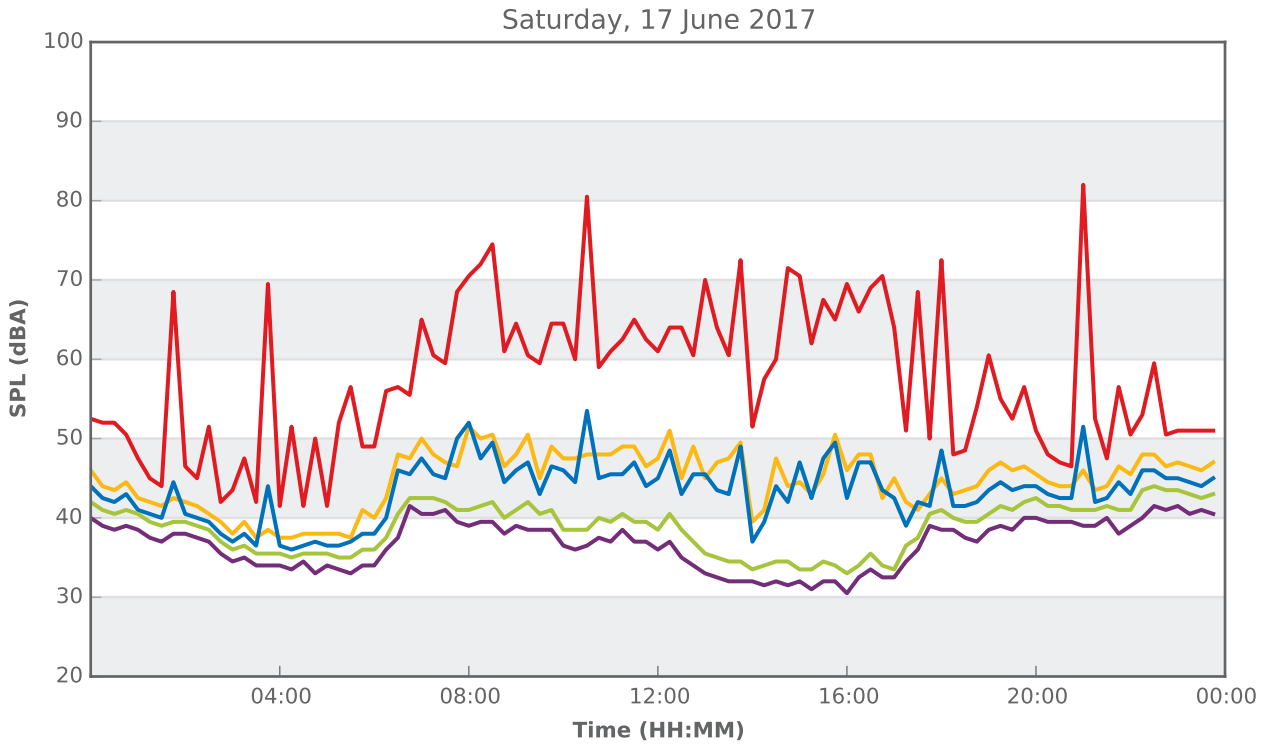
ICNG. Construction NMLs have been established for sensitive receivers based on the established RBL. A computer noise model has been developed to predict $L_{Aeq,15min}$ construction noise levels at sensitive receivers. The predicted $L_{Aeq,15min}$ construction noise levels exceed the established NML at several receivers, but no exceedances of the 75 dBA highly affected levels were predicted. It is recommended that a CNMP be developed and that all reasonable and feasible measures be implemented to manage construction noise levels down towards the NML.

APPENDIX A

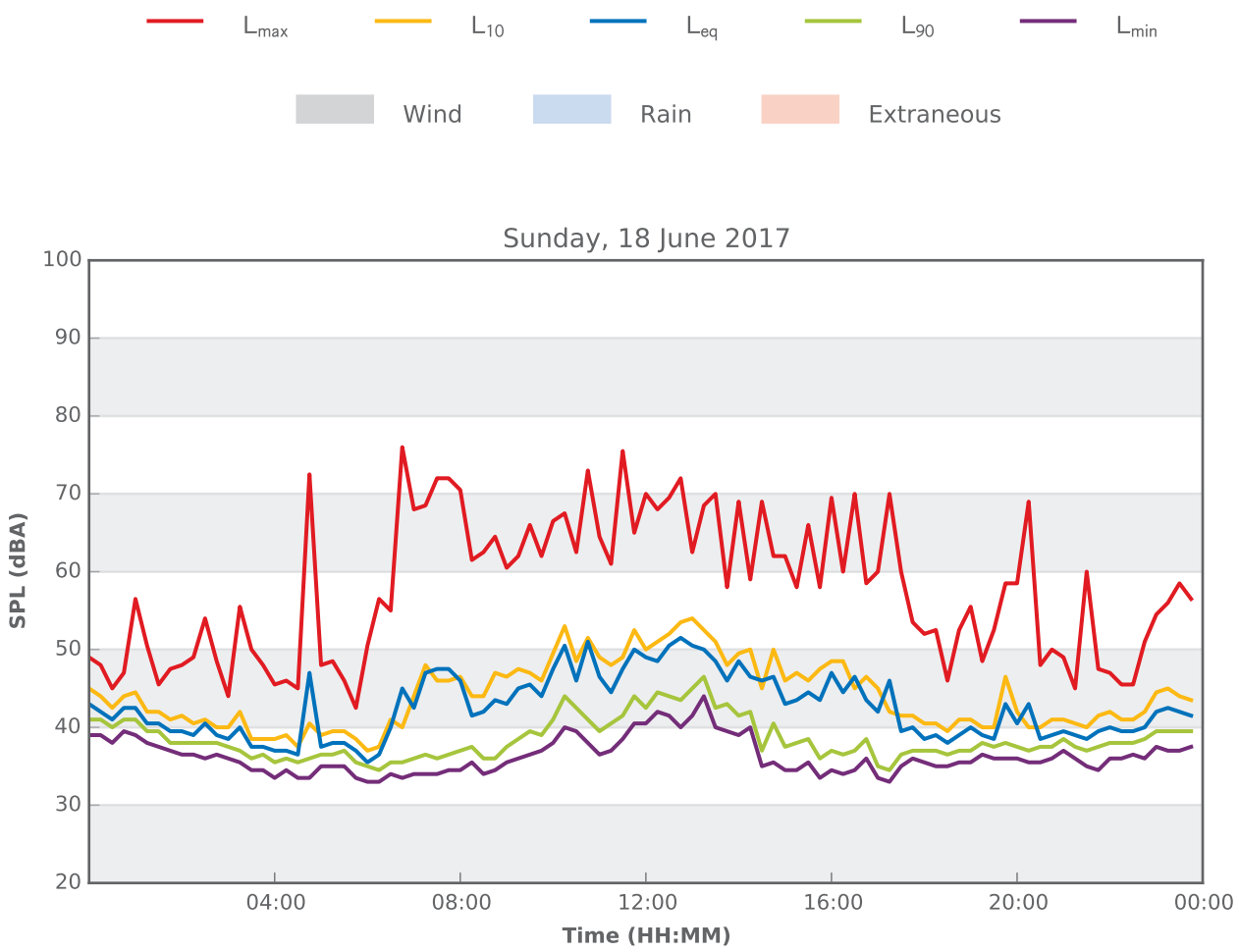
NOISE MEASUREMENT RESULTS

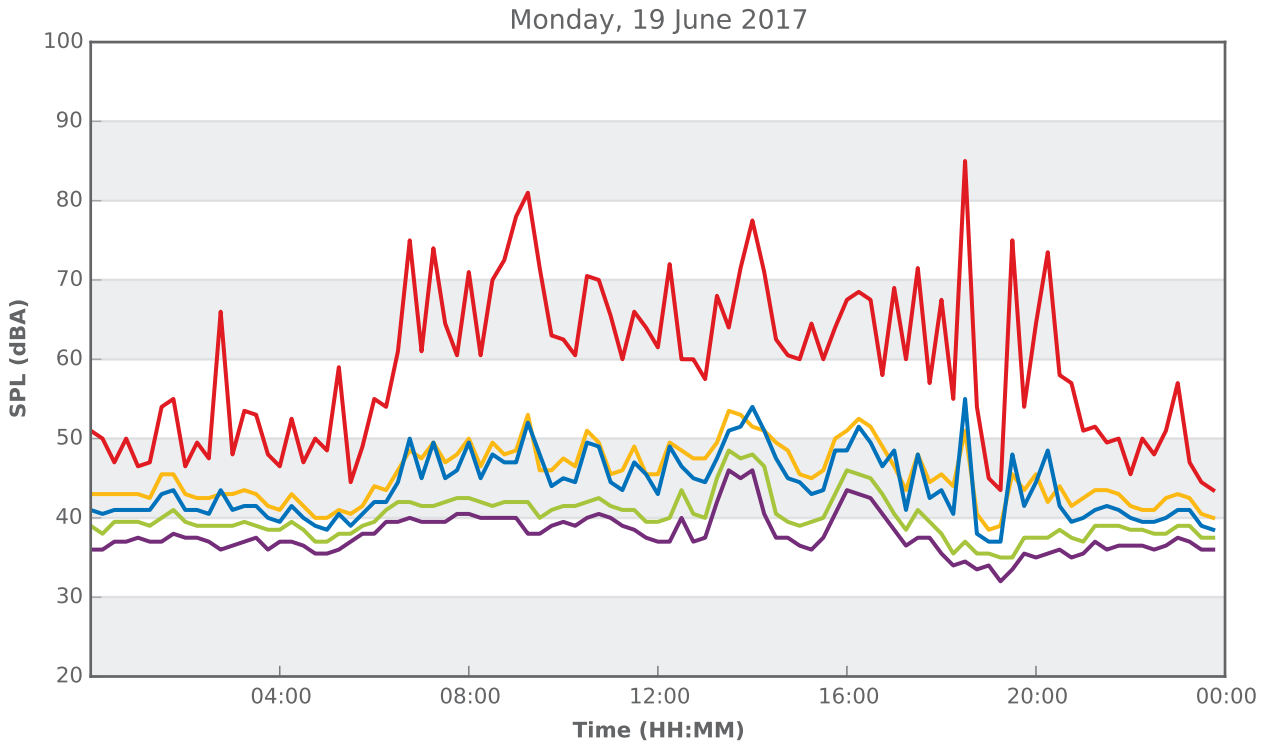
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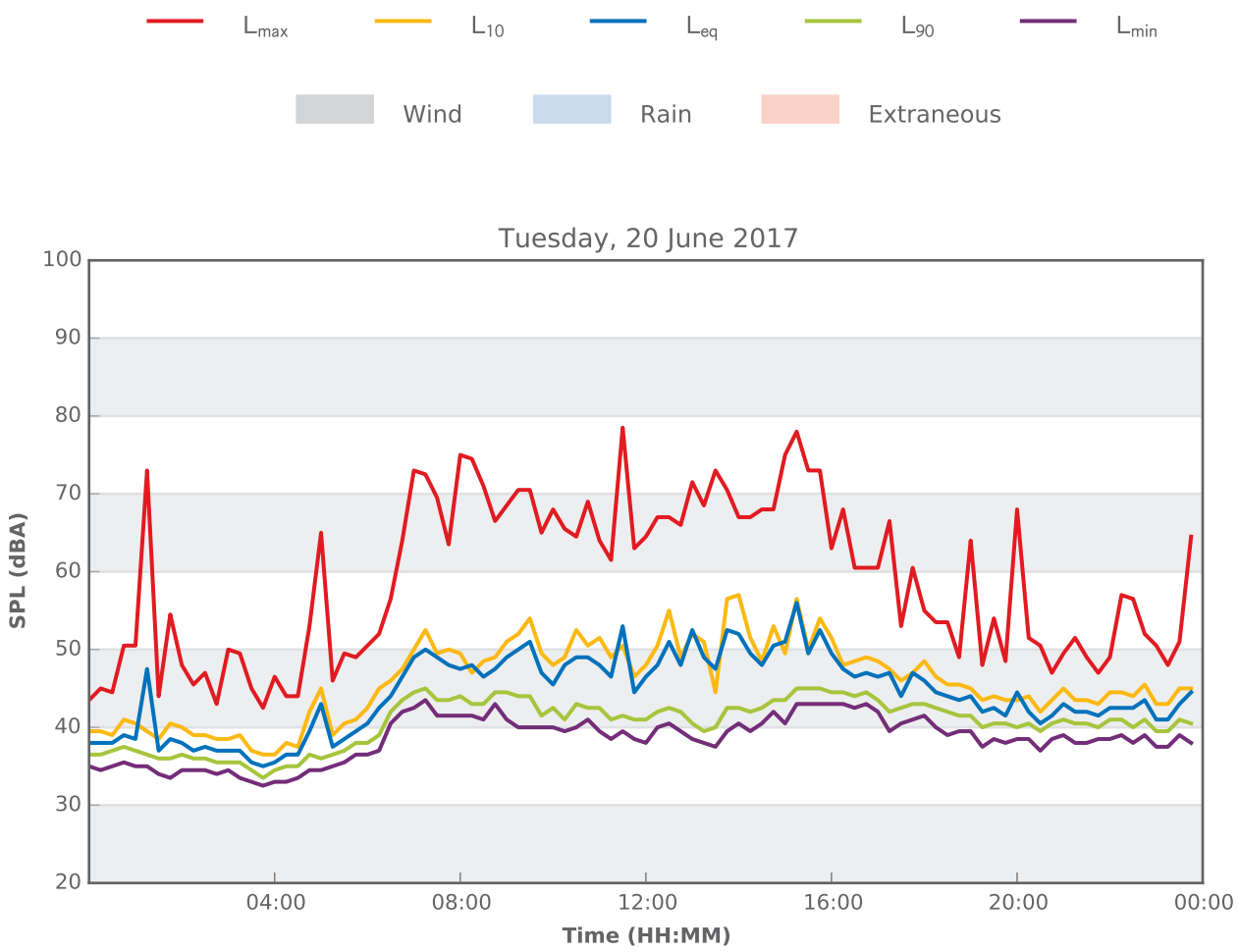


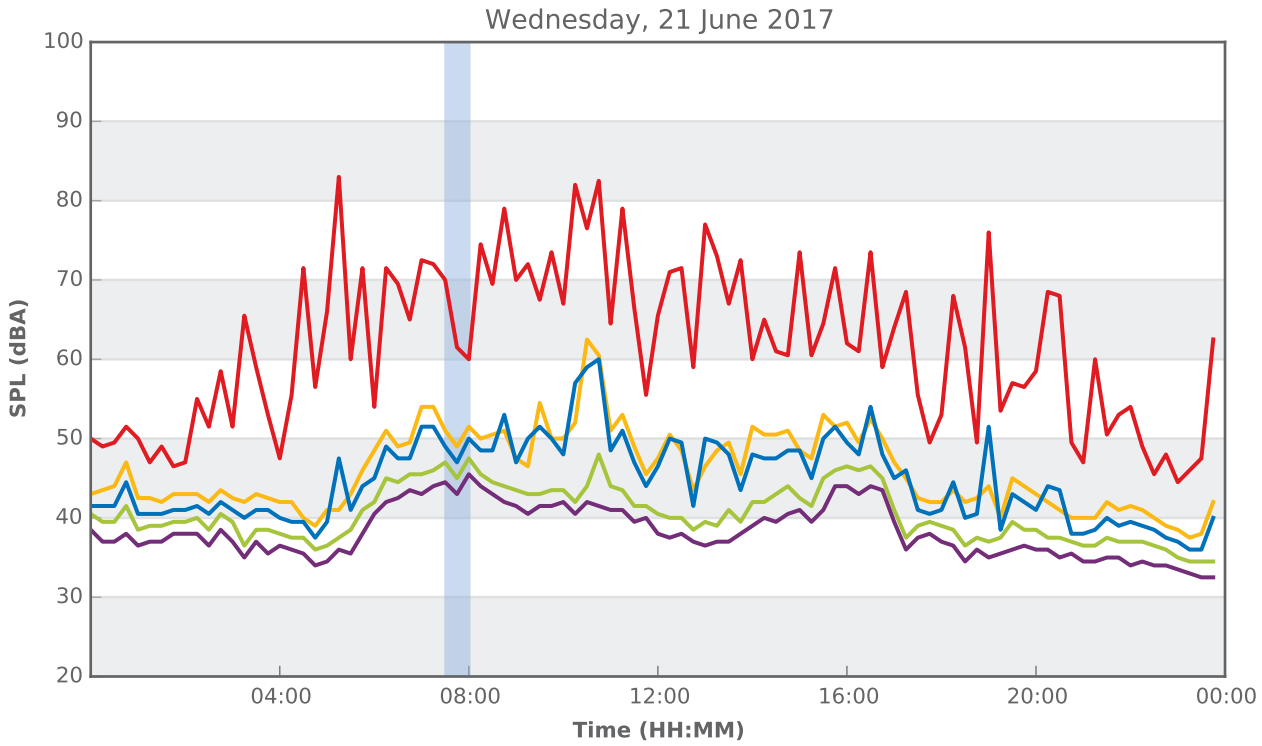
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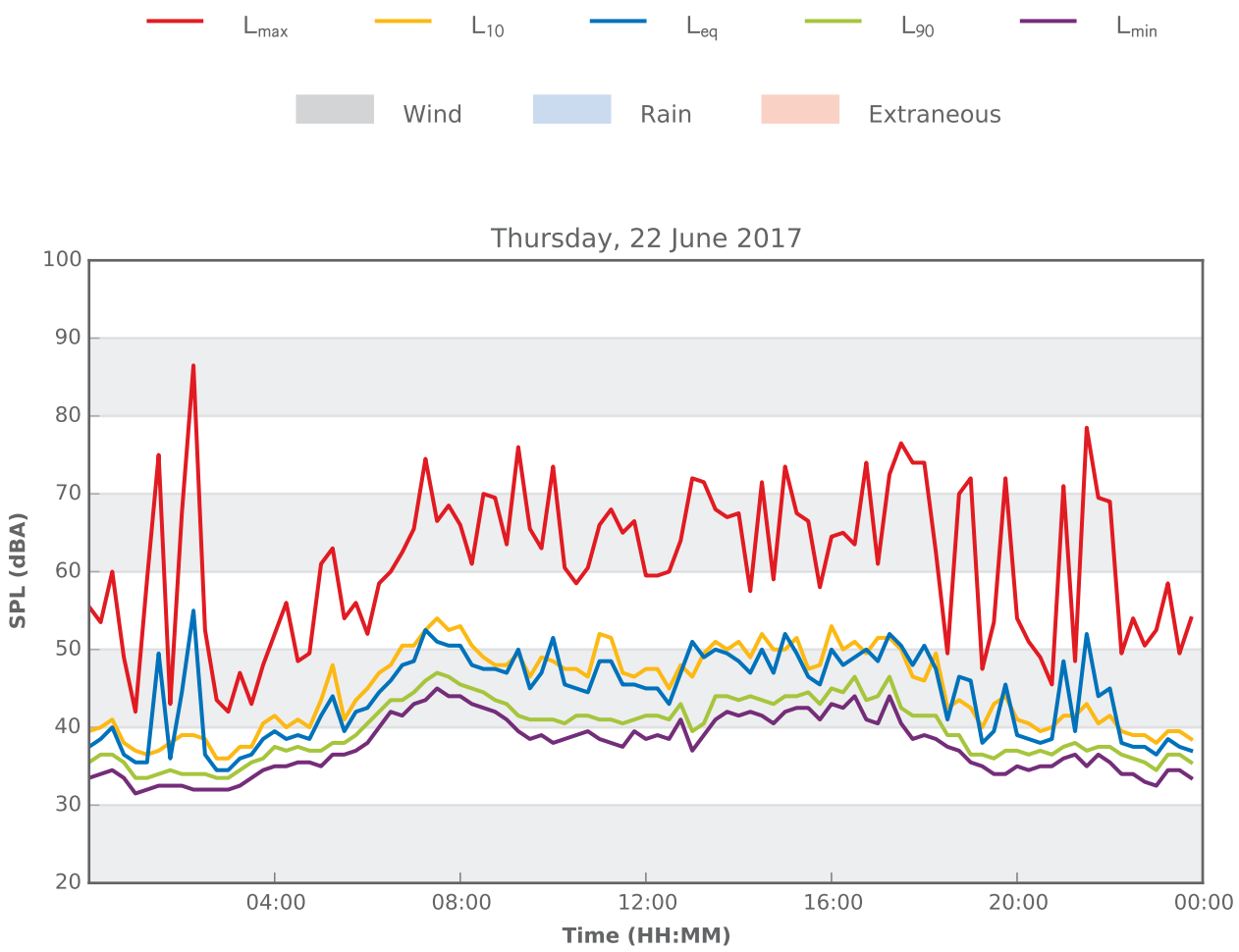


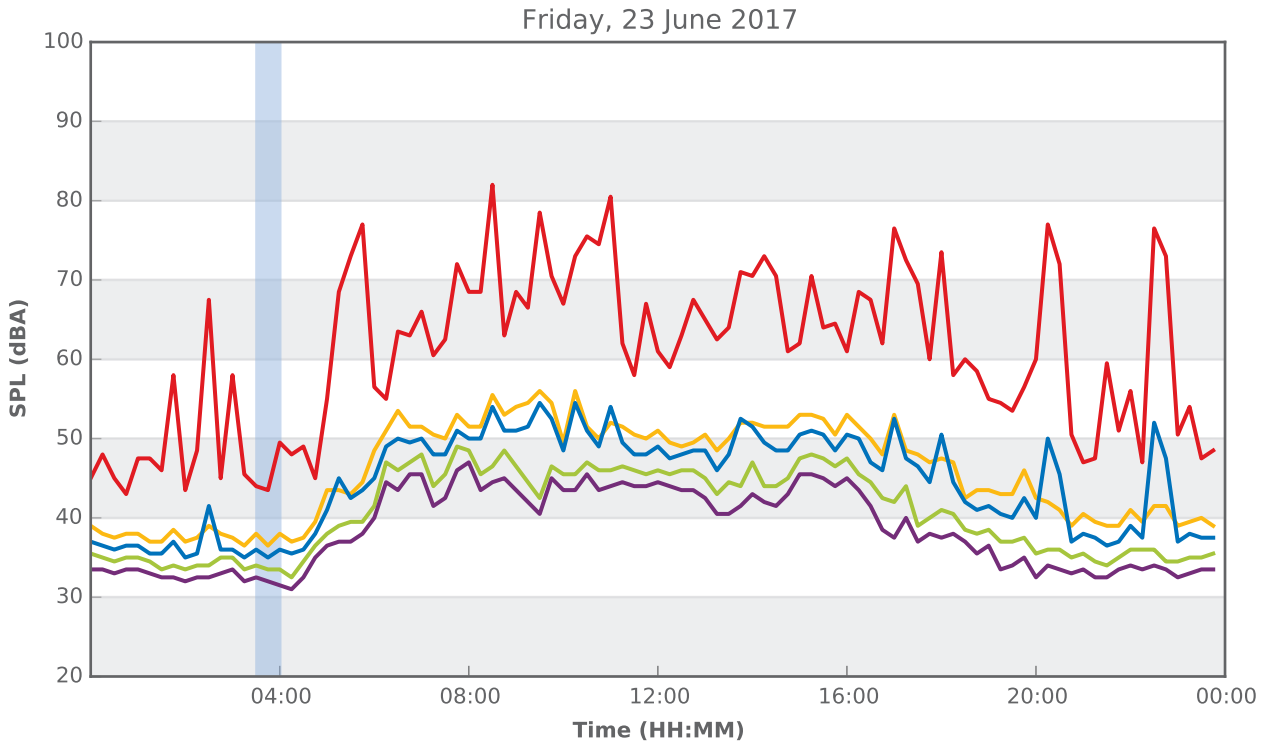
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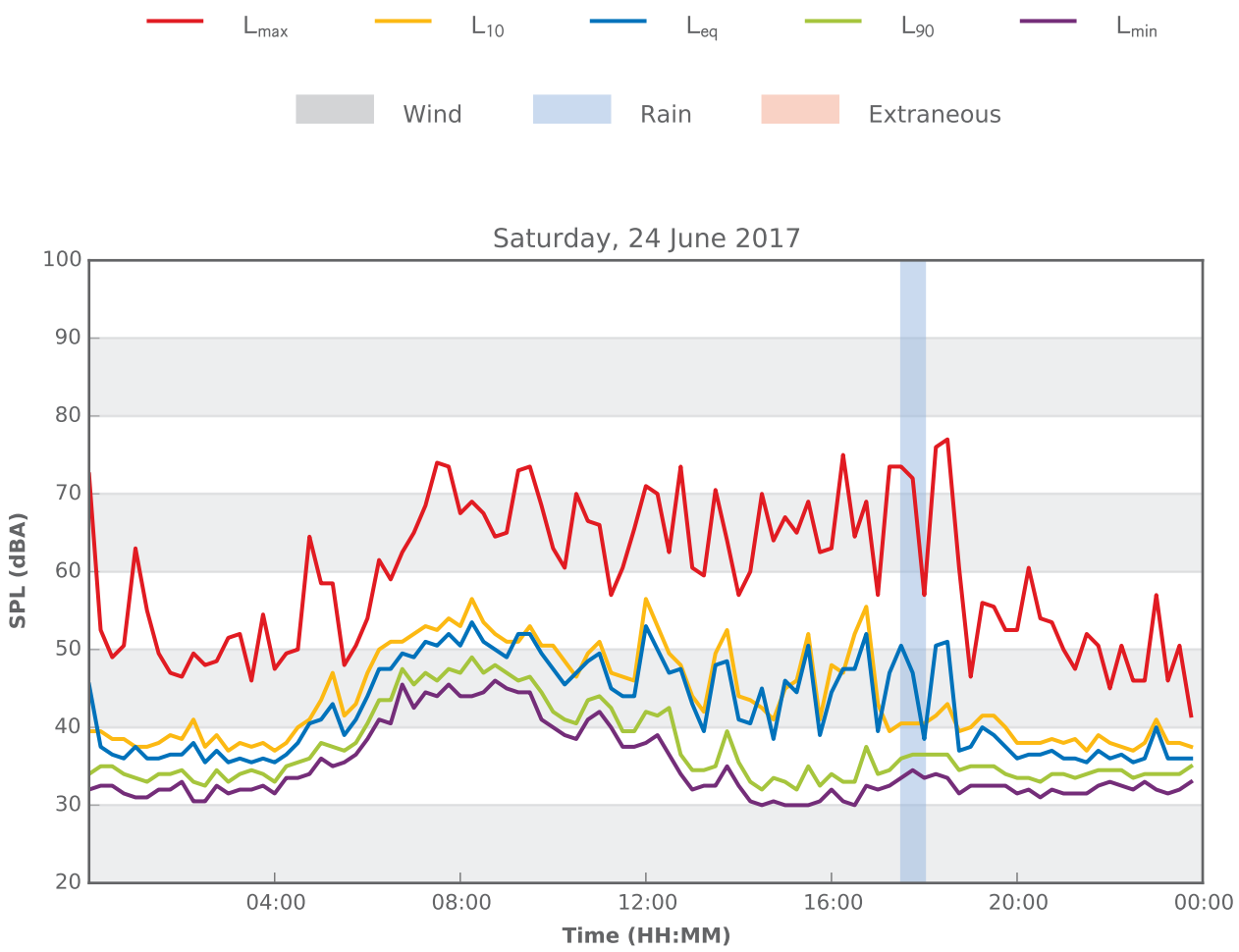


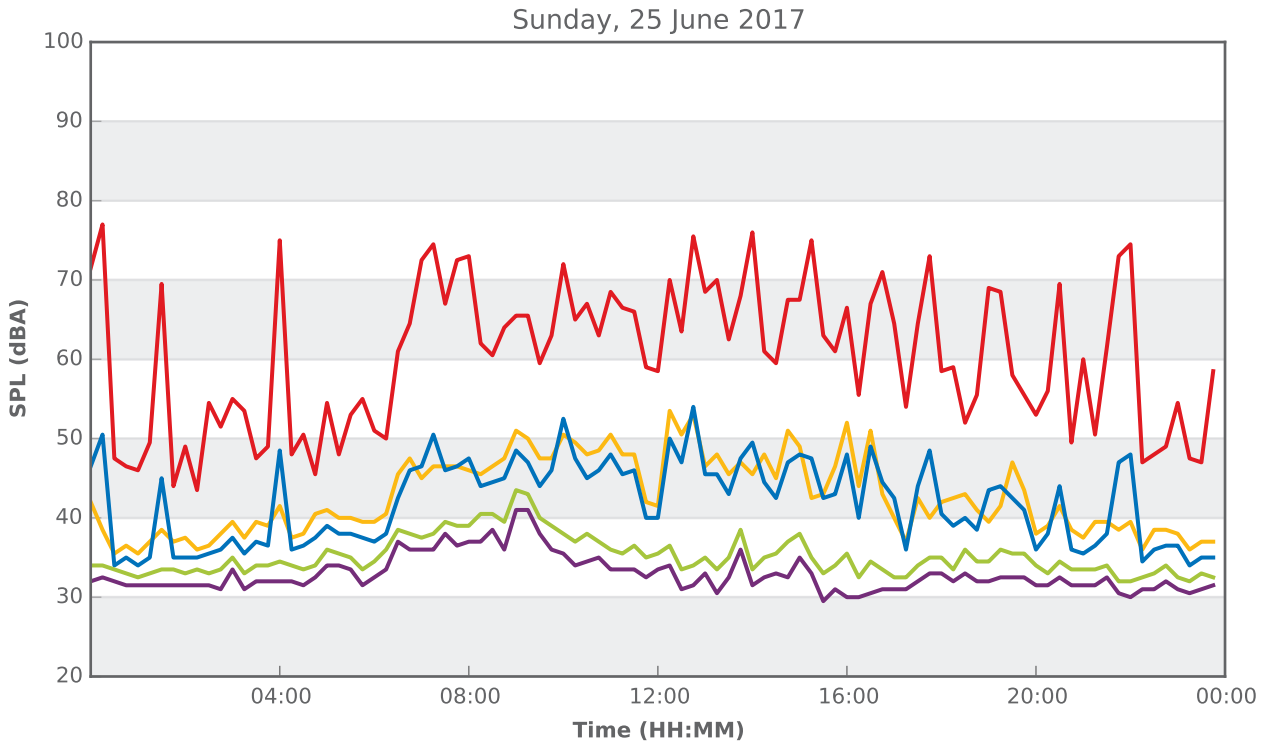
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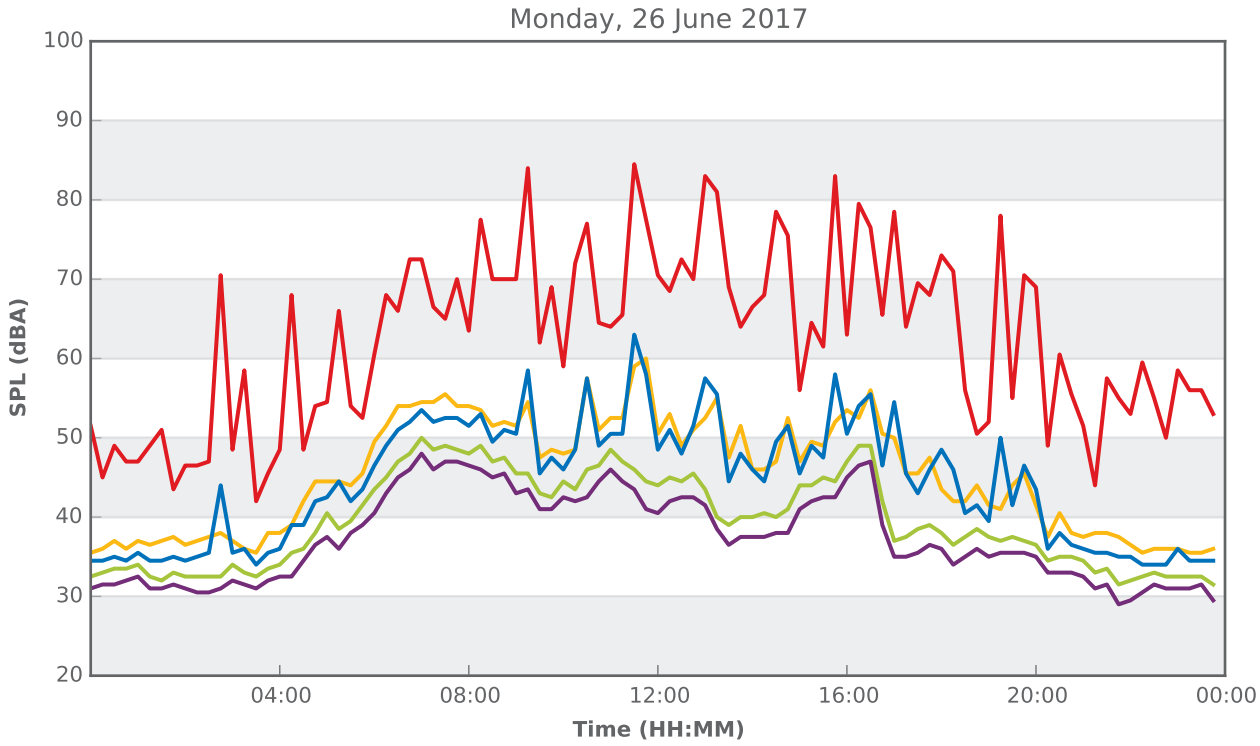
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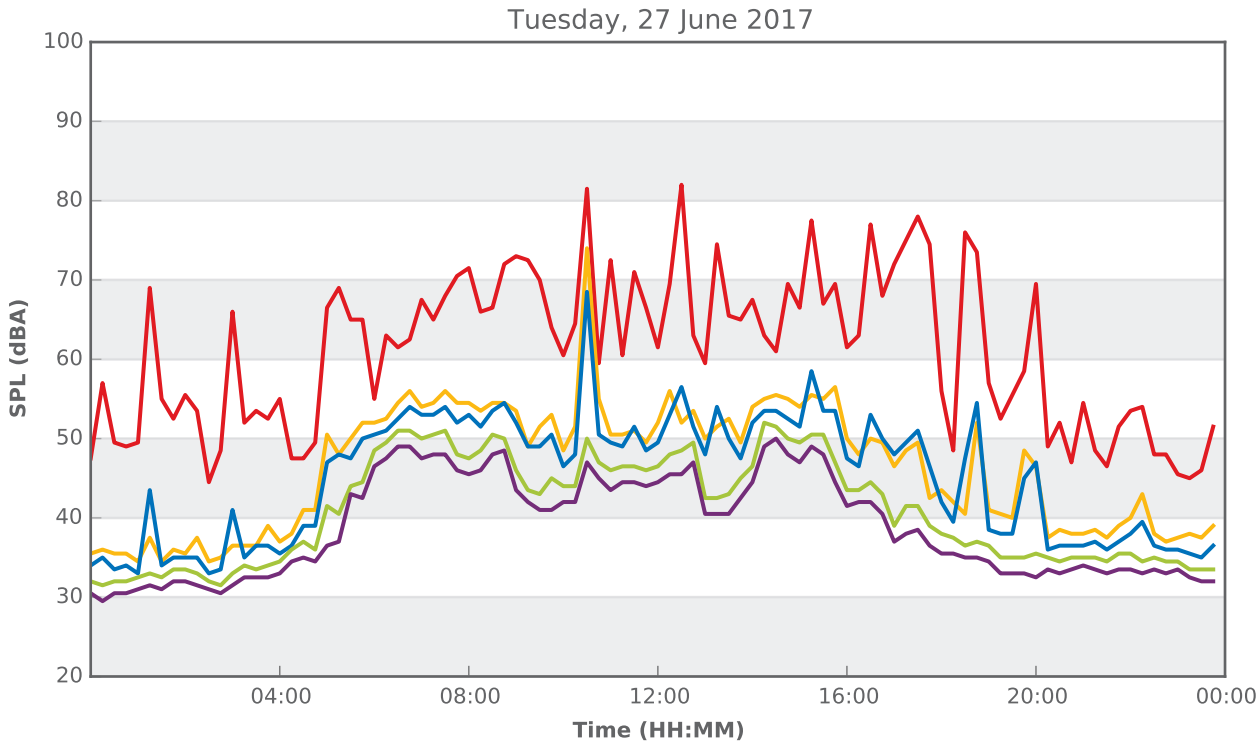




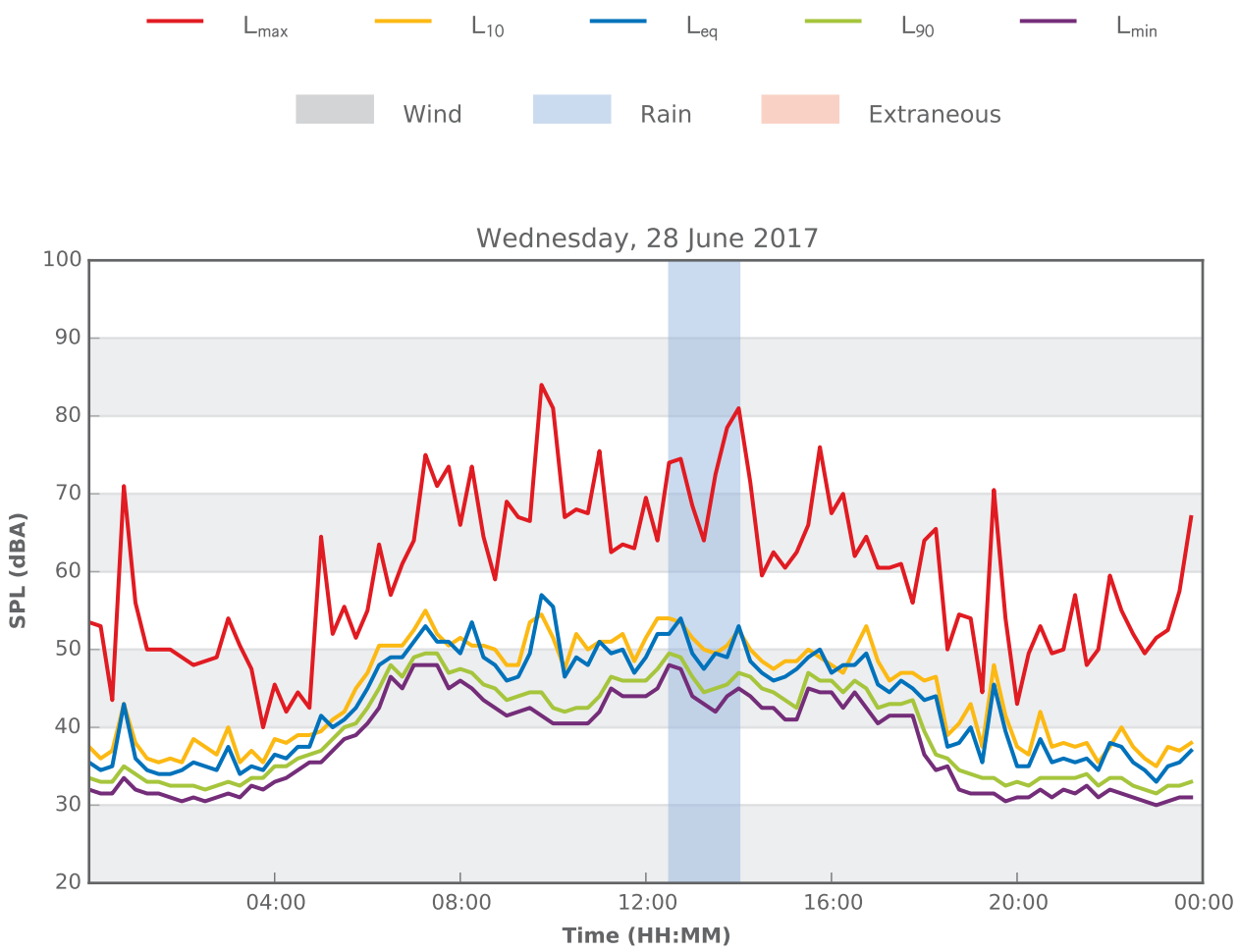
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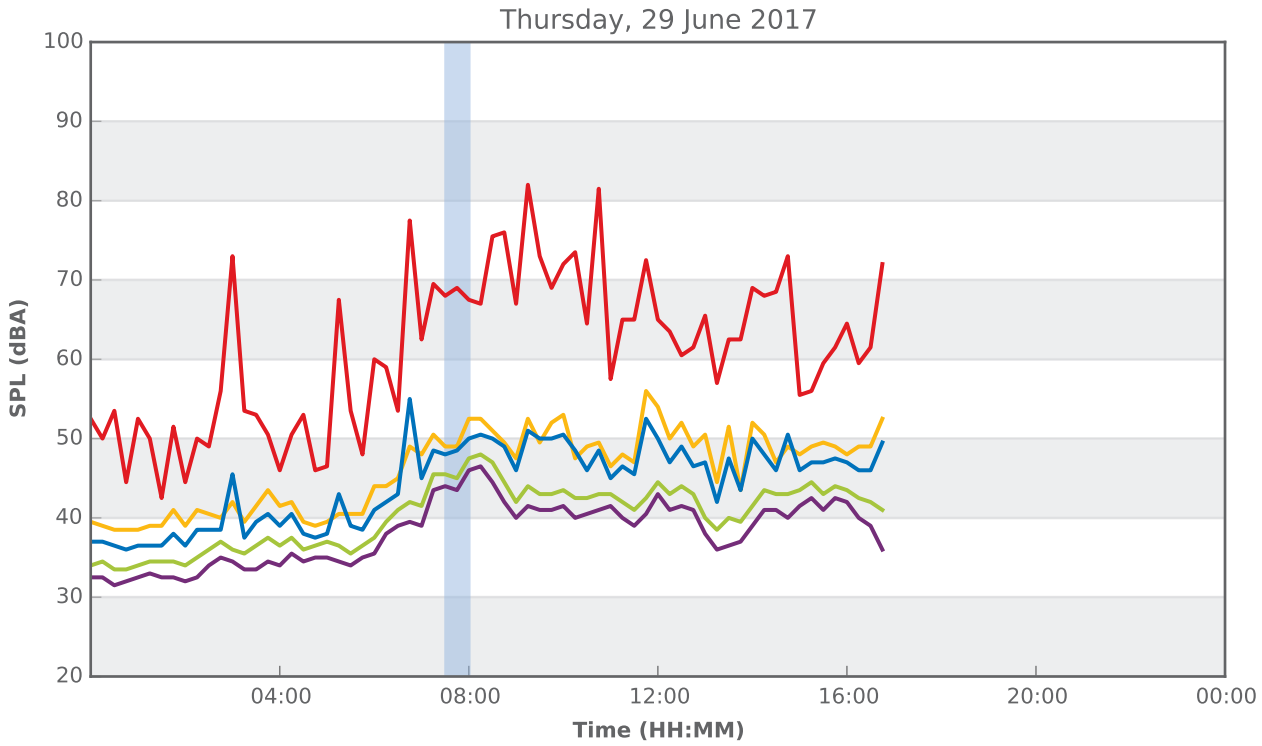




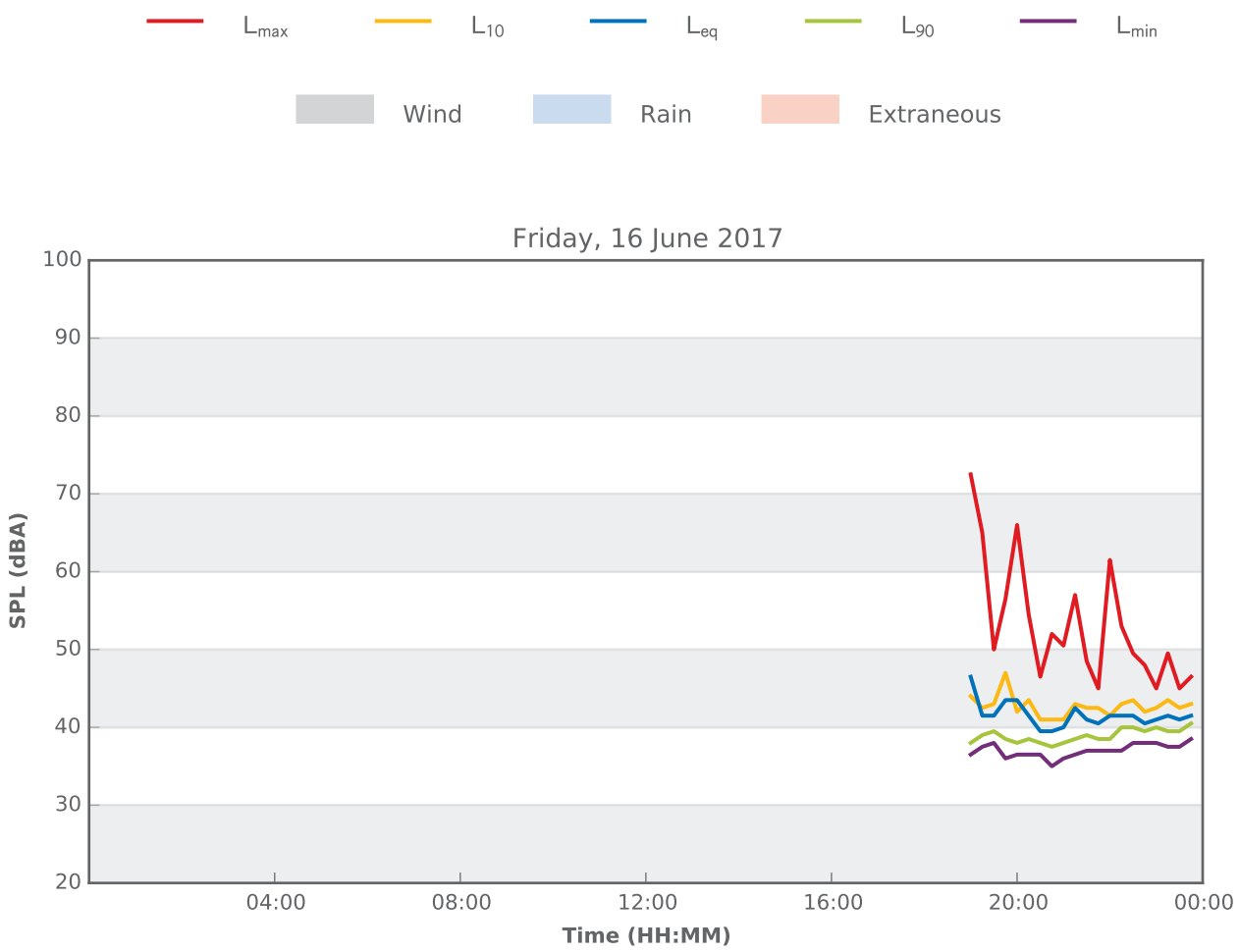


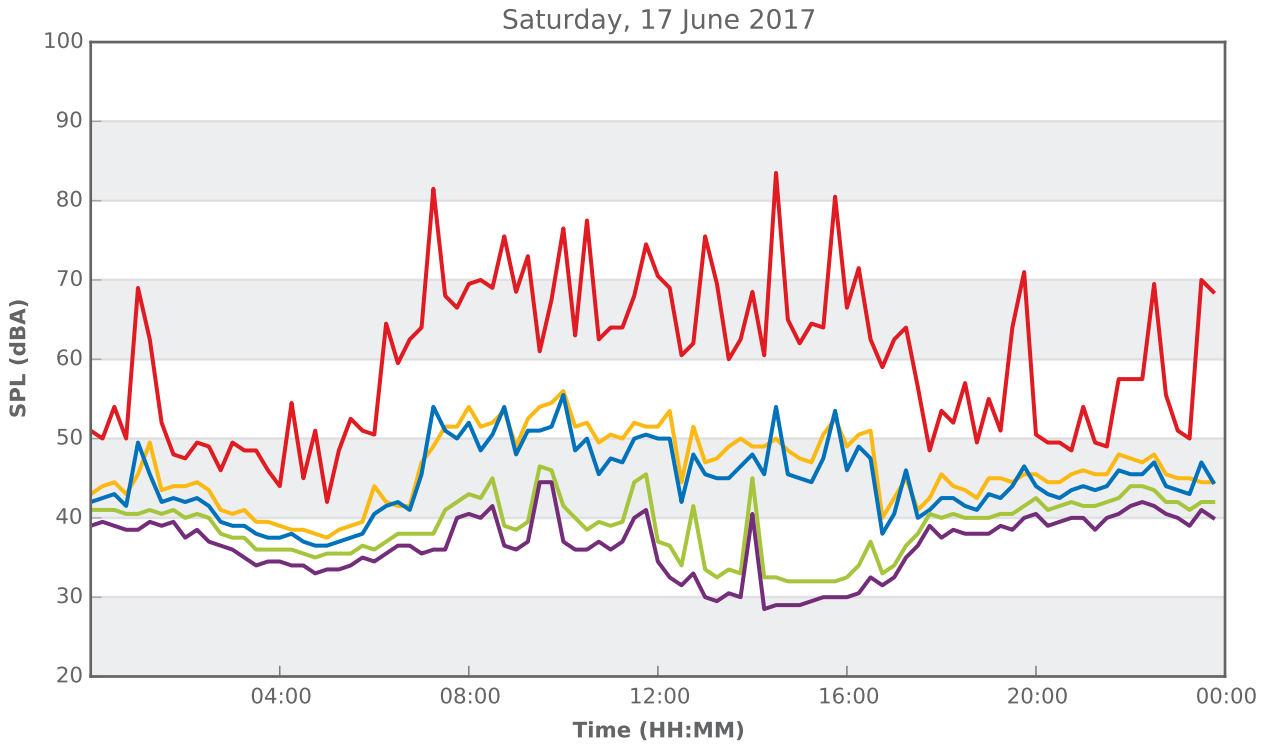
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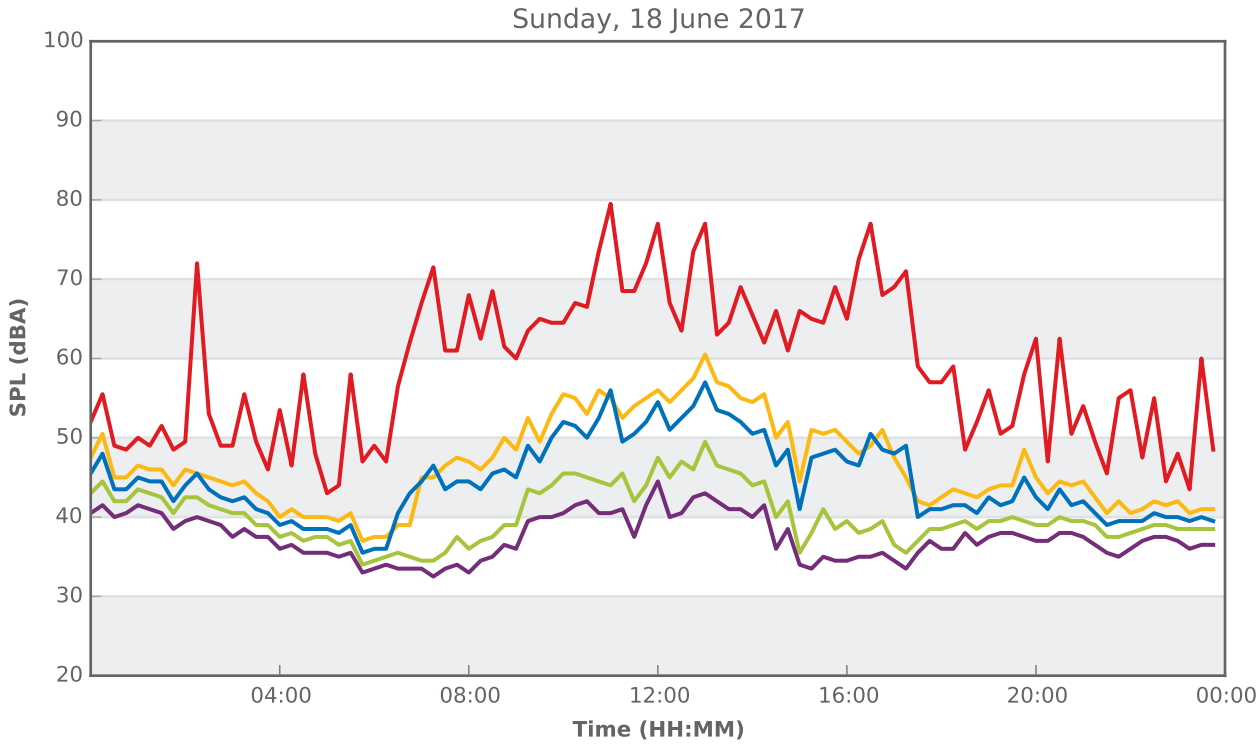
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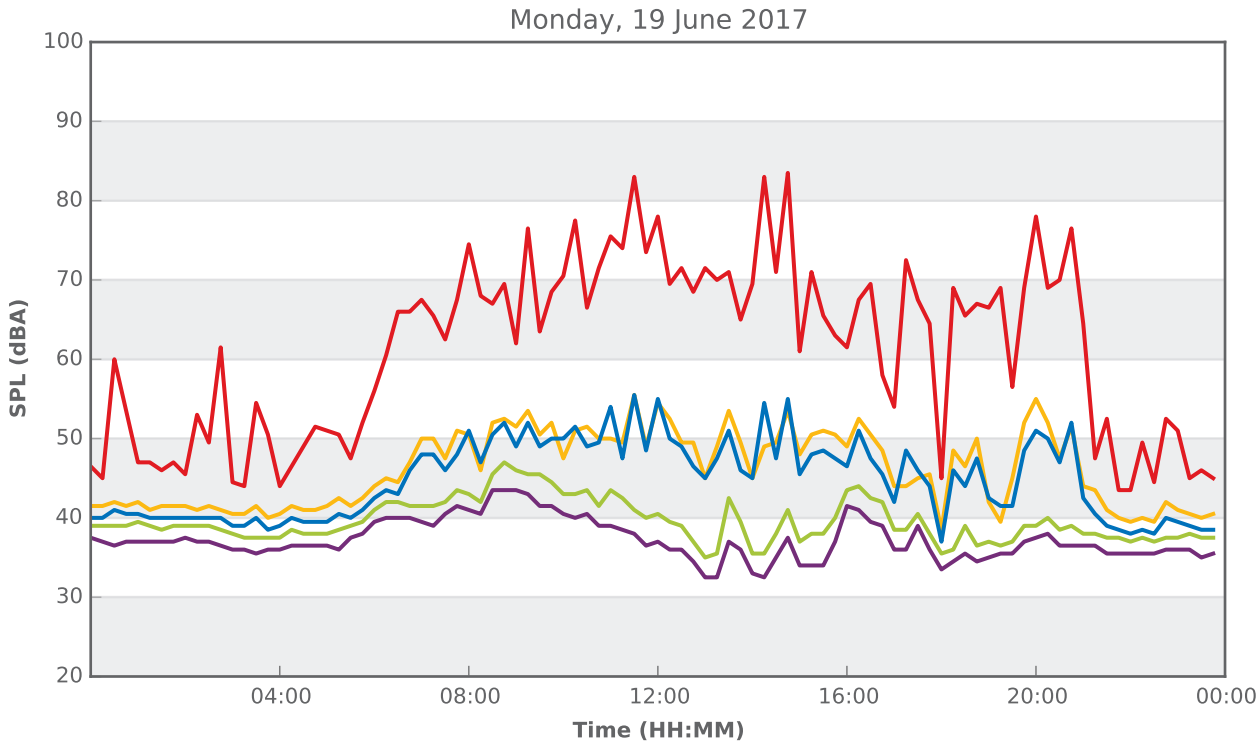




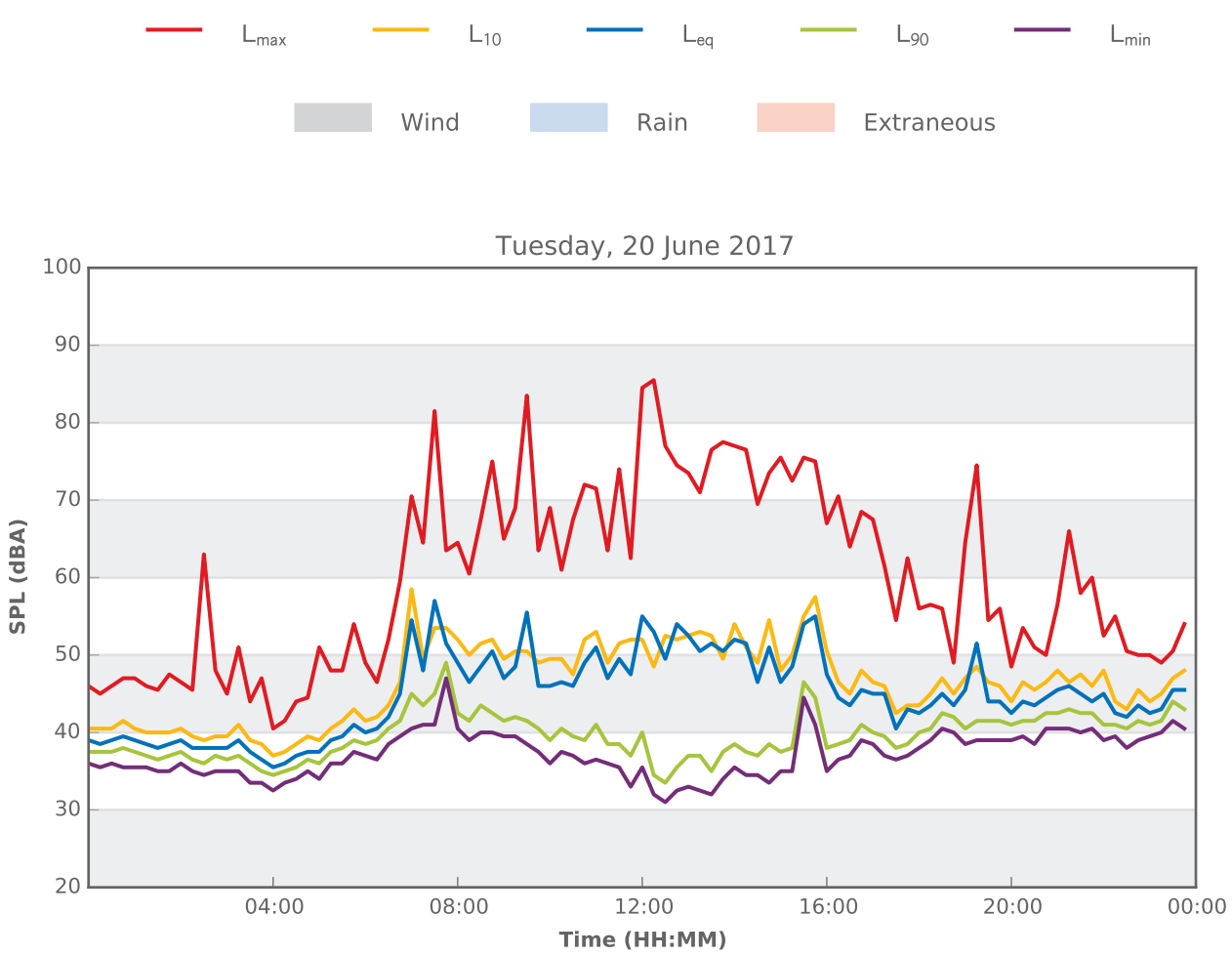
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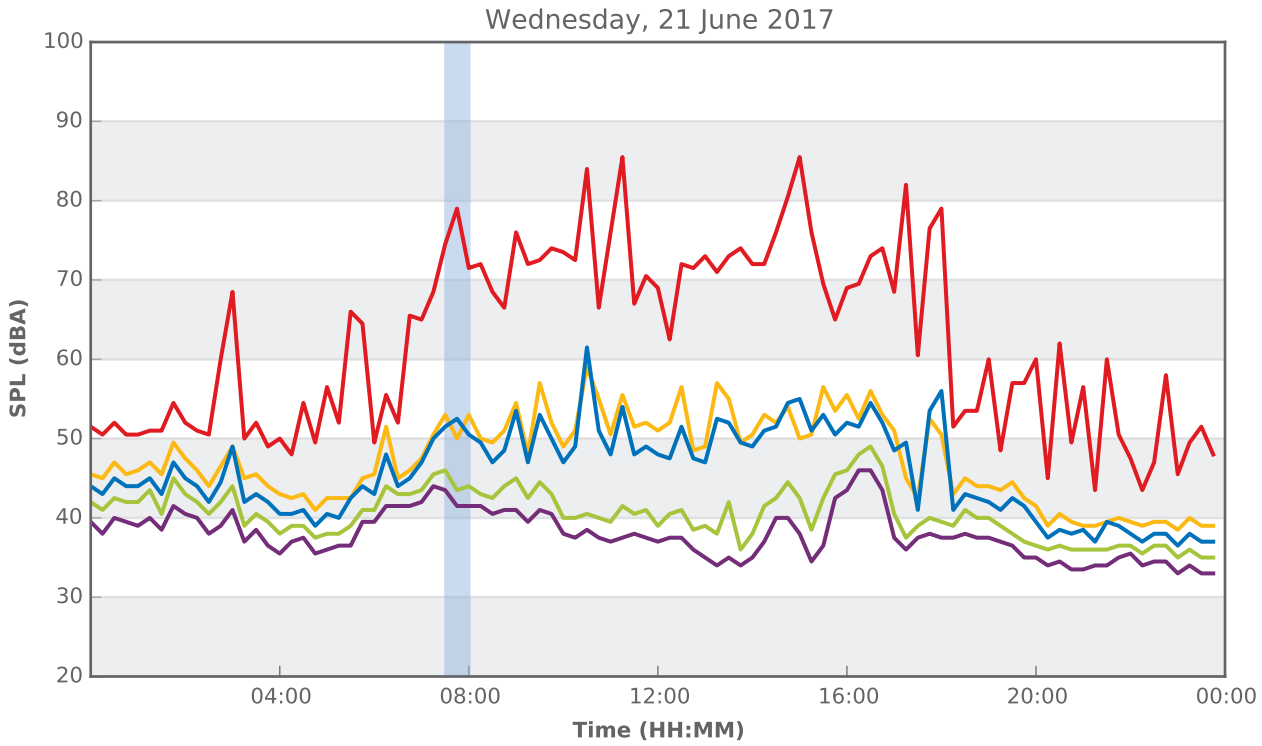




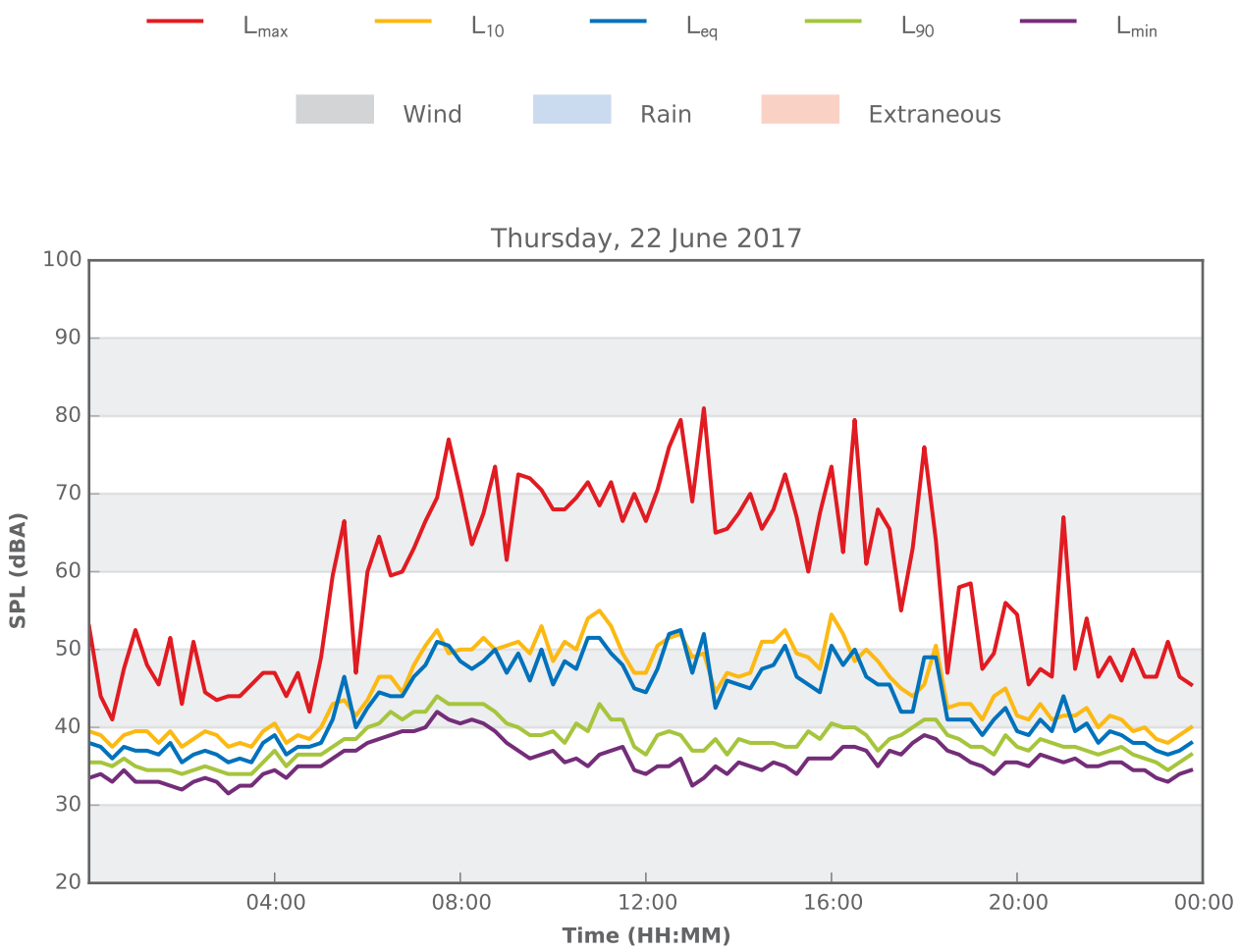


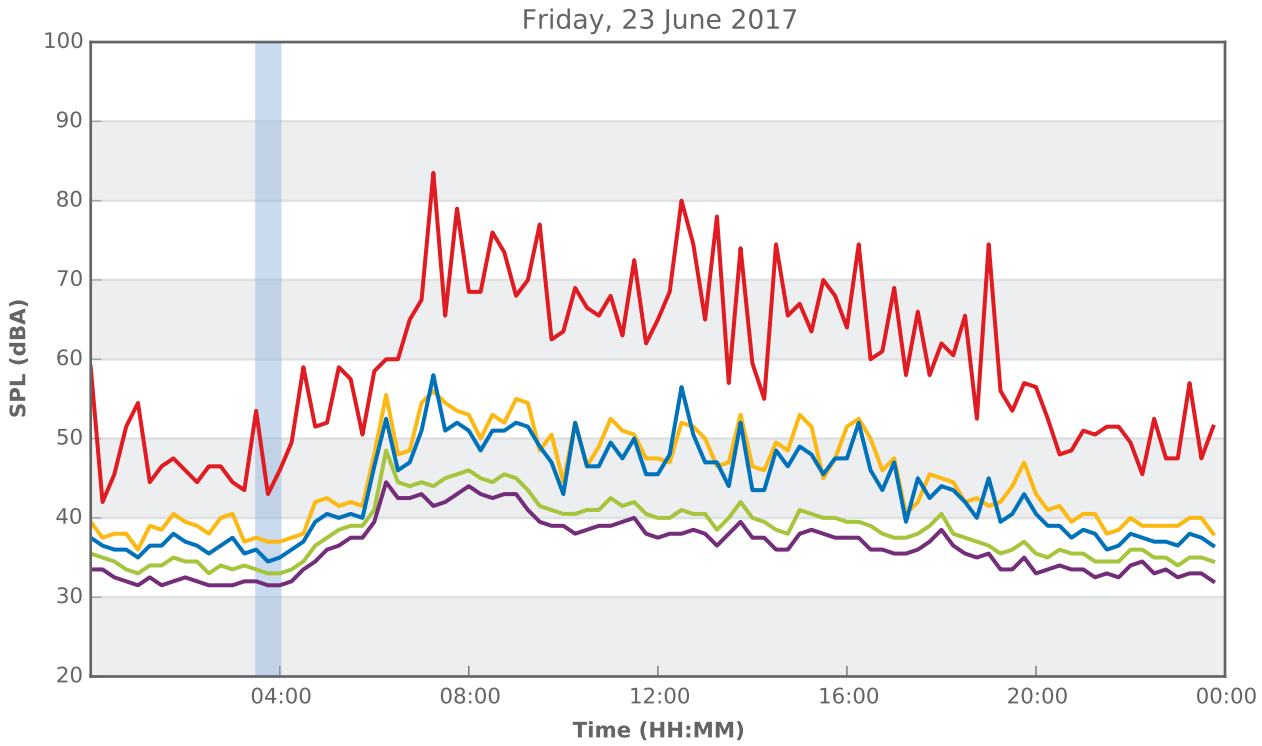
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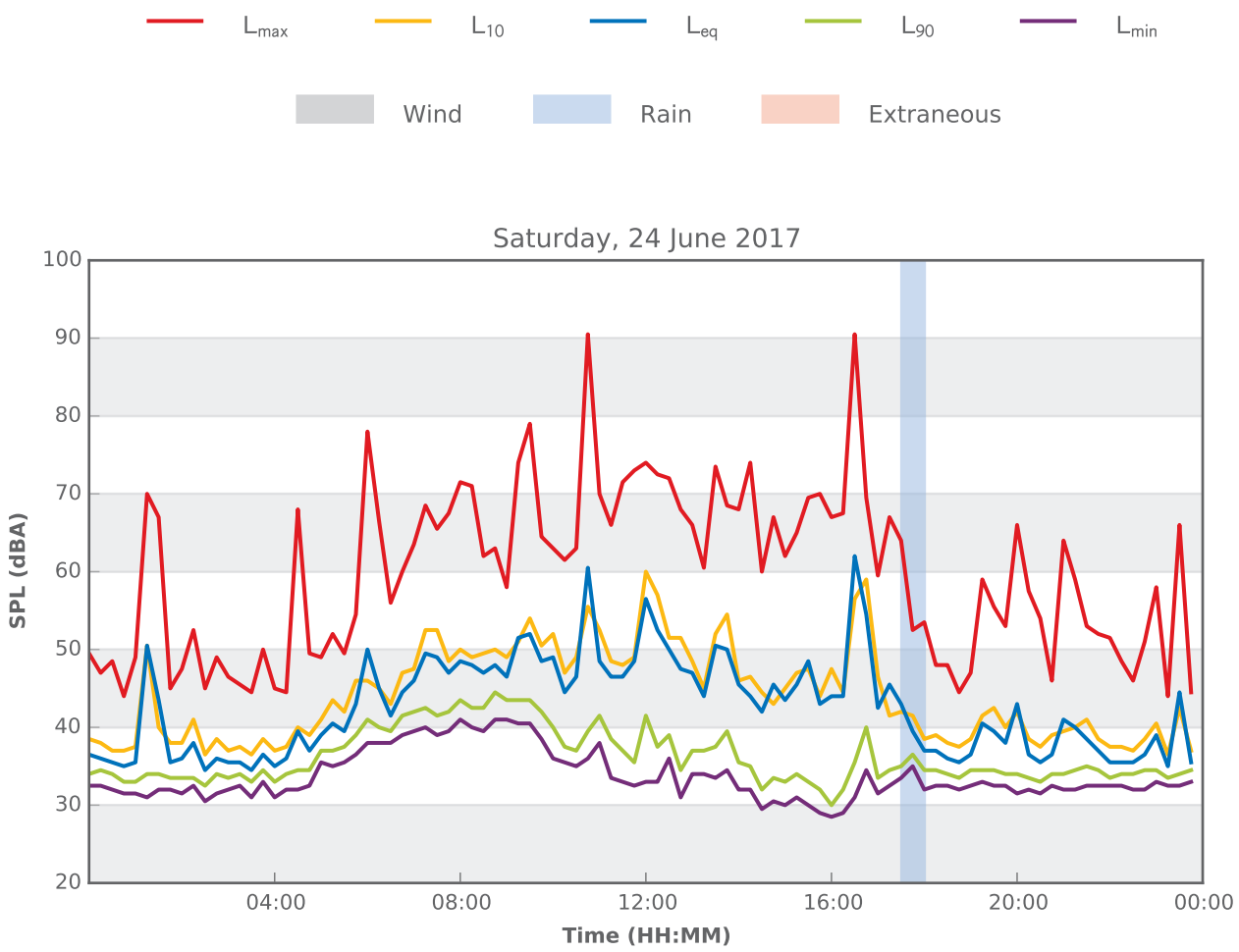


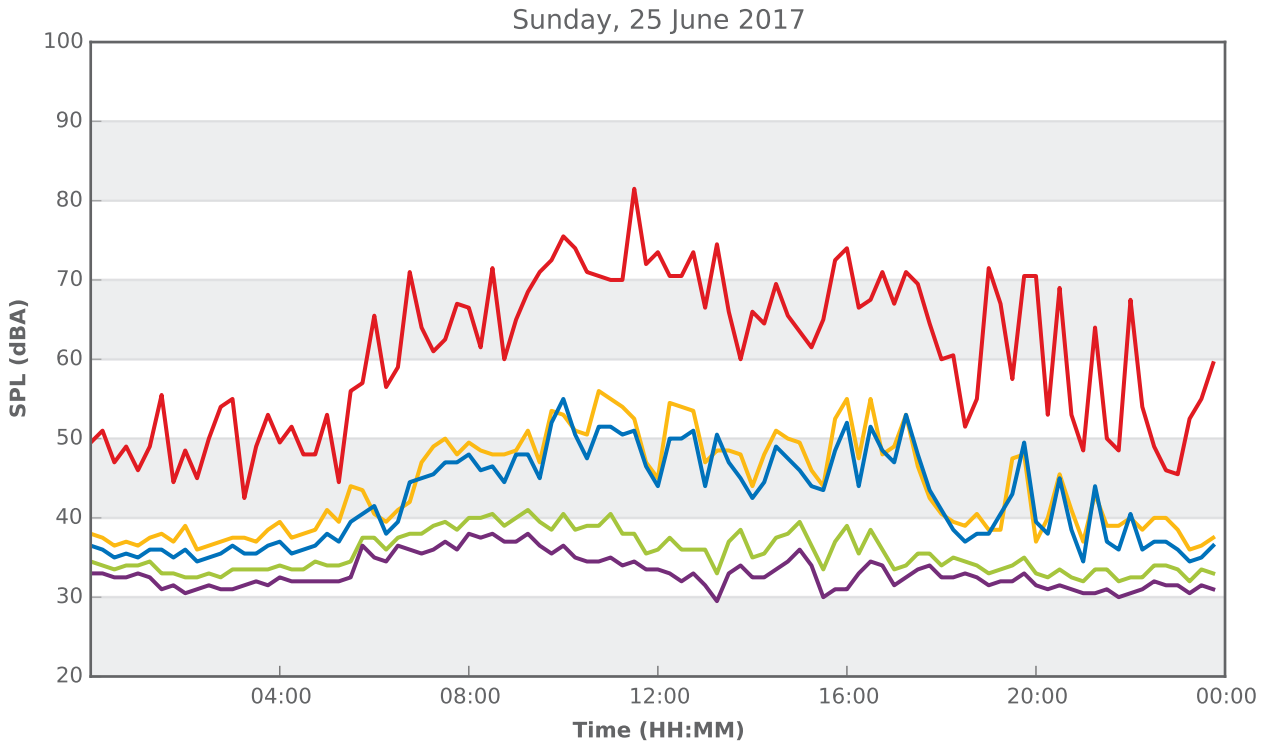
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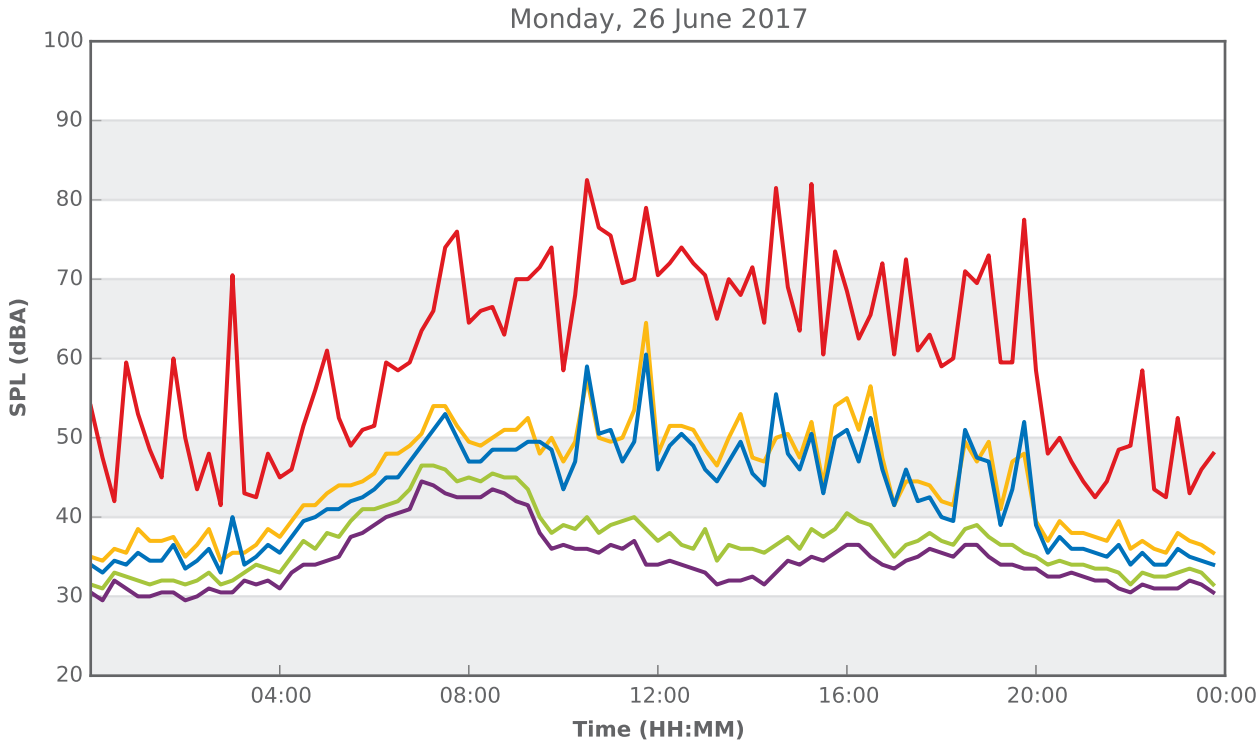
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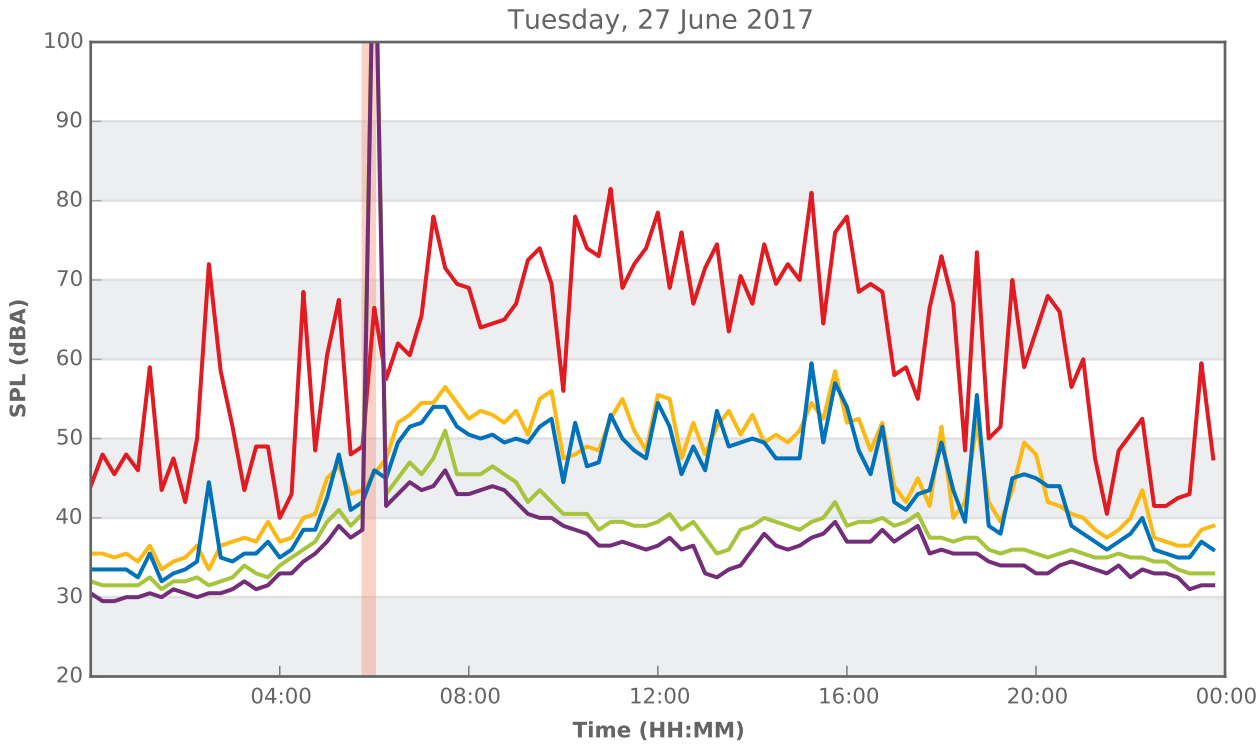




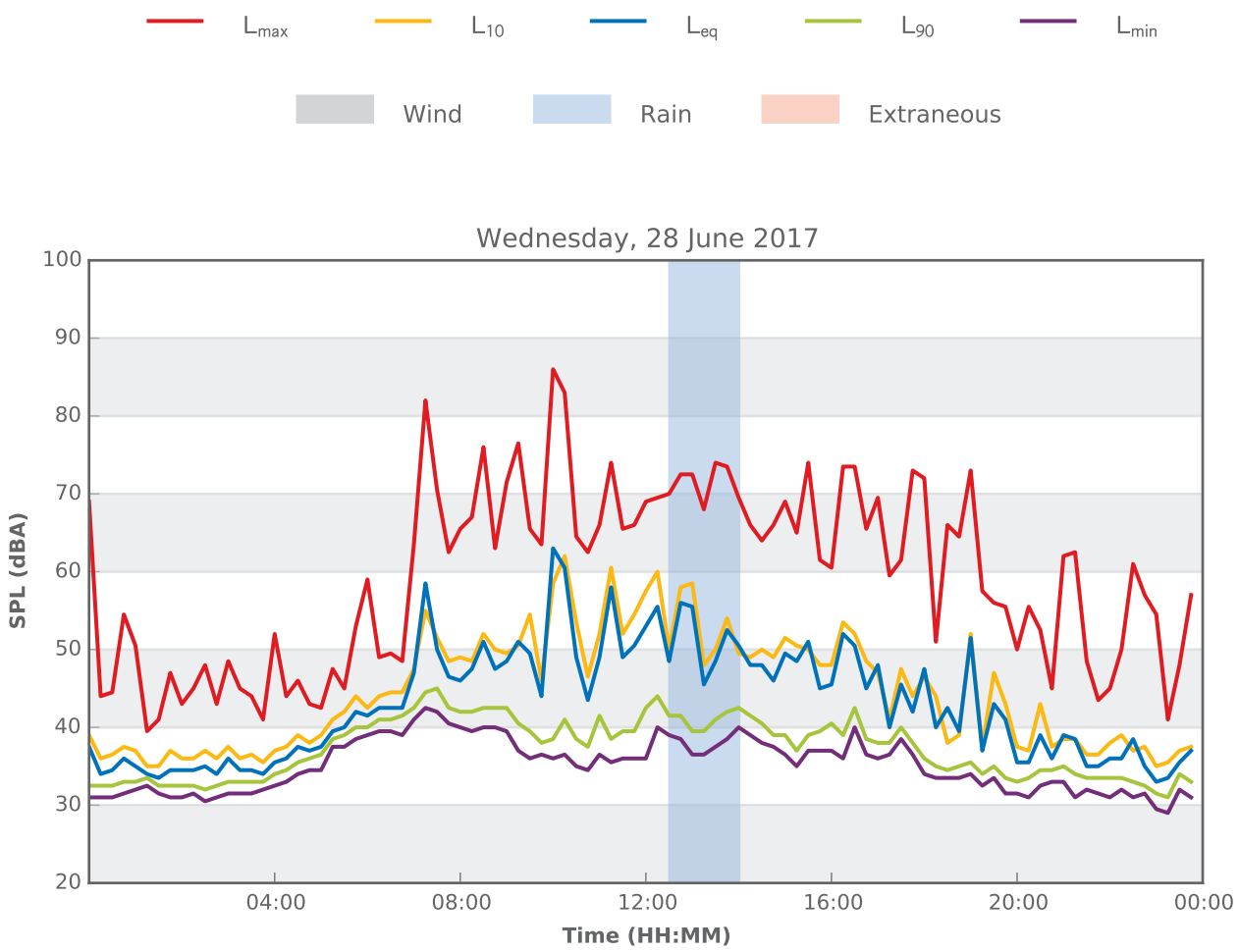
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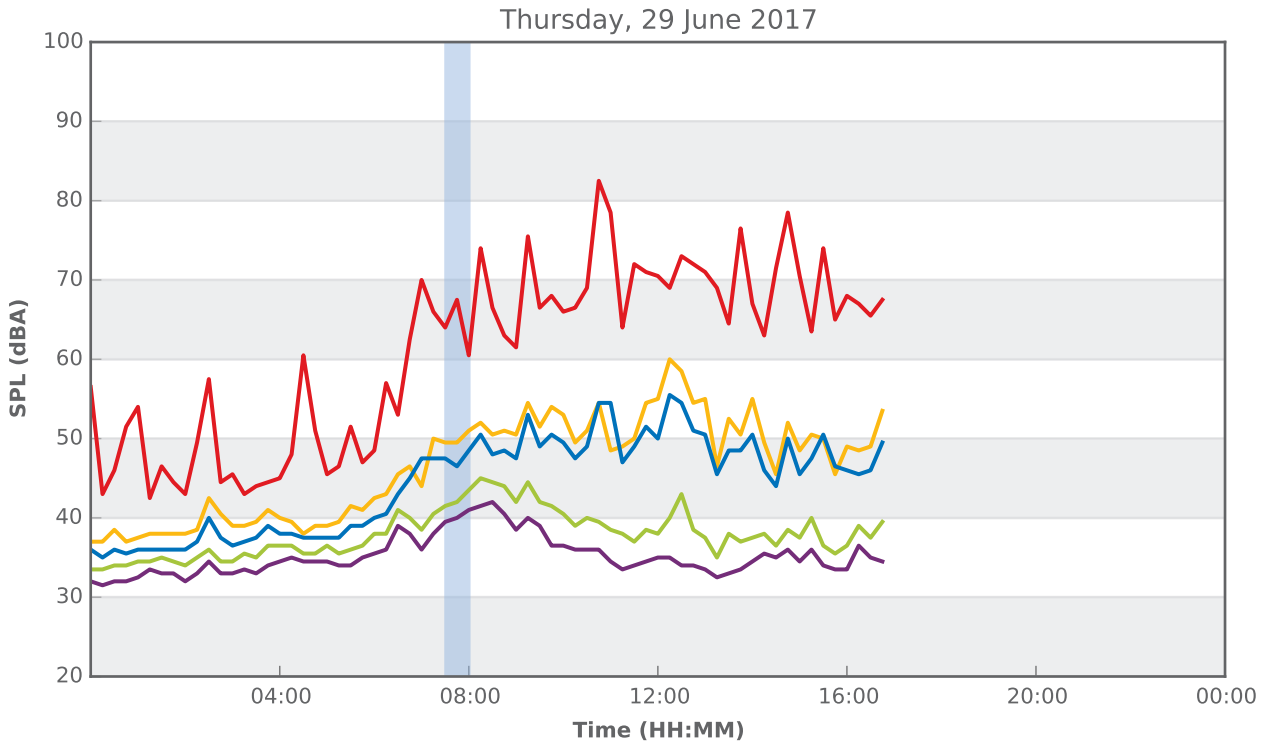




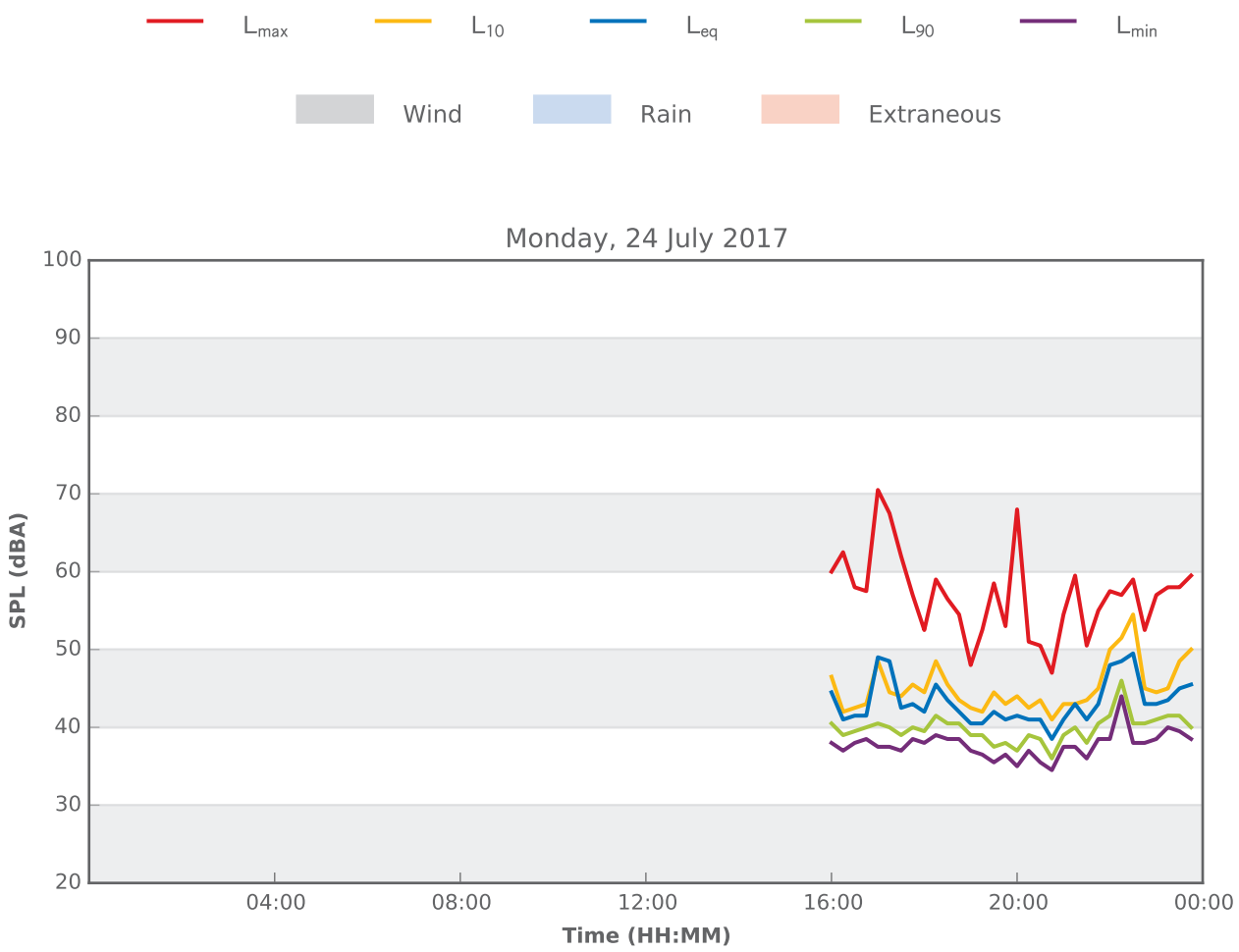


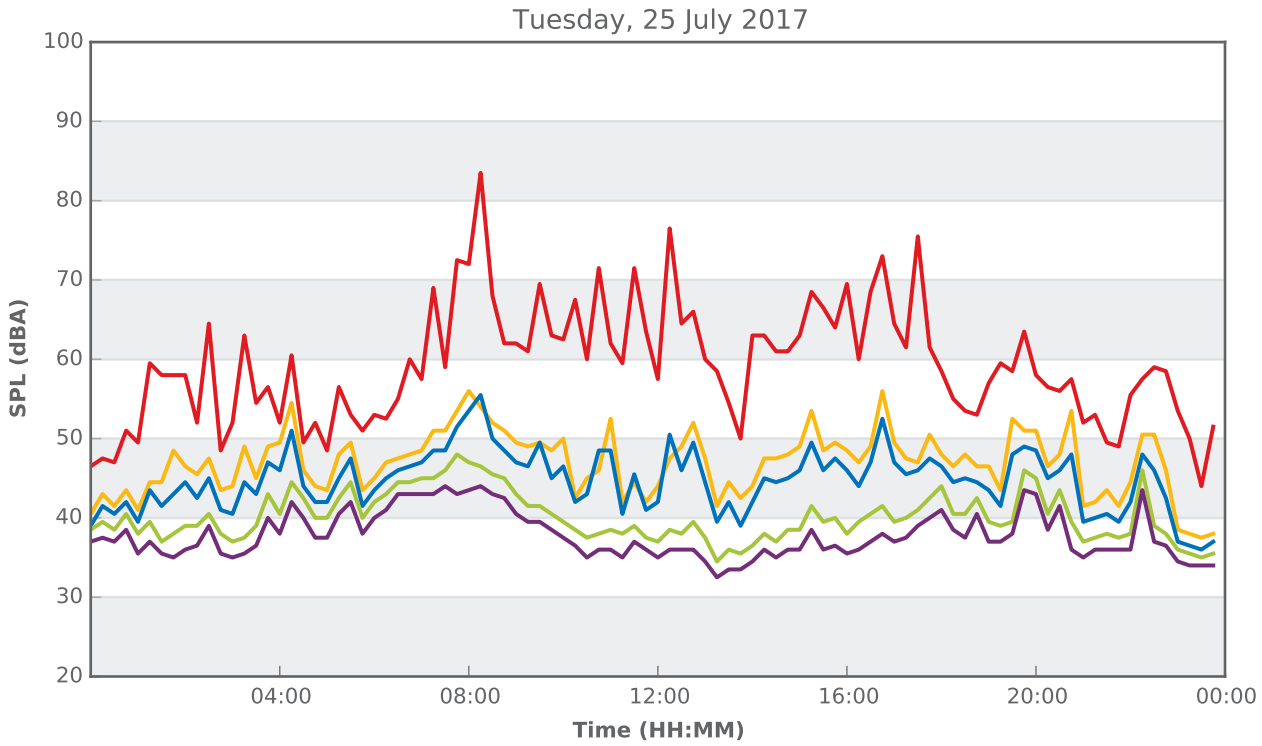
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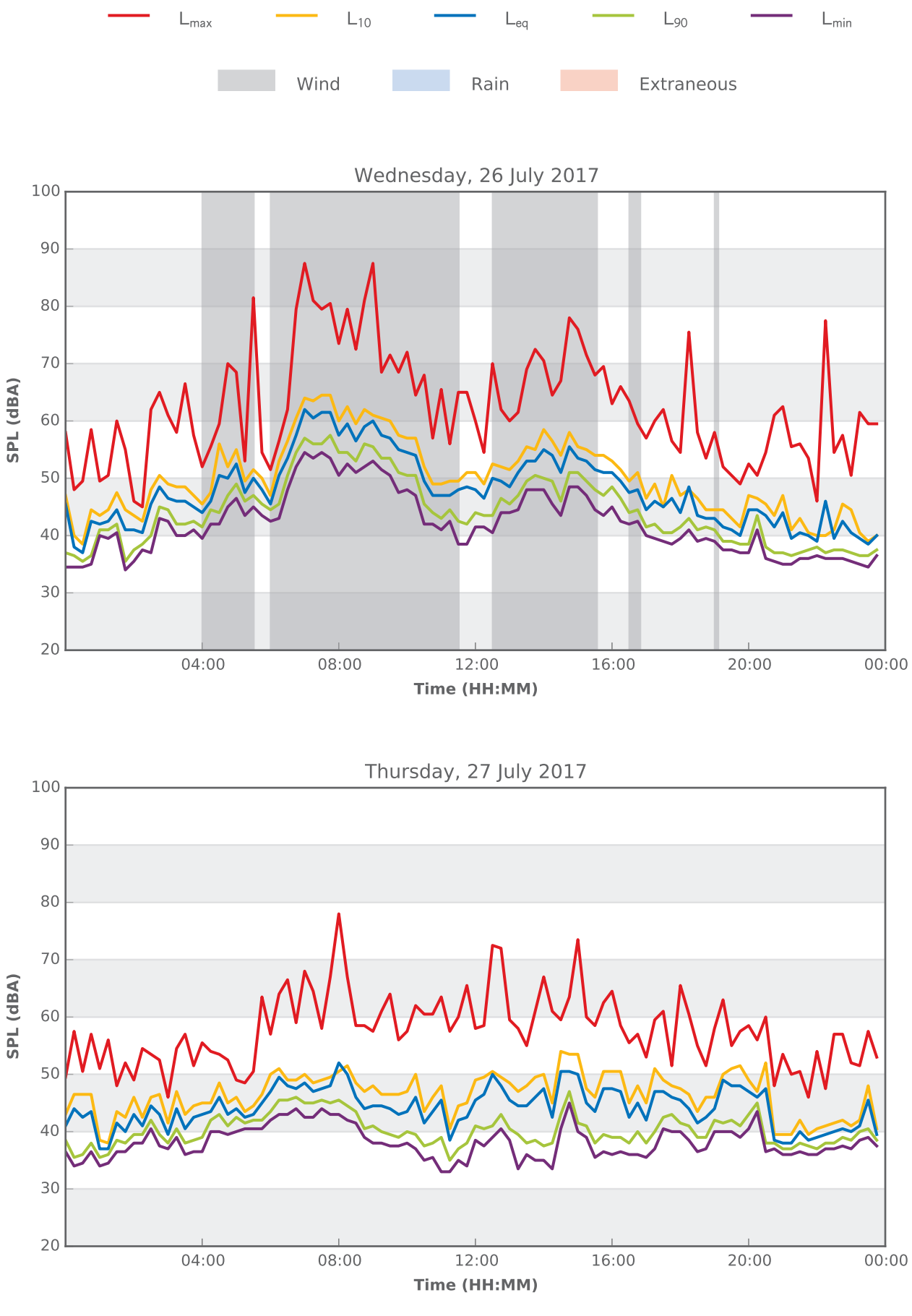


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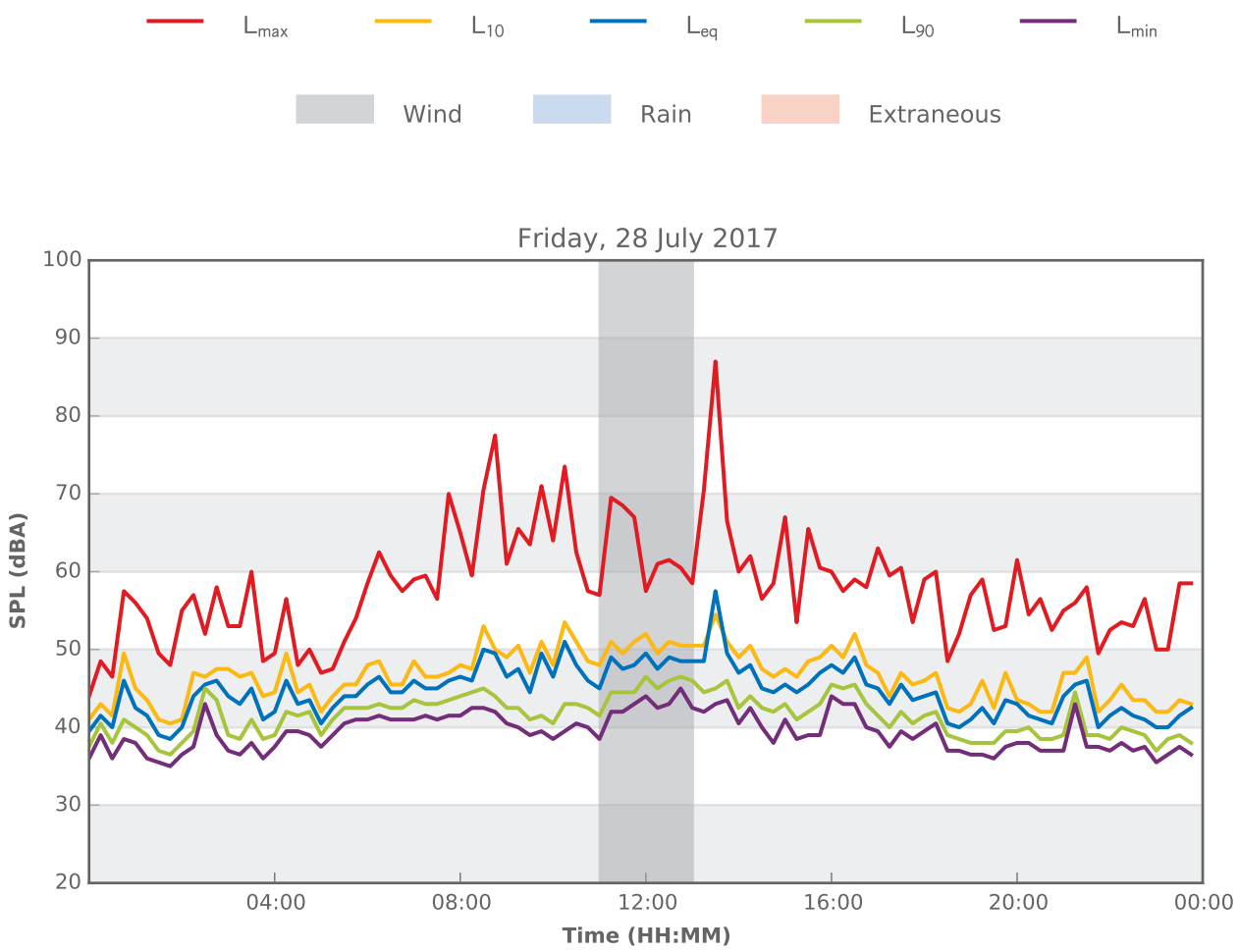


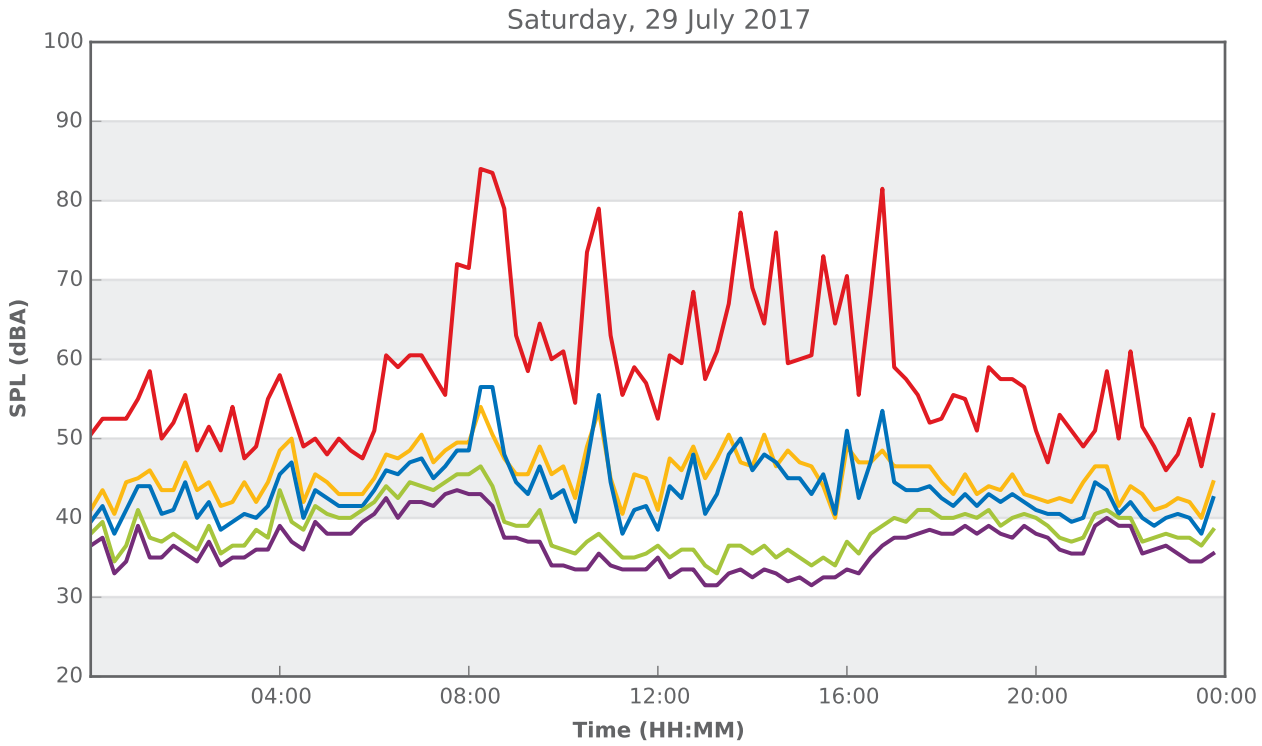


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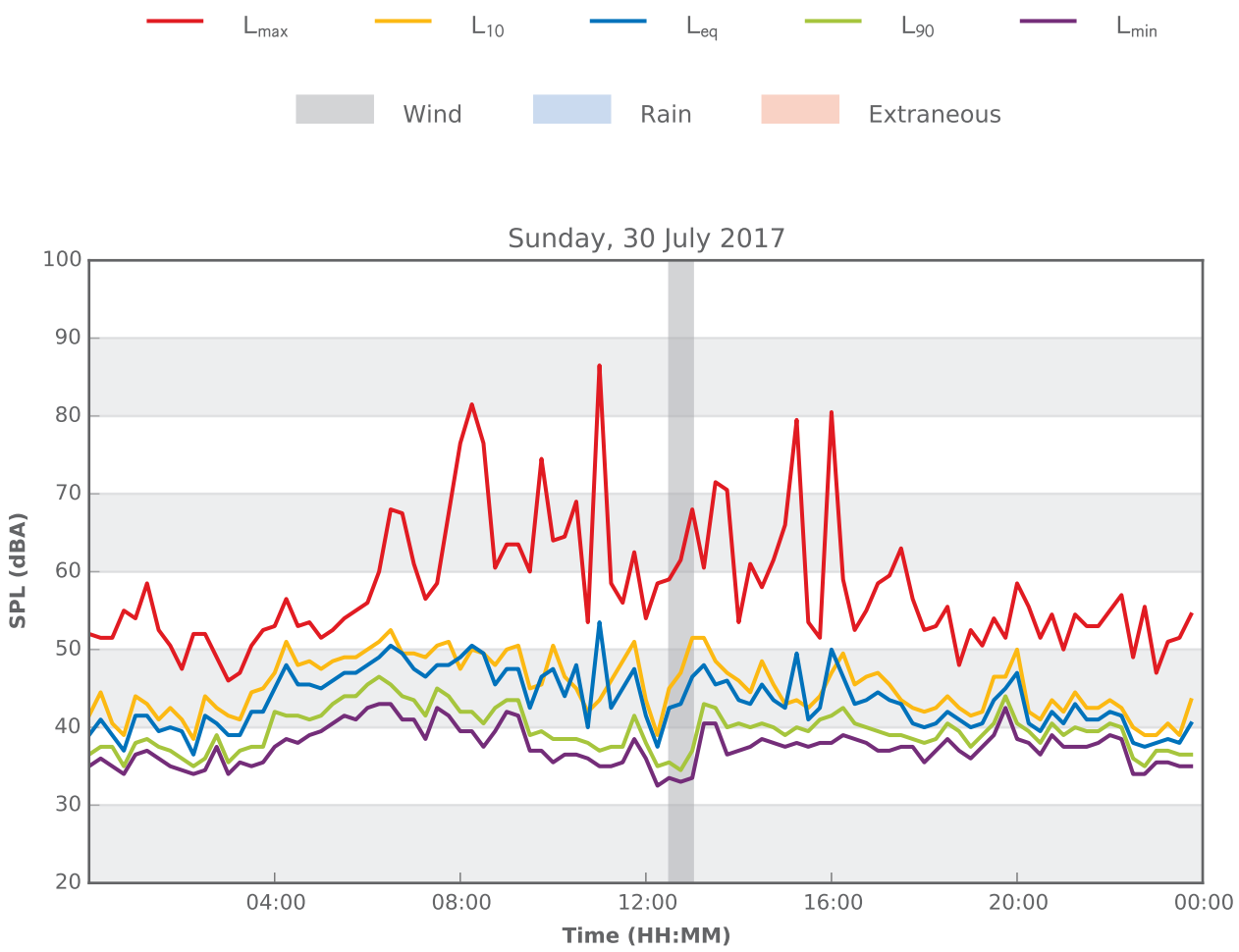


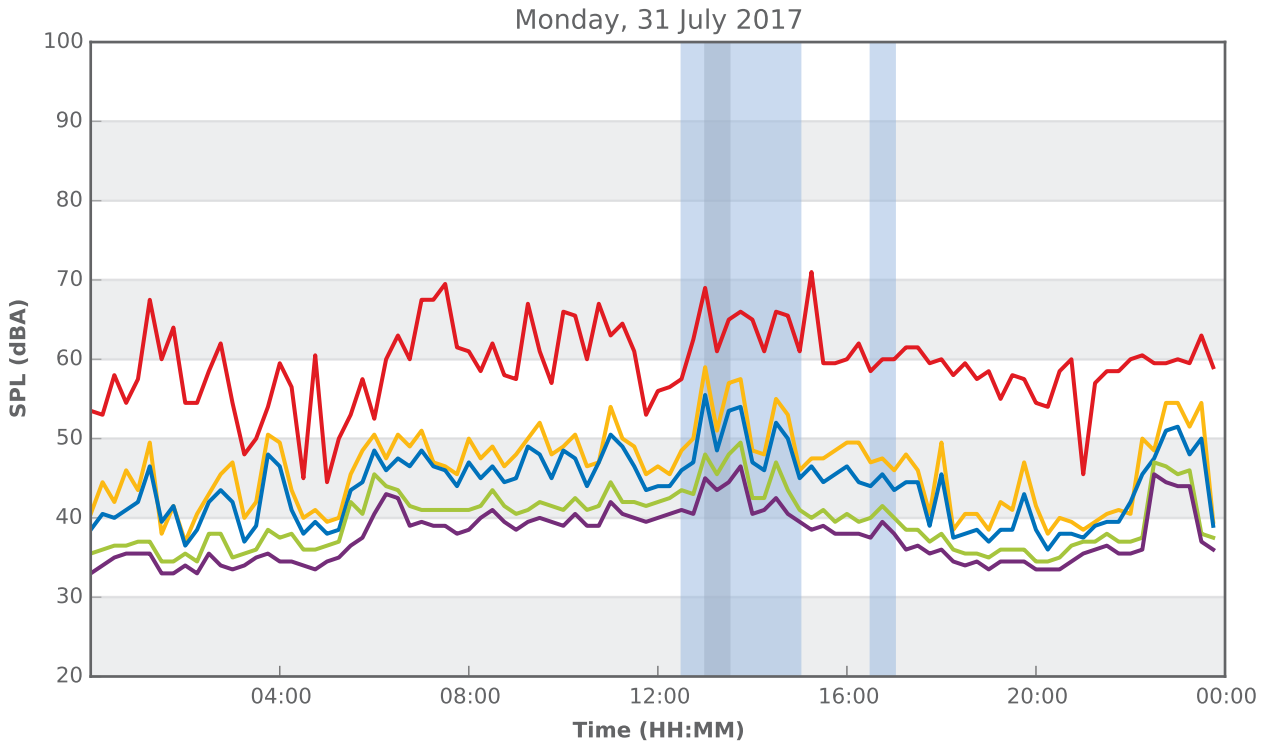
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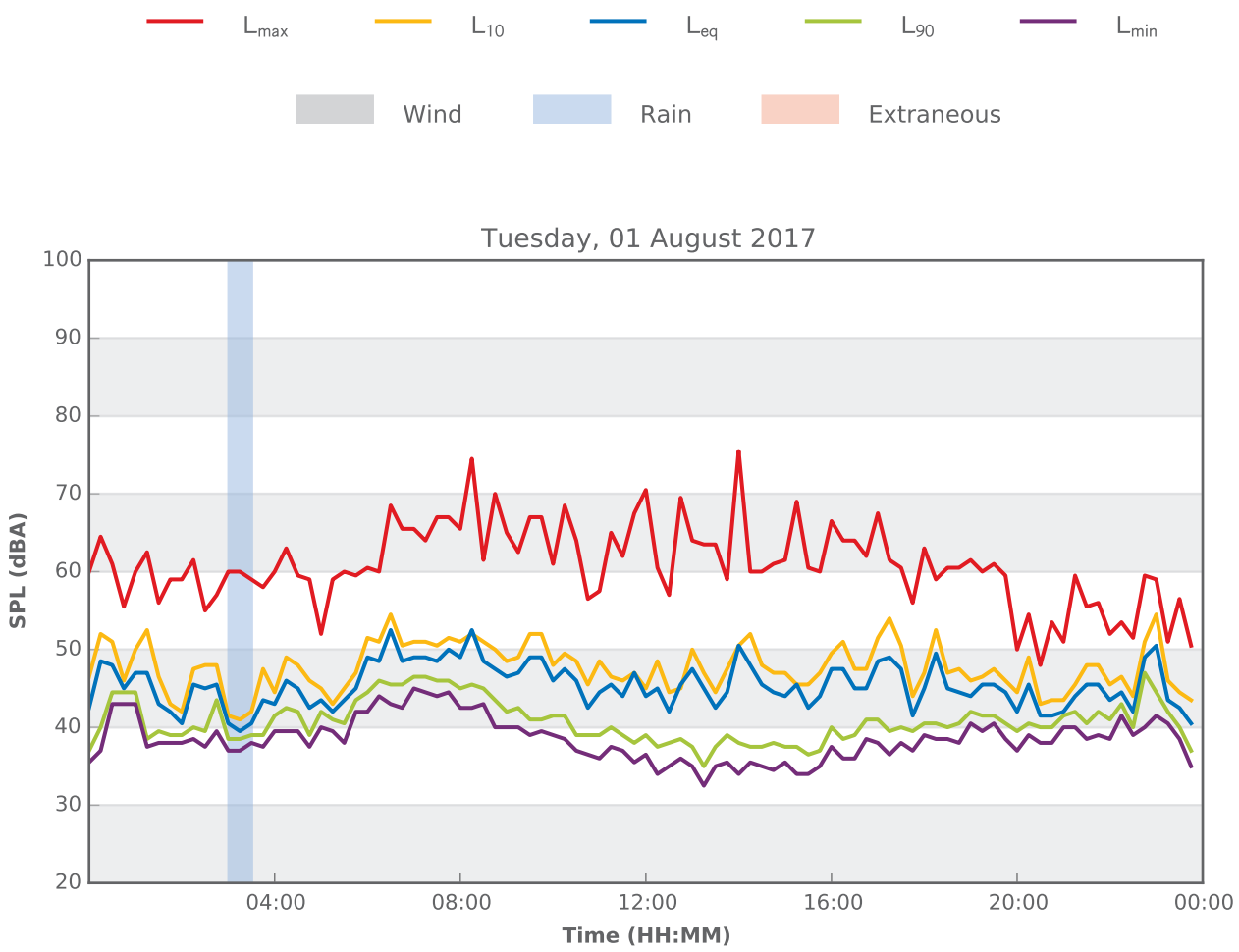


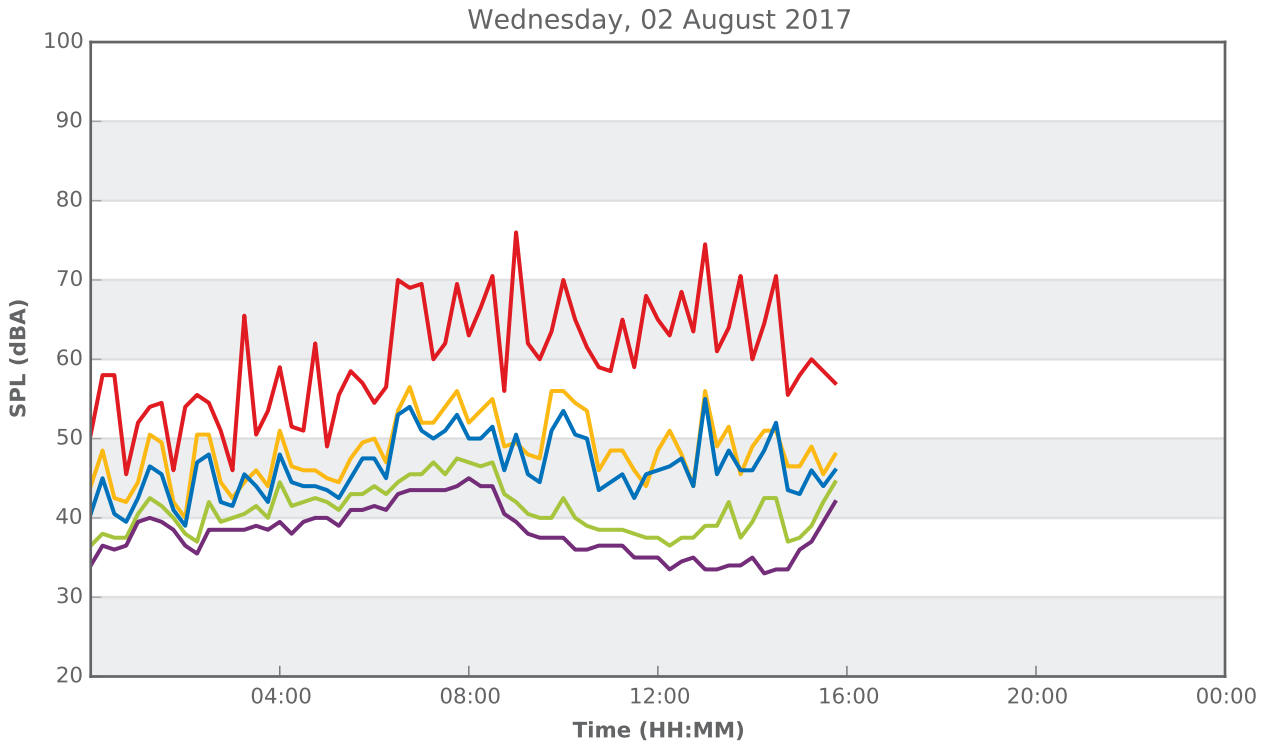
48 Victor Avenue, Kemps Creek





48 Victor Avenue, Kemps Creek





APPENDIX B

NOISE MODELLING SOURCE LOCATIONS

Figure B-6-1 Modelled Noise Sources – Phase 1, Overburden Removal in Pit 3



Figure B-2 Modelled Noise Sources – Phase 1, Raw Material Extraction in Pit 3



Figure B-3 Modelled Noise Sources – Phase 2



Figure B-4 Modelled Noise Sources – Phase 3



Figure B-5 Modelled Noise Sources – Phase 4



APPENDIX C

OPERATIONAL NOISE CONTOUR PLOTS

Figure C-1 $L_{Aeq,15min}$ Noise Levels – Phase 1, Morning Shoulder, Calm Meteorology

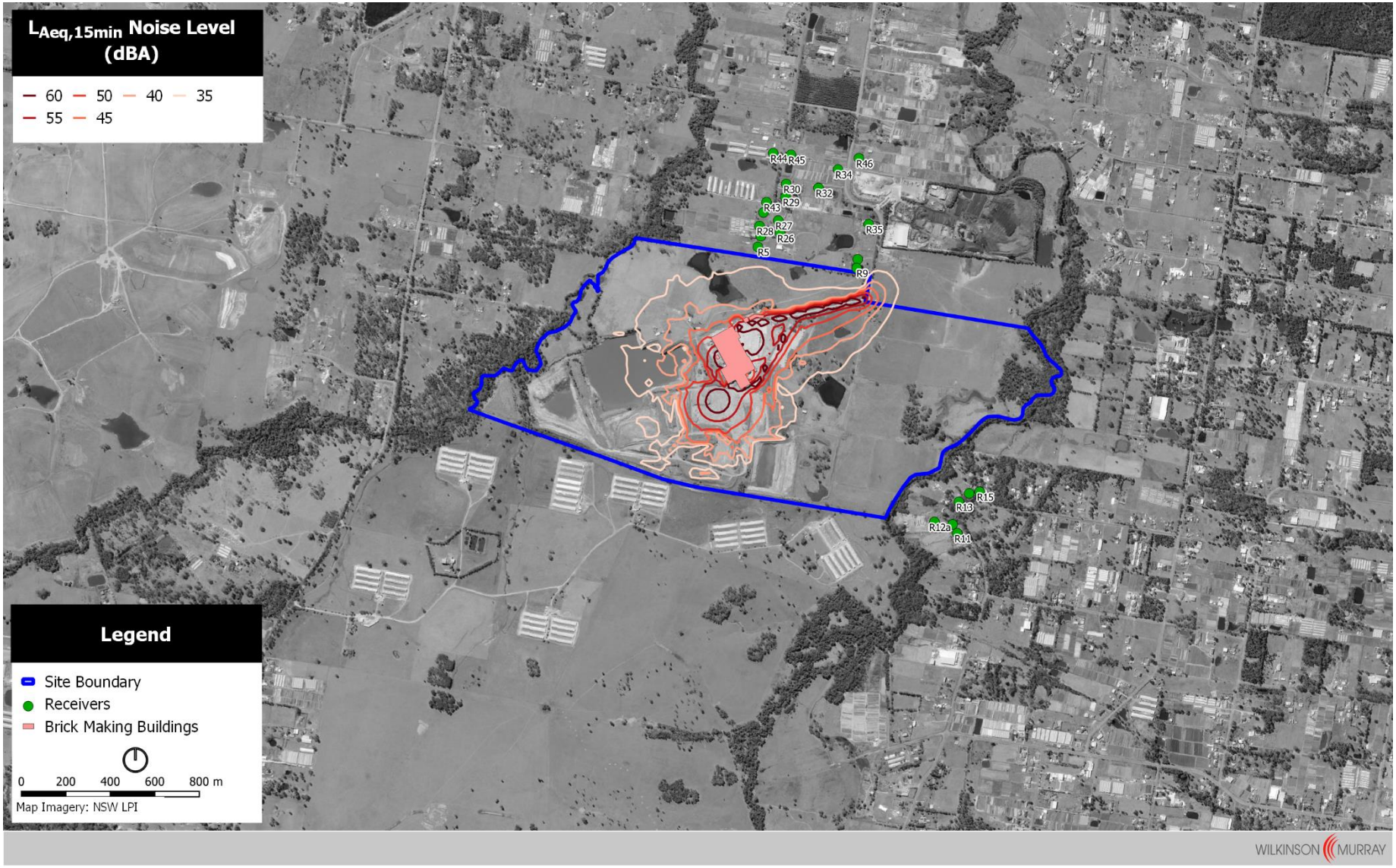


Figure C-2 $L_{Aeq,15min}$ Noise Levels – Phase 1, Morning Shoulder, Noise Enhancing Meteorology

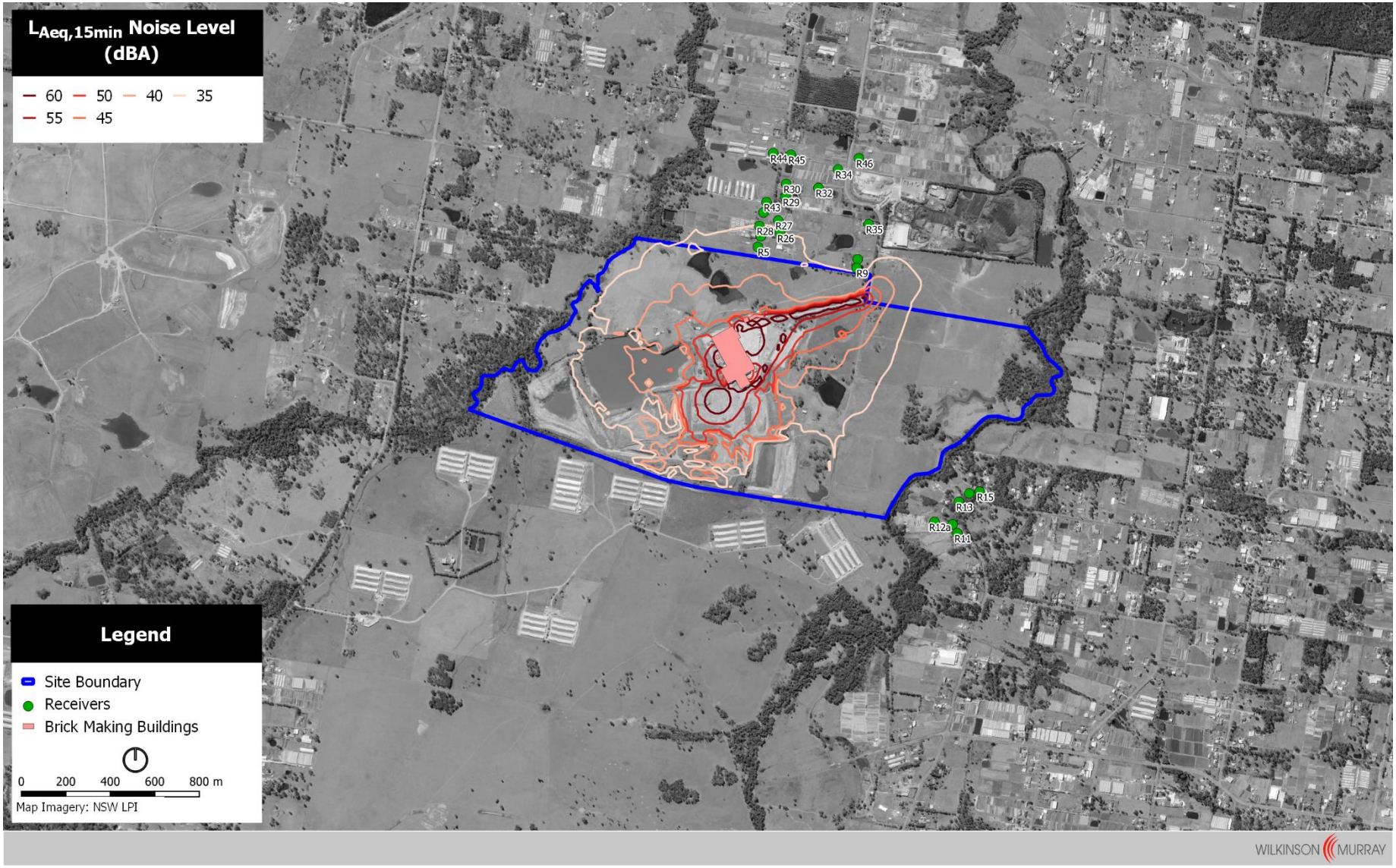


Figure C-3 $L_{Aeq,15min}$ Noise Levels – Phase 1, Daytime, Calm Meteorology

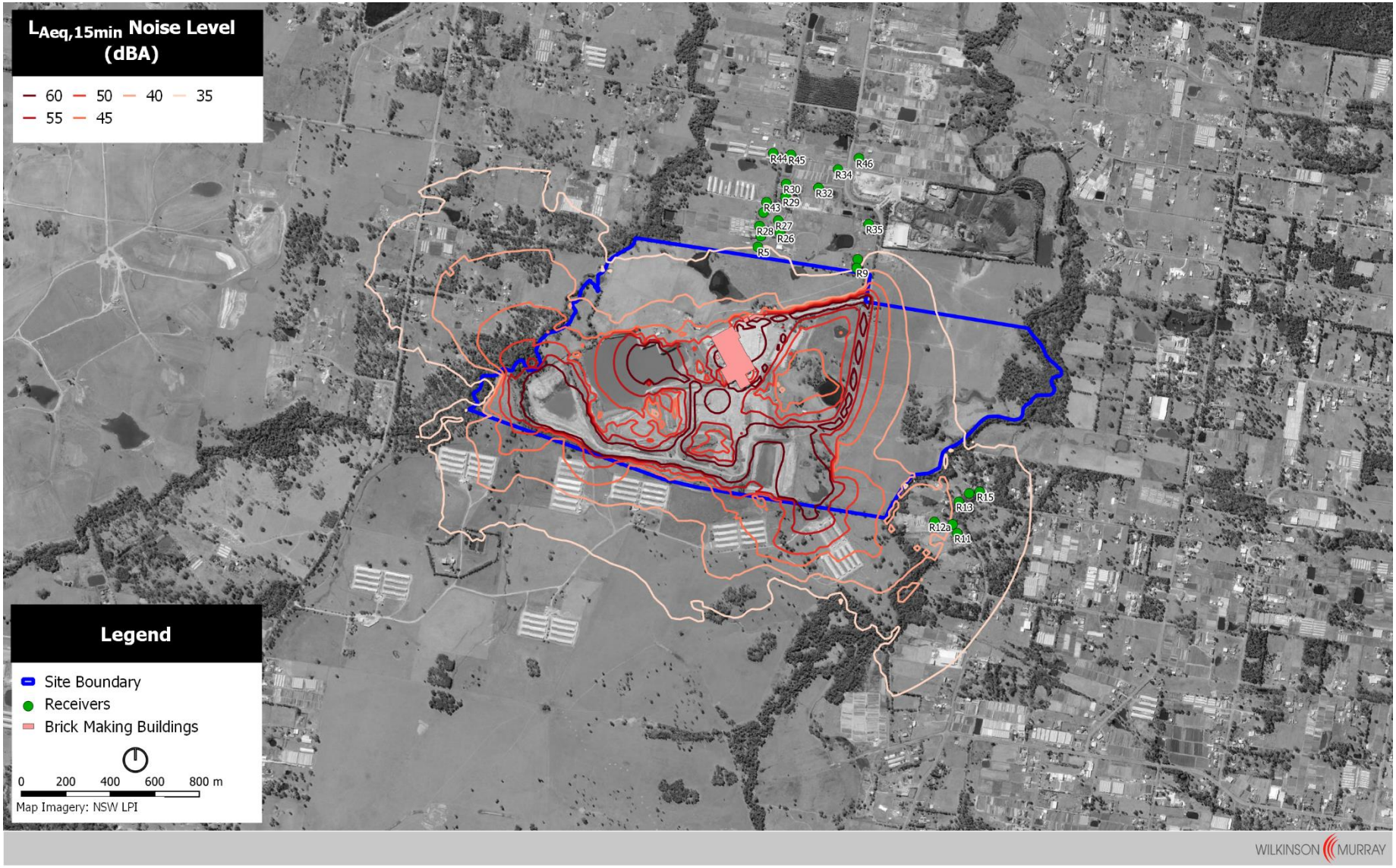


Figure C-4 $L_{Aeq,15min}$ Noise Levels – Phase 1, Daytime, Noise Enhancing Meteorology

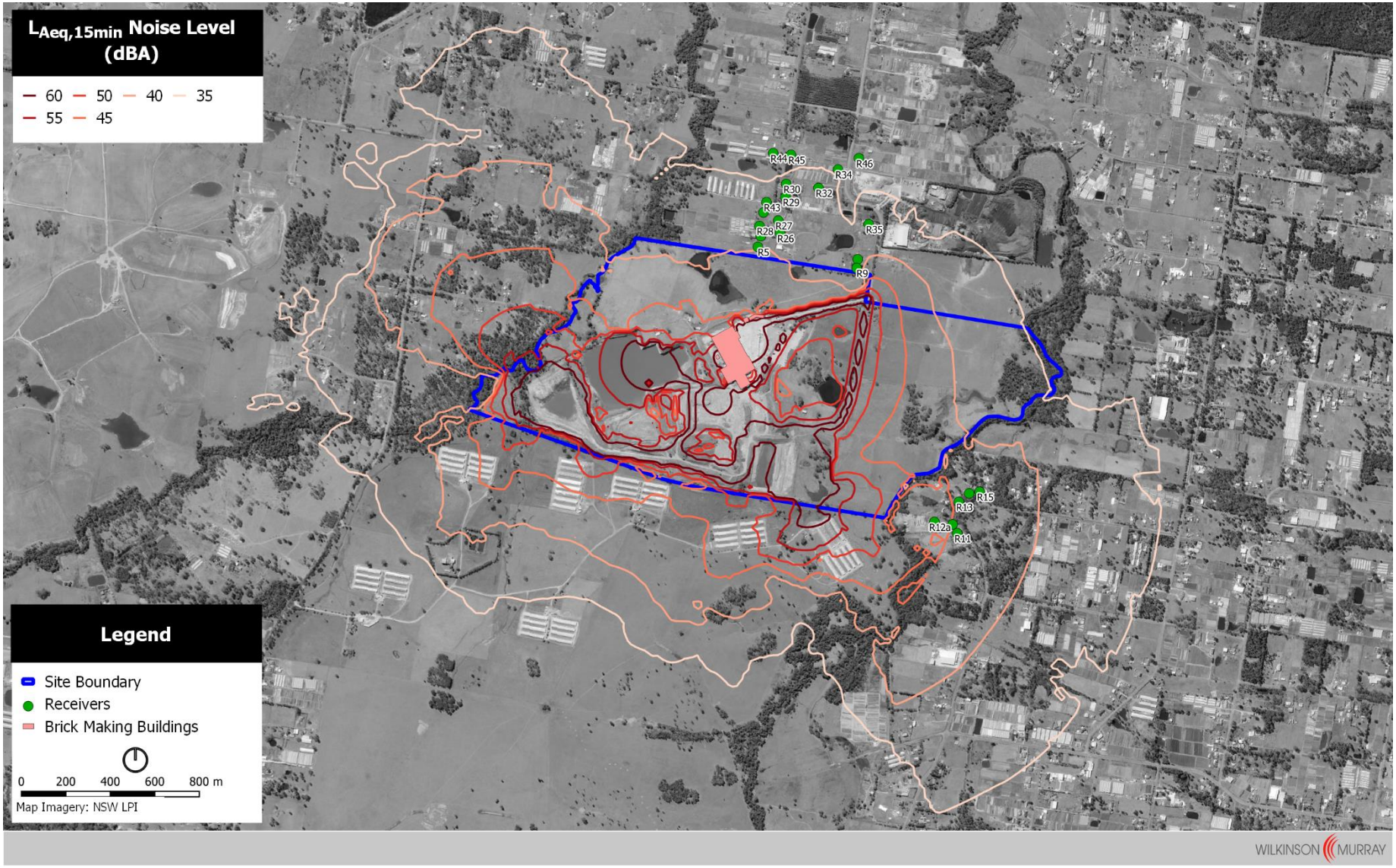


Figure C-5 $L_{Aeq,15min}$ Noise Levels – Phase 1, Evening, Calm Meteorology

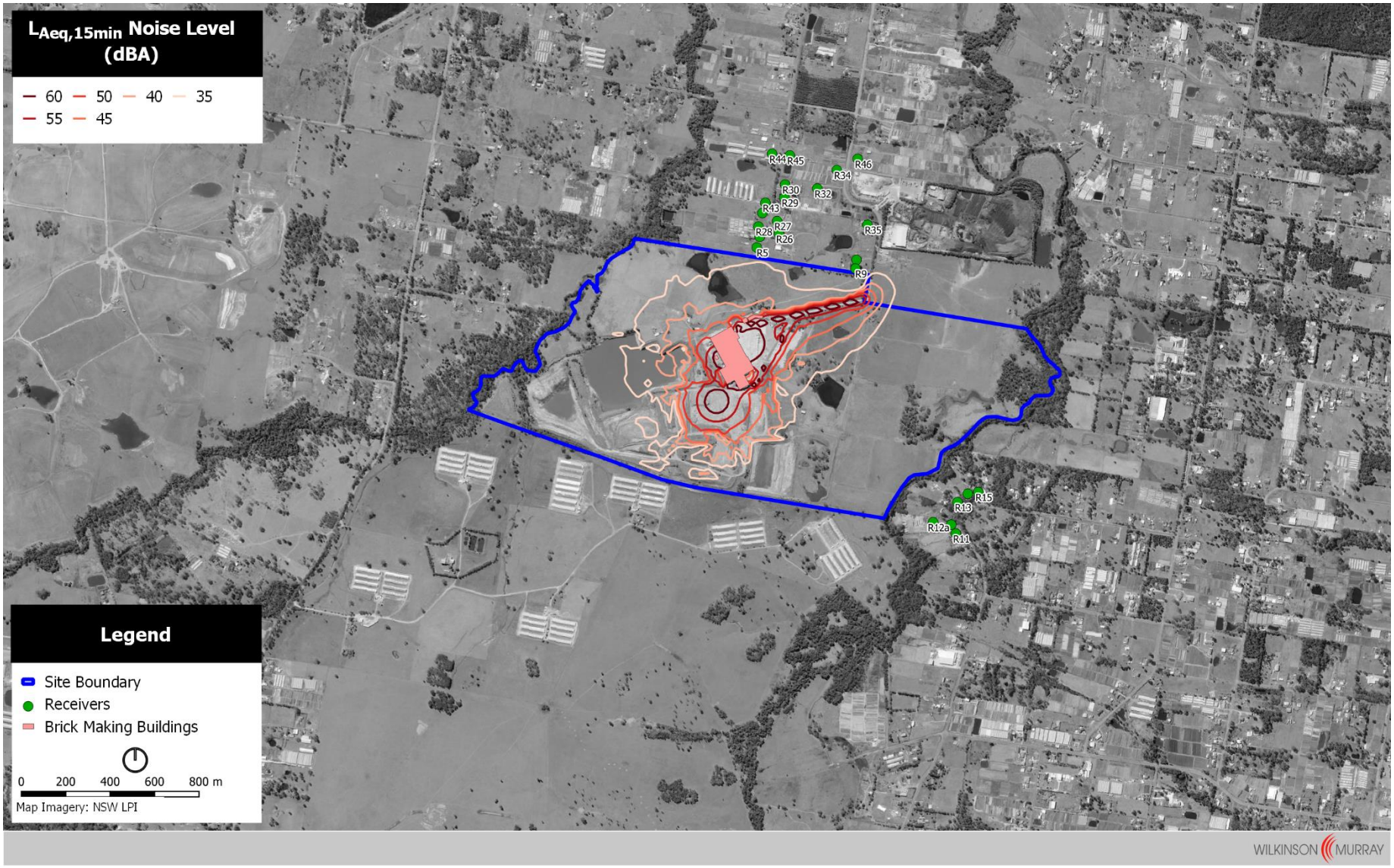


Figure C-6 $L_{Aeq,15min}$ Noise Levels – Phase 1, Evening, Noise Enhancing Meteorology



Figure C-7 $L_{Aeq,15min}$ Noise Levels – Phase 1, Night, Calm Meteorology

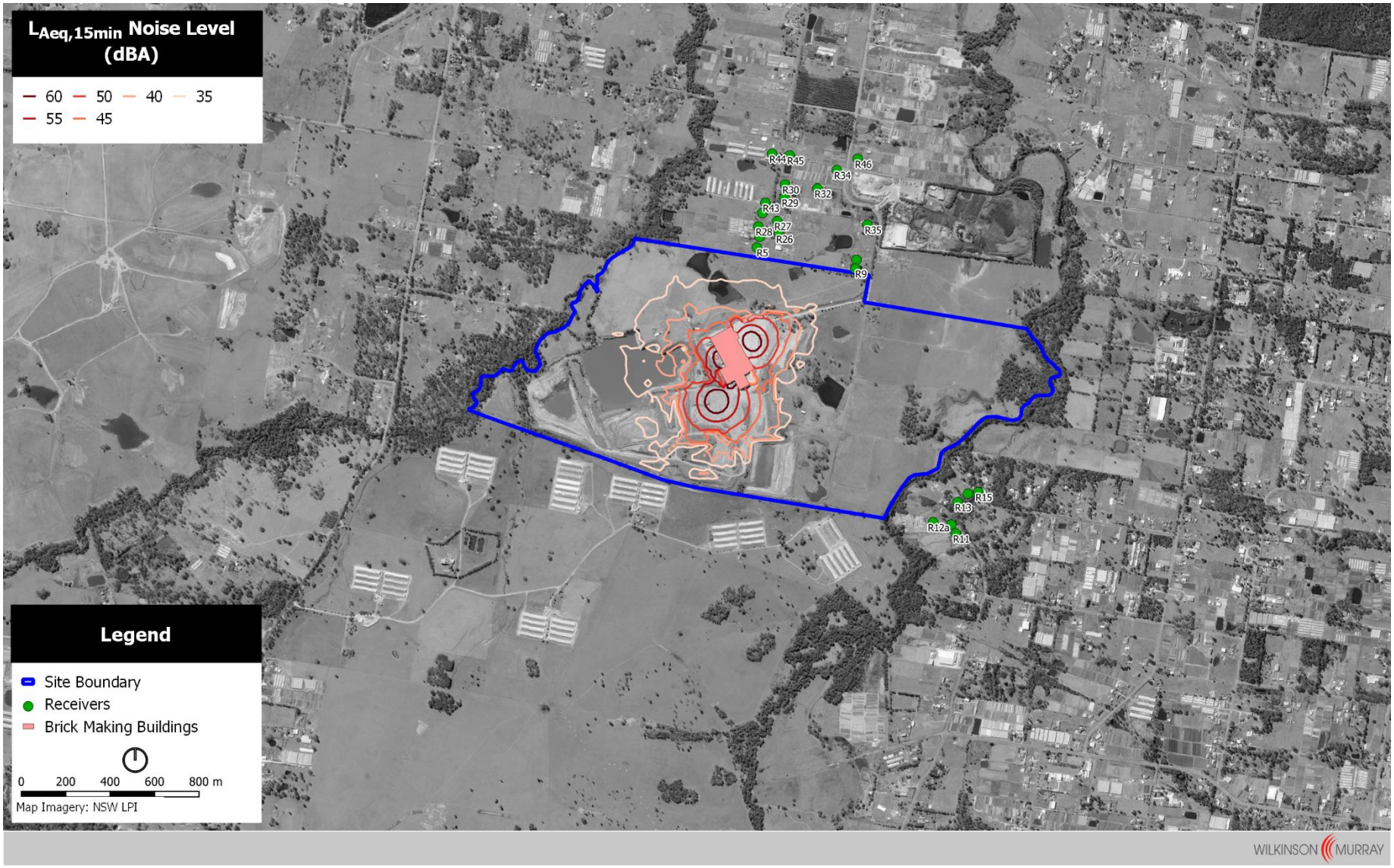


Figure C-8 $L_{Aeq,15min}$ Noise Levels – Phase 1, Night, Noise Enhancing Meteorology



Figure C-9 $L_{Aeq,15min}$ Noise Levels – Phase 4, Morning Shoulder, Calm Meteorology

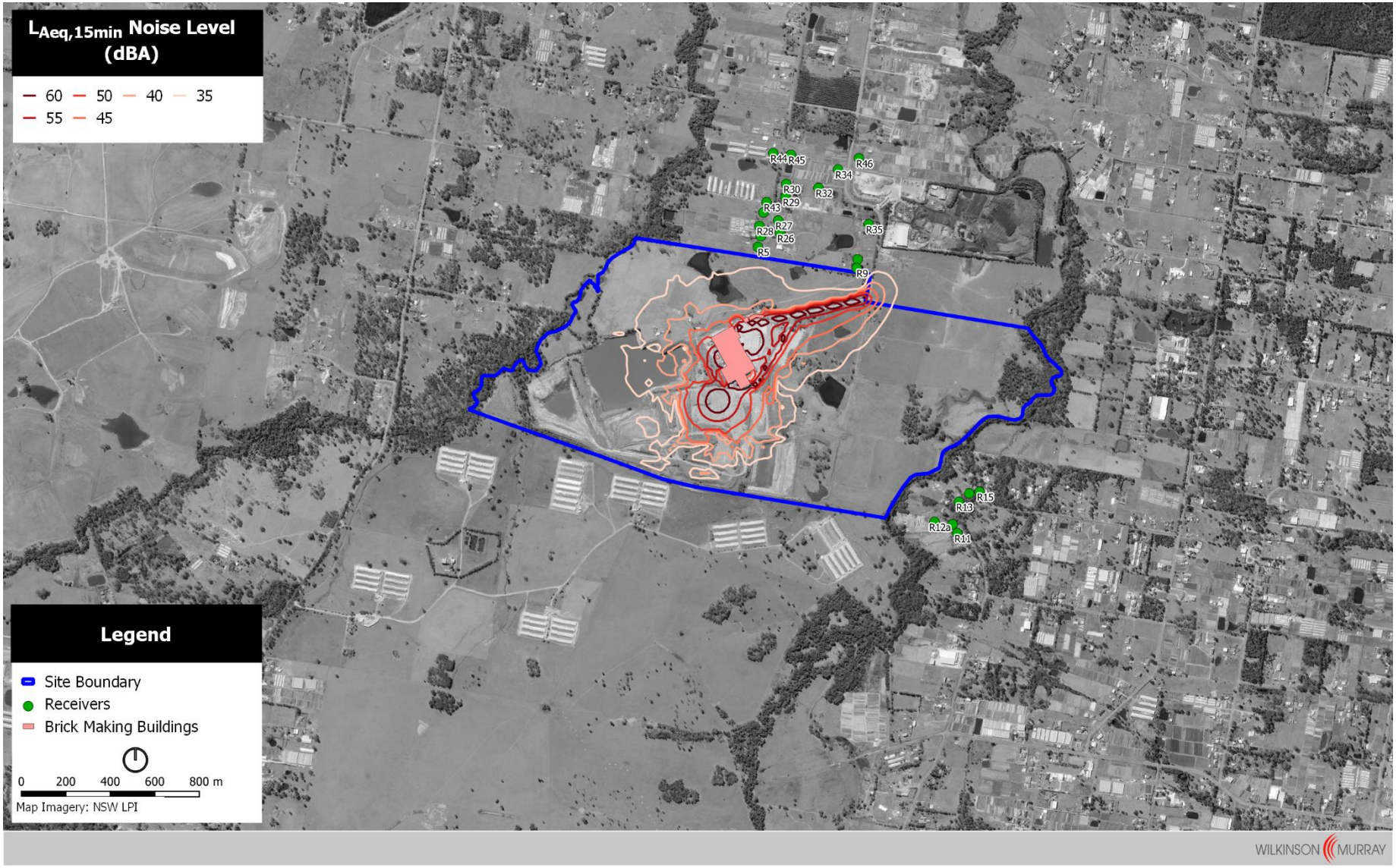


Figure C-10 $L_{Aeq,15min}$ Noise Levels – Phase 4, Morning Shoulder, Noise Enhancing Meteorology



Figure C-11 $L_{Aeq,15min}$ Noise Levels – Phase 4, Daytime, Calm Meteorology

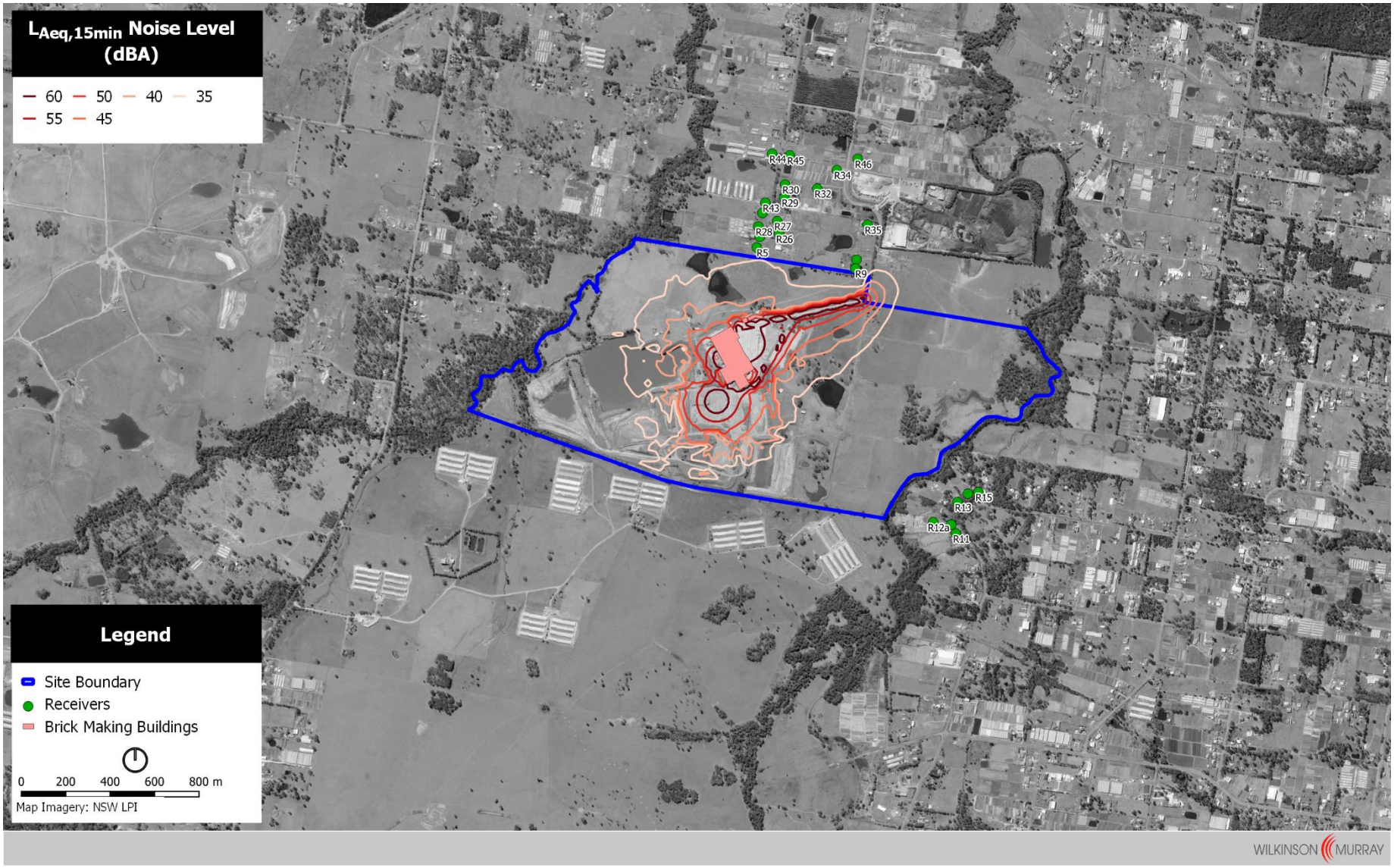


Figure C-12 $L_{Aeq,15min}$ Noise Levels – Phase 4, Daytime, Noise Enhancing Meteorology

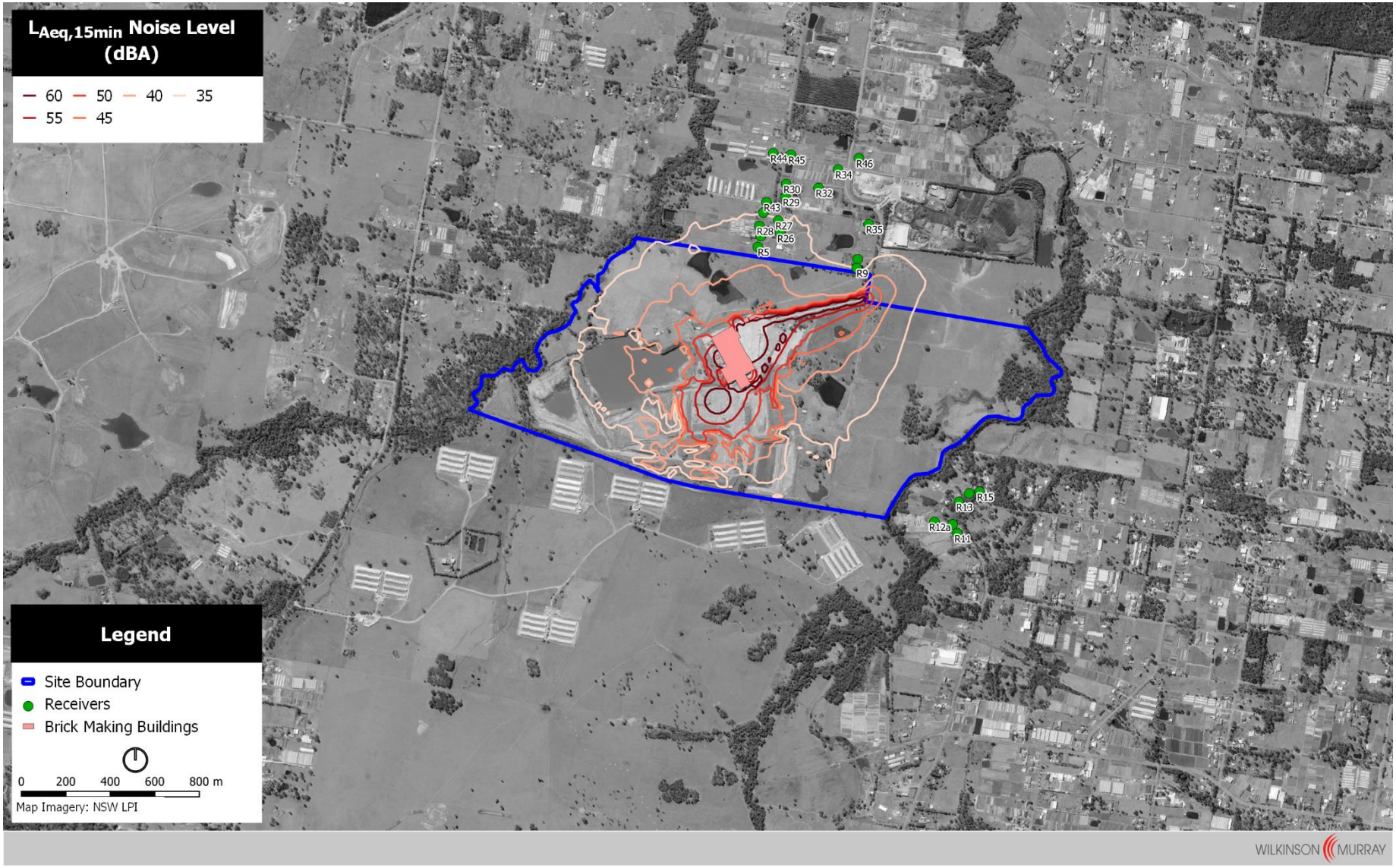


Figure C-13 $L_{Aeq,15min}$ Noise Levels – Phase 4, Evening, Calm Meteorology

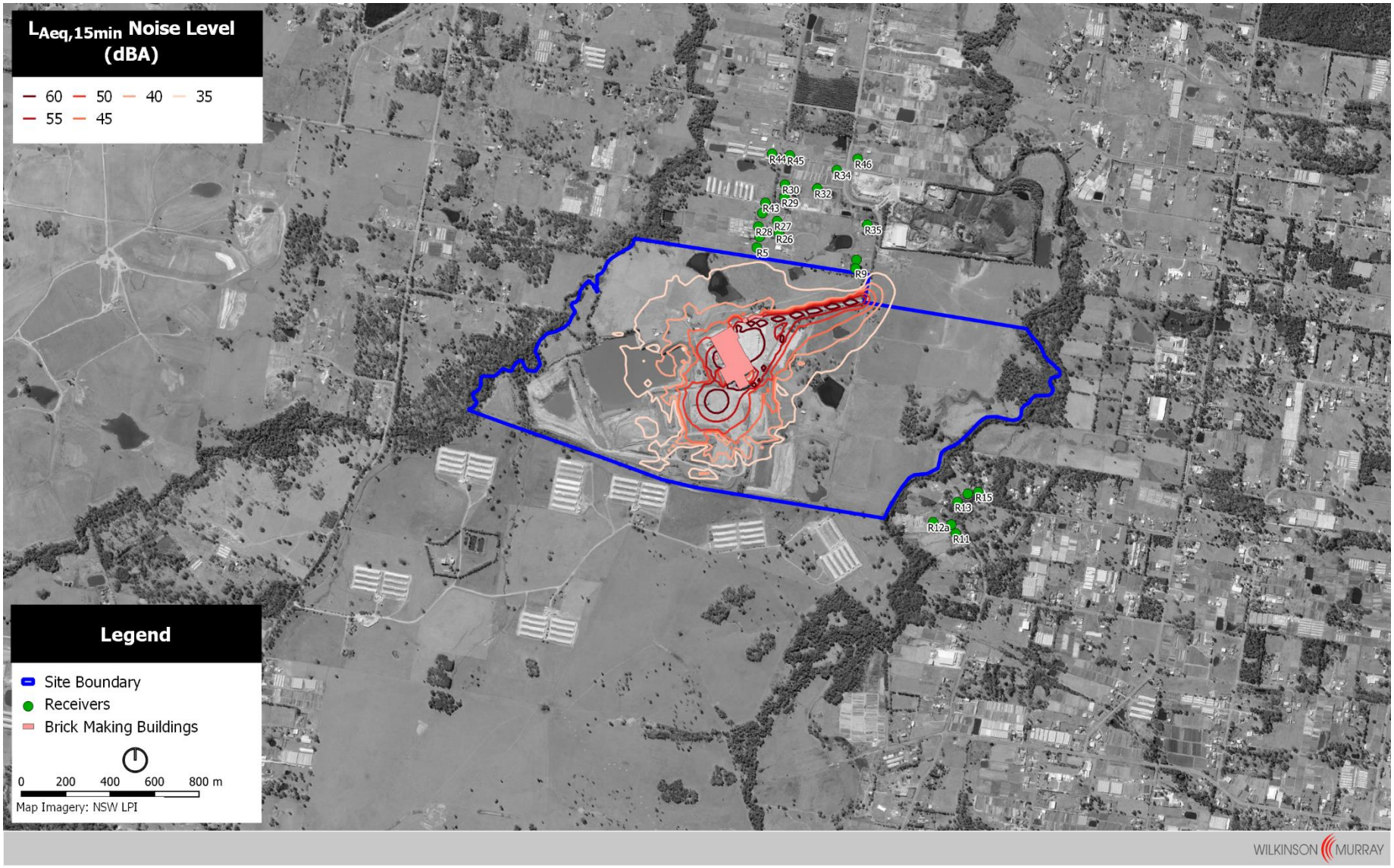


Figure C-14 $L_{Aeq,15min}$ Noise Levels – Phase 4, Evening, Noise Enhancing Meteorology



Figure C-15 $L_{Aeq,15min}$ Noise Levels – Phase 4, Night, Calm Meteorology

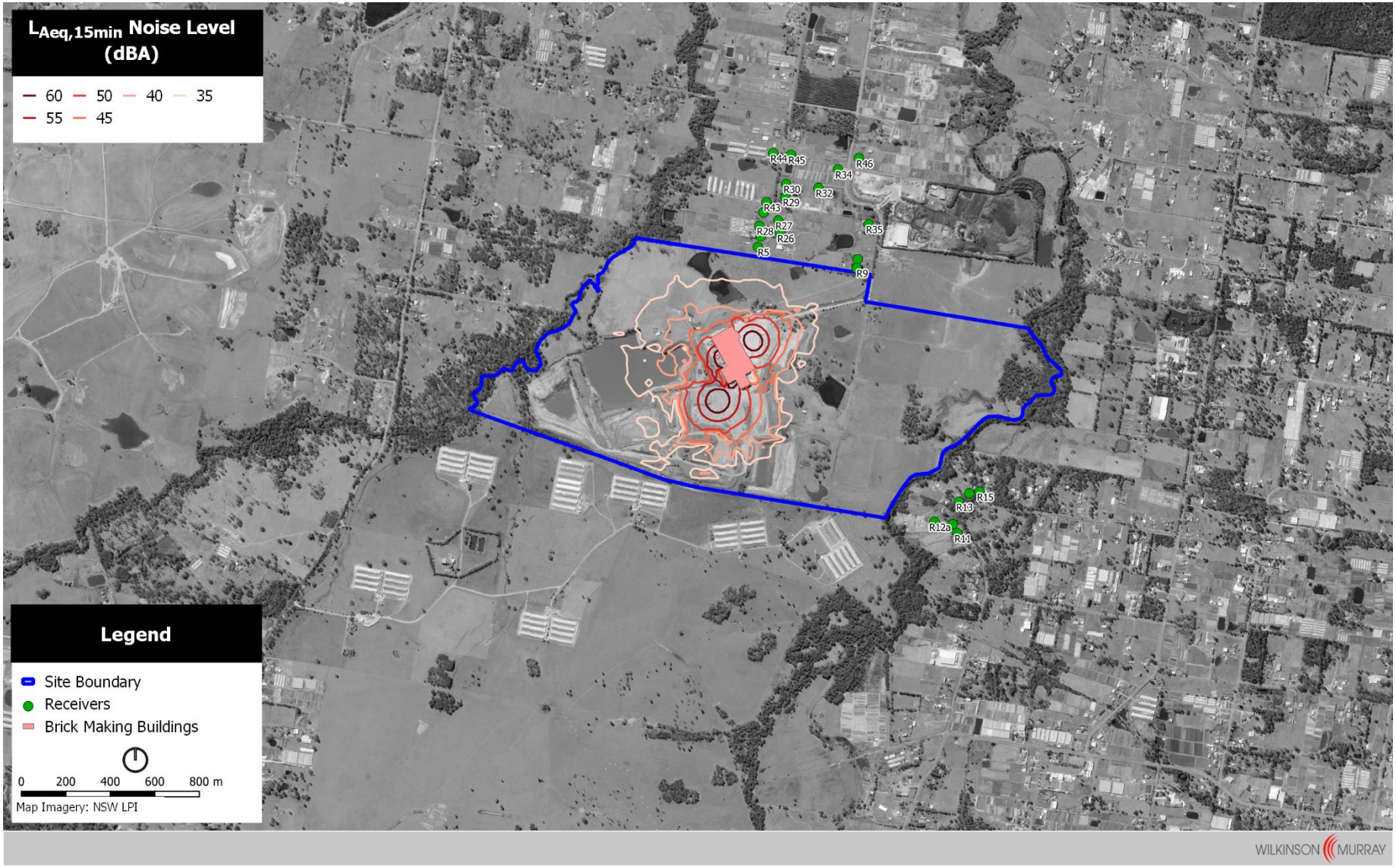


Figure C-16 $L_{Aeq,15min}$ Noise Levels – Phase 4, Night, Noise Enhancing Meteorology





APPENDIX D

CSR ADVANCED MANUFACTURING HUB AT BADGERYS CREEK PREFERRED PROJECT SURFACE WATER MANAGEMENT

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Ref: 301015-03926
File: lt301015-03926wjh_crt190930-Preferred Project SW.docx

Element Environment
PO Box 1563
WARRIEWOOD NSW 2102

30th September 2019

Attention: Mr Neville Hattingh

Dear Neville,

CSR ADVANCED MANUFACTURING HUB AT BADGERYS CREEK PREFERRED PROJECT SURFACE WATER MANAGEMENT

The Western Sydney Planning Partnership (WSPP) provided a submission to both CSR's Advanced Manufacturing Hub modification applications (3 and 4), raising concern that the proposed modifications were inconsistent with the *Western Sydney Aerotropolis Land Use and Infrastructure Plan – Stage 1: Initial Precincts* (LUIIP).

CSR met with DPIE and WSPP on 3 July 2019 to discuss concerns raised in WSPPs submission on the consistency of the modification with the LUIIP. It was agreed in this meeting that the modifications would need to:

- discuss how and when parts of the site could be made available for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- that a 40m wide easement for the future realignment and extension of Martin Road through the site can be accommodated.

Following the 3 July meeting, CSR revisited their proposed modifications and developed a 'preferred project' which:

- reduces the extent and duration of quarrying on the site, thereby reducing the volume of virgin excavated natural material (VENM) and the duration of VENM importation required to backfill quarry pits on the site;
- removes the proposed Monier roof products manufacturing facility and solar farm;
- frees up all but a 30 hectare (Ha) portion of the 200 Ha site for development consistent with the type of land uses proposed for the aerotropolis in the LUIIP; and
- accommodates a six lane road within a 40m wide easement for the future realignment and extension of Martin Road through the site.

CSR had an additional meeting with DPIE on 3 September 2019 to present the preferred project. DPIE requested that the response to submissions reports for modification 3 and 4 should include:

- a description of the preferred project and changes to the modification 3 and 4 project descriptions;
- a description of the changes to the impacts associated with the preferred project; and

- a response to all submissions received on the modification 3 and 4 environmental assessments (EAs) from government agencies and neighbouring landowners that are relevant to the preferred project.

Advisian has been engaged by Element Environment, on behalf of CSR, to described the changes required to the surface water management approach to accommodate the preferred project.

1. MODIFICATION 3 PROJECT SURFACE WATER MANAGEMENT

Modification 3 (Mod 3) as presented in the Modification 3 EA involves the following works at the brick making facility:

- An increase in the footprint of the existing brick making facility, which will occur on existing hardstand area;
- An increase in the building footprint of the existing office to develop a NATA Laboratory, which will occur on existing hardstand area;
- An increase in the footprint of the existing administration building, which will occur on existing hardstand area;
- Extension of the existing visitor carpark;
- Construction of an innovation centre to the south-east of the visitor carpark;
- A new brick factory staff parking area on existing hardstand area and access road;
- A weighbridge; and
- New rainwater tanks.

The following water management measures were proposed for the brick making facility in the Modification 3 EA and surface water assessment:

- Sediment Basins 5 and 6 are to be constructed in Years 1 to 5 to capture runoff from the expanded brick making facility and piped to Pit 1 to empty them ready for the next storm.
- Overtopping of SB5 to Sediment Basins 1 and 2 and then Badgerys Creek.
- Overtopping of SB6 to Sediment Basin 3 and then South Creek.
- SB6 was to be decommissioned once Pit 4 extraction commences, with runoff being treated the same as other Pit 4 runoff.
- SB5 was to be decommissioned once Pit 5 extraction commences, with runoff being treated the same as other Pit 5 runoff.

Sediment Basin 4 at Pit 2 was required to be constructed in Years 6 to 7 to manage runoff from the backfilled and rehabilitated Pit 2 void. SB4 would be decommissioned in Years 17 to 18.

Modification 3 included the construction of the Monier roof products manufacturing plant beyond the eastern boundary of the approved project. Stormwater from this plant was to be treated via a new stormwater management basin along the eastern edge of the plant, prior to discharge towards South Creek.

Modification 3 also included quarrying from Pit 4, starting in Years 8 to 10, and from Pit 5, starting in Years 19 to 21. Water management from these pits involved piping to other pits when required. These pits would also accept water piped from other pits if required.

2. MODIFICATION 4 PROJECT SURFACE WATER MANAGEMENT

Modification 4 (Mod 4) as presented in the Modification 4 EA would involve the Modification 3 works, plus the following activities:

- Initial dewatering of Pits 1, 2 and 3 over a period of about 1 year.
- Pit 1 would be quarried further.
- Pits 1, 3, 4 and 5 would be progressively filled with VENM and rehabilitated following the completion of extraction activities. This would lead to an outwardly draining site, reinstating as much as practicable the natural pre-extraction topography and drainage catchment delineation.
- A solar farm in the south-east portion of the site.

Surface water management for Modification 4 presented in the Modification 4 EA and surface water assessment would involve the following:

- Initial dewatering of Pits 2 and 3 into Pit 1. Dewatering of Pit 1 would involve reuse of water onsite for dust suppression and irrigation, potential transfer to the Western Sydney Airport (WSA) site or controlled discharge to Badgerys Creek as a last resort. The rate of discharge to Badgerys Creek is not expected to exceed 100,000 litres per hour (L/hr) and could be reduced to approximately 80,000 L/hr maximum, accounting for reuse onsite of 20,000 L/hr.
- Ongoing dewatering of pits during progressive extraction and filling via the same methods as for the initial dewatering, albeit at a reduced rate.

It was recommended that sediment properties in Badgerys Creek be investigated to check potential impacts of a continuous discharge on creek geomorphology.

It was recommended that a water quality and biological monitoring program be continued/established for Badgerys Creek to assess any impact of the discharges on ecology.

3. PREFERRED PROJECT SURFACE WATER MANAGEMENT

The preferred project, which extends over a 30-year period, has been described in detail in the Mod 3 and 4 RTSs and has been separated into four phases. Each phase of the Preferred Project is summarised below with discussion on the key differences in the surface water management approach from that described in the Mod 3 and Mod 4 EAs.

Overall key differences in the Preferred Project surface water management approach from Mod 3 or Mod 4 include the following:

- The Monier roof products manufacturing plant is no longer part of the project and hence no stormwater treatment basin is required for this component.
- Pits 4 and 5 will no longer be quarried and hence water management at these pits is not required. Ongoing dewatering of these pits will no longer be required.

3.1 Phase 1 (Years 1 to 6)

Proposed works:

- Expansion of brick making facility as per Mod 3.
- Pits 2 and 3 dewatered into Pit 1 over a period of 10 weeks.
- Pit 1 is then dewatered over a period of 1 to 3 years.
- Pit 1 and 2 are backfilled and rehabilitated using existing fill material in Pit 2, existing unusable material/burden stockpiles and imported VENM. The initial VENM haul road alignment will be via extension of Martin Road to the south to beside Pit 3 and across the southern side of the brick making facility to Pits 1 and 2.
- Extraction from Pit 3.
- Landscaped earth bund to be constructed around the western, southern and eastern sides of the brick making facility's raw material stockpile area by the end of Year 6.
- Residual areas available for development include to the west of Pit 2, former Pit 4 and Pit 5 areas, former Monier plant and solar farm areas.

Proposed surface water management for Phase 1 (*refer* **Figure 1**):

- Initial dewatering of Pit 1 over a period of 1 to 3 years will be according to the same process as Mod 4, prioritising onsite water reuse, transfer to the WSA site and then discharge to Badgerys Creek as a last resort. The maximum rate of discharge to Badgerys Creek will not exceed that proposed under Mod 4 (100,000 L/hr).
- Irrigation reuse demand during the initial dewatering is expected to increase relative to Mod 4 due to the demand of grassed areas no longer being developed into the Monier roof products plant or the solar farm. These areas total about 15 Ha, representing a 30% increase in area for initial irrigation. Accordingly, the onsite reuse would be increased by 5,000 L/hr relative to Mod 4, meaning the potential maximum discharge to Badgerys Creek could be reduced to 75,000 L/hr.
- As per Mod 4, during Pit 1 VENM filling a perched water treatment basin is to be installed at the north-west corner of Pit 1 to take water collected in the pit.
- Sediment Basins 5 and 6 are required to treat stormwater from the expanded brick making facility, as per Mod 3 and 4. These basins are to be dewatered into Pit 1 following a storm until Pit 1 is backfilled. During filling of Pit 1 these sediment basins can be piped to the perched basin in Pit 1.
- Following the completion of Pit 1 filling, the perched basin in Pit 1 is to be removed. From this point onwards SB5 and SB6 water is to be treated and discharged to SB1 and SB3, respectively. This may require flocculation or use of a pump with filter.
- Alternatively, the SB5 and SB6 water could be treated and discharged to SB1 and SB3 at the commencement of operations or during filling of Pit 1. The treatment to be provided by the basins would be subject to further detailed design. SB5 and SB6 may need to be upgraded to incorporate additional treatment capacity if not constructed for stand-alone treatment from the beginning.

- Sediment Basin 4 is required to manage stormwater from the Pit 2 area during filling and rehabilitation. SB4 is to be dewatered into Pit 1 following a storm until Pit 1 is backfilled. Following the completion of Pit 1 filling, stormwater in SB4 is to be treated and discharged to Badgerys Creek. SB4 can be decommissioned following completion of Pit 2 filling and rehabilitation.
- New sediment basin(s) are required on the inside of the landscaped earth bund (*once constructed*) to treat stormwater from the brick making facility raw material stockpile area. Discharge from these basins during Phase 1 would be to existing drainage paths towards Badgerys Creek or South Creek via SB5 or SB6. An alternative option would be to direct runoff to the new sediment basin at Pit 3 (see following).
- A new sediment basin is required in the south-east corner of the Pit 3 footprint, to treat water from Pit 3 once Pit 1 is backfilled. Water collected in the basin is to be treated prior to discharge to the small drainage channel flowing to South Creek.
- Surface water from the development of adjacent properties and CSR land in accordance with the LUIIP will need to be managed via detention and stormwater treatment, which will form part of future development applications.
- Appropriate erosion and sediment control measures are to be implemented for the revised VENM haul road alignment.

As for the Mod 4 initial dewatering discharges to Badgerys Creek (*if required*), it is recommended that sediment properties in Badgerys Creek be investigated to check the potential impact of a continuous discharge on geomorphology. It is also recommended that water quality and biological monitoring programs be continued/ established for Badgerys Creek to assess any impact of the discharges on ecology.

Ongoing dewatering activities (*after Year 3*) will be limited to stormwater collected in Pit 3 during the latter part of Phase 1 and during phases 2 and 3. This dewatering is considered separate to stormwater collected at proposed sediment/treatment basins. These ongoing discharges from Pit 3 will be to South Creek via the proposed treatment basin at Pit 3.

The Mod 4 Dewatering Strategy report identified that the discharge of initial pit water from Pit 3 to South Creek could lead to an impact on some water quality parameters in South Creek, including pH, total alkalinity as $CaCO_3$, arsenic and copper. Initial dewatering of Pit 3 will be to Pit 1 and not to South Creek.

It is expected that appropriate measures can be implemented to improve or treat the ongoing stormwater dewatered from Pit 3, thus minimising the impact of ongoing discharges to South Creek. The standard of treatment required will be based on further assessment of water quality in South Creek to determine appropriate constituent levels.

The rate of discharge to South Creek is expected to be minor and therefore the impact on geomorphology would be limited. However, it is recommended that the water quality monitoring program be continued for South Creek to assess any impact of the ongoing discharges to water quality.

If it is found that the Pit 3 water cannot meet the water quality standards for South Creek but can meet those for Badgerys Creek, then an alternative option would involve the laying of an underground pipeline within an easement through the developable land to the perched basin in Pit 1 for treatment and discharge of Pit 3 water to Badgerys Creek. In this case the perched basin in Pit 1 would need to be retained until the end of Phase 3, when Pit 3 VENM backfilling is complete.

3.2 Phase 2 (Years 7 to 10)

Proposed works:

- Continued operation of the expanded brick making facility as per Mod 3 .
- Continued use of the raw materials stockpile area for the brick making facility.
- Continued extraction from Pit 3 and importation of VENM to backfill parts of Pit 3.
- VENM haul road to be shortened, only leading to Pit 3.
- Former Pit 1 and Pit 2 areas, and areas south of the landscaped earth bund are now available for development.

Proposed surface water management for Phase 2 (refer **Figure 2**):

- Surface water from any new adjacent developments will need to be managed via detention and stormwater treatment, which will form part of future development applications.
- Stormwater from SB5 and SB6 is to be treated and discharged to SB1 and SB3, respectively, or to flow paths created through new adjacent developments once SB1, SB2 and SB3 have been removed. This may require flocculation of SB5 and SB6 or the use of a pump with filter.
- Stormwater from the basins inside the landscaped bund is to be treated and discharged to flow paths created through new adjacent developments. An alternative option would be to direct runoff to the new sediment basin at Pit 3.
- Stormwater from Pit 3 is to be treated in the Pit 3 sediment basin prior to discharge
- Appropriate erosion and sediment control measures are to be implemented for the revised VENM haul road alignment.

3.3 Phase 3 (Years 11 to 13)

Proposed works:

- Continued operation of expanded brick making facility as per Mod 3 .
- Continued use of the raw materials stockpile area for the brick making facility.
- Filling of Pit 3 with VENM.
- VENM haul road leading to Pit 3.

The proposed surface water management for Phase 3 would be the same as Phase 2 (refer **Figure 3**).

3.4 Phase 4 (Year 14 Onwards)

Proposed works:

- Continued operation of expanded brick making facility as per Mod 3.
- Continued use of the raw materials stockpile area for the brick making facility.
- Pit 3 becomes available fore development in accordance with the LUIIP.
- VENM haul road no longer required.

The proposed surface water management for Phase 4 would be the same as for Phase 3, but with Pit 3 measures removed (refer **Figure 4**).

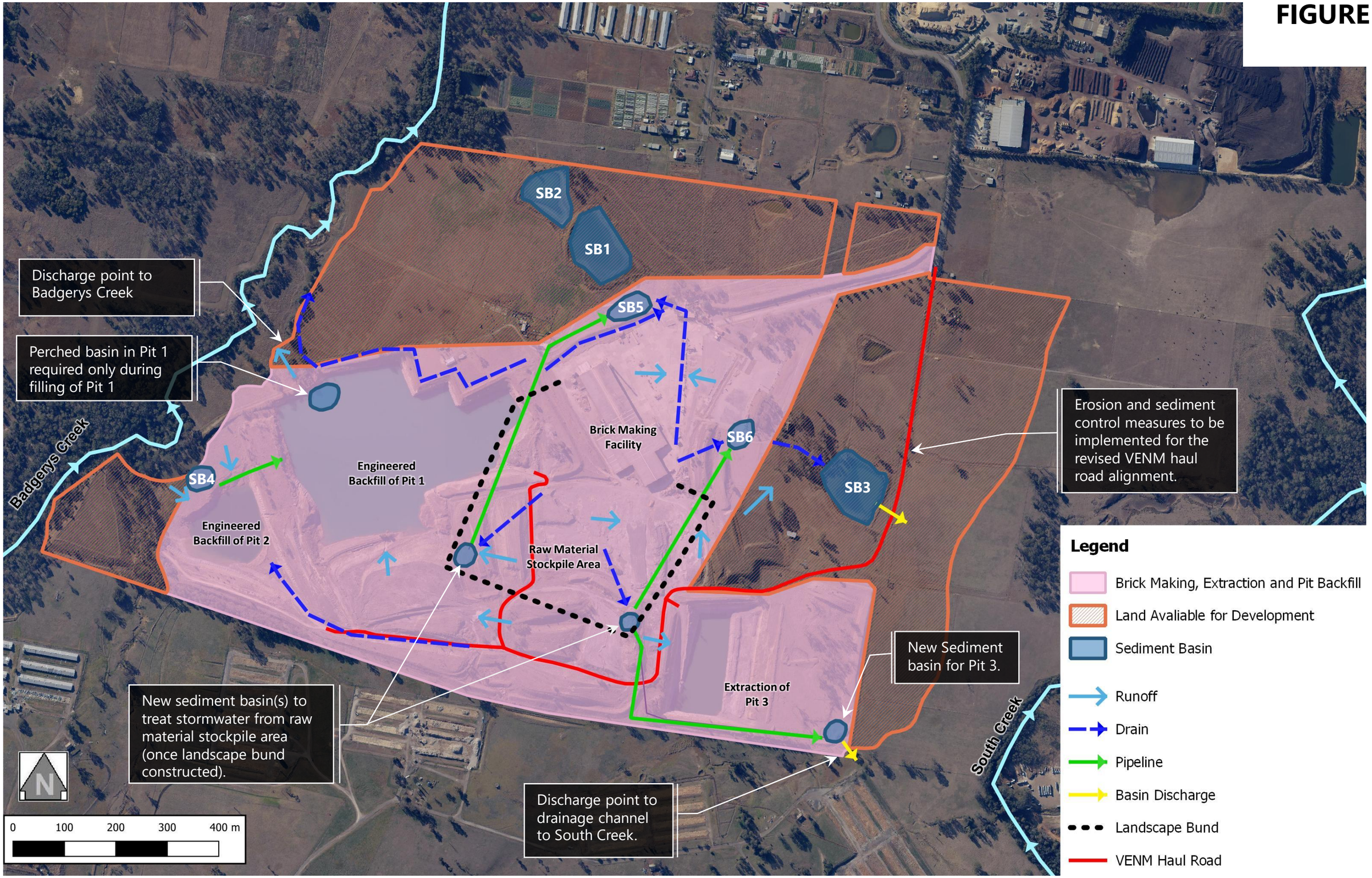
I trust that the above suitably addresses the conceptual assessment of surface water management measures for the Preferred Project, including comparison to Modifications 3 and 4. Should you have any queries, please do not hesitate to contact me on (02) 8456 7232.

Yours faithfully
ADVISIAN



Warick Honour
Principal Engineer, Water Resources

FIGURE 1

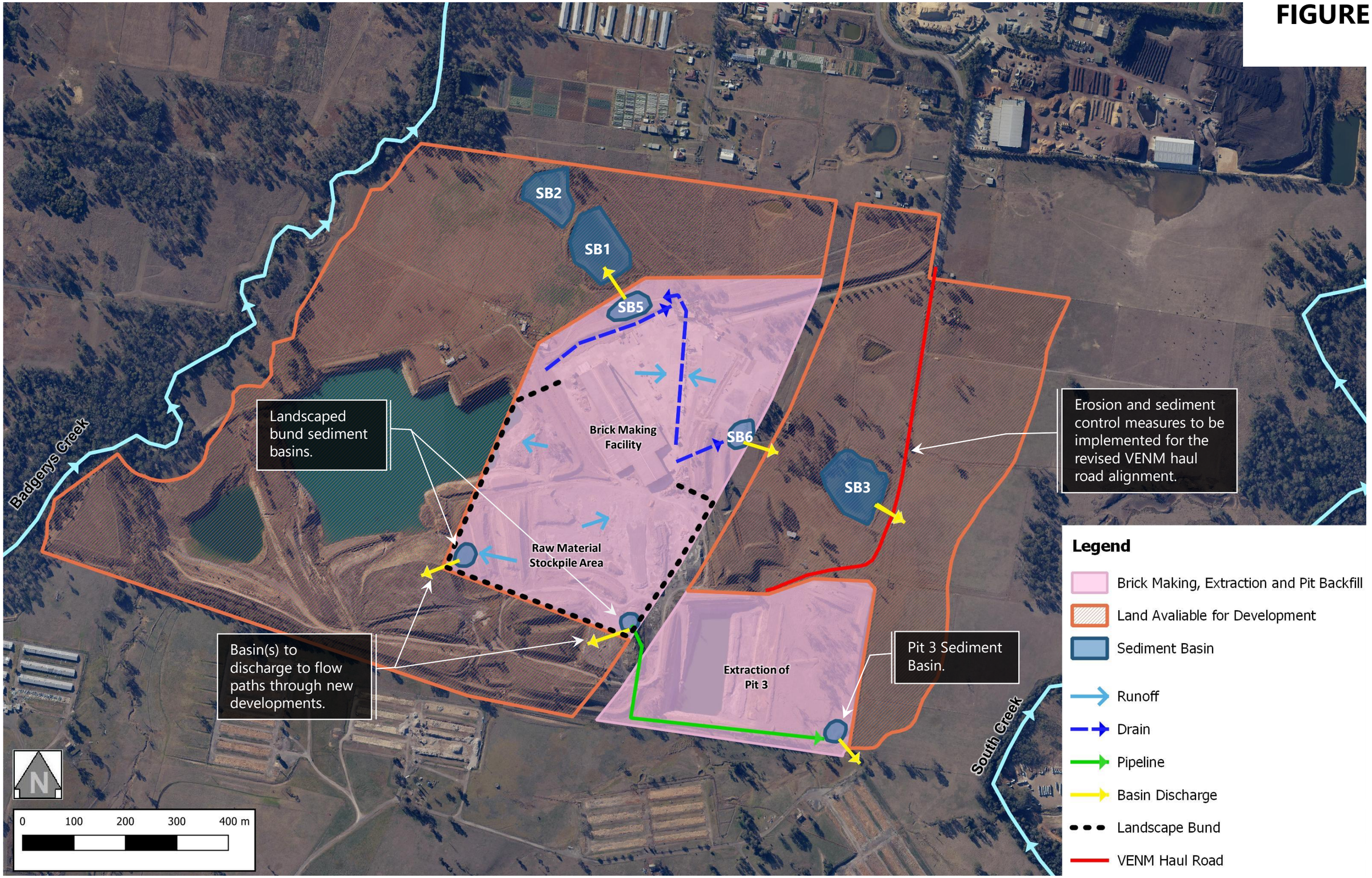


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PREFERRED PROJECT WATER MANAGEMEMT PHASE 1 (YEARS 1 TO 6)

FIGURE 2

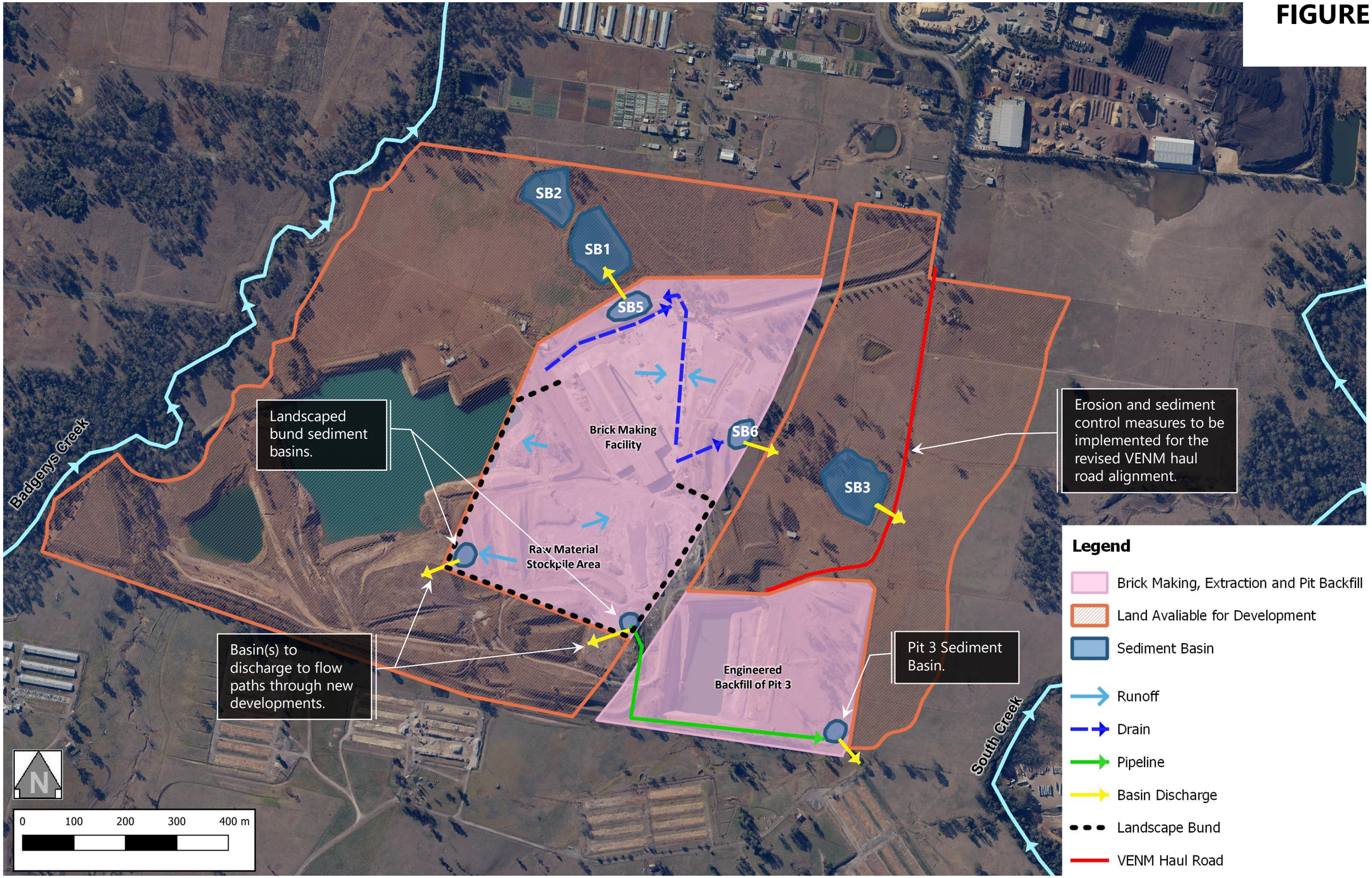


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PREFERRED PROJECT WATER MANAGEMEMT PHASE 2 (YEARS 7 TO 10)

FIGURE 3

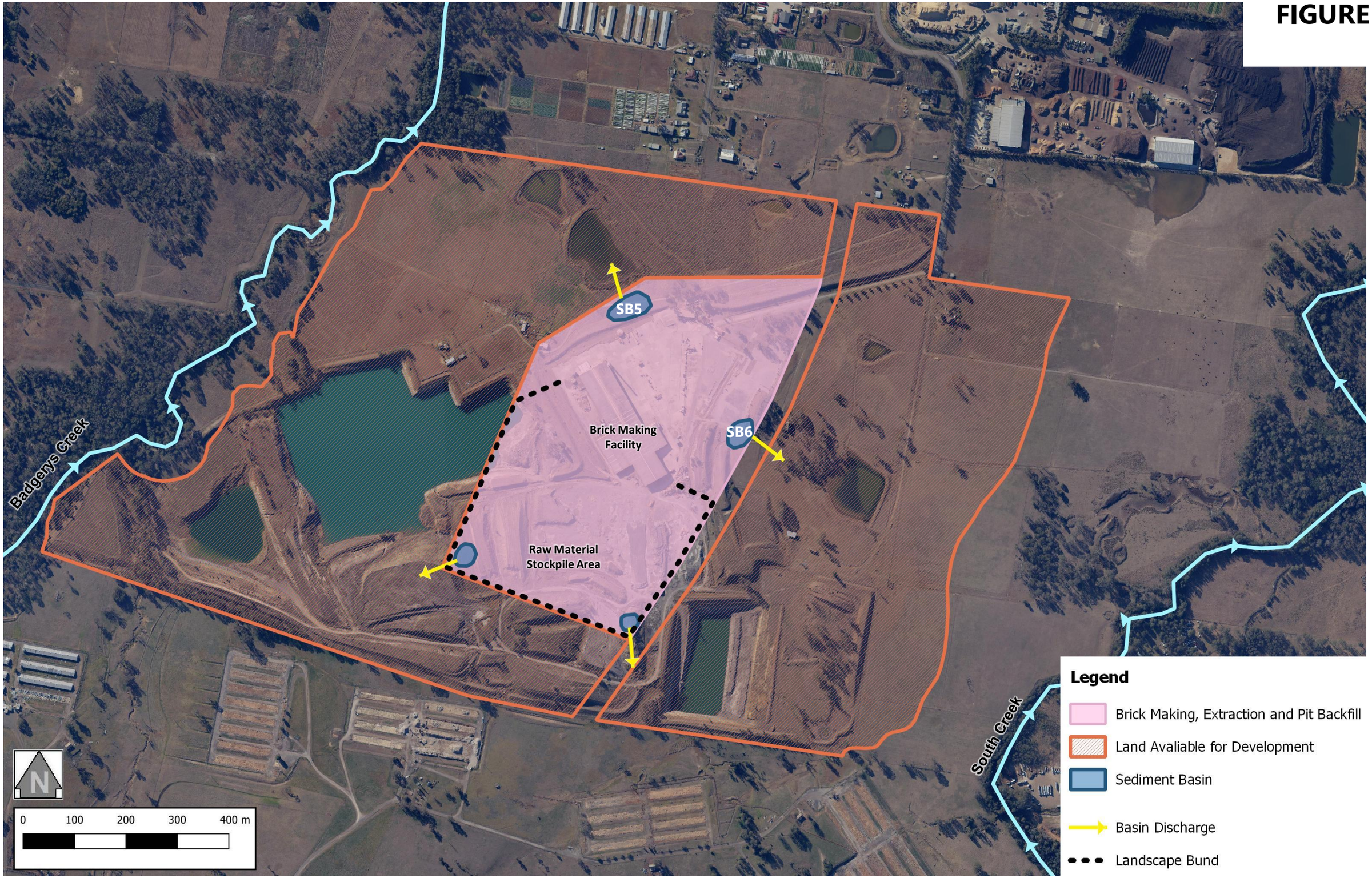


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PREFERRED PROJECT WATER MANAGEMEMT PHASE 3 (YEARS 11 TO 13)

FIGURE 4



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PREFERRED PROJECT WATER MANAGEMEMT PHASE 4 (YEAR 14 ONWARDS)



APPENDIX E

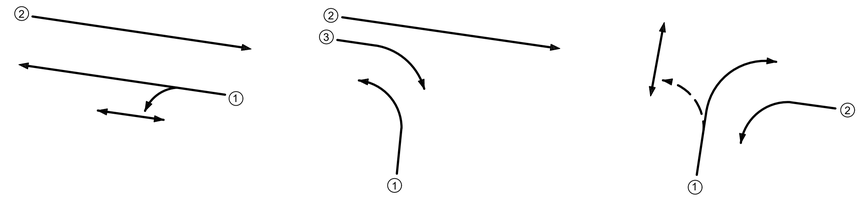
TRAFFIC CONTOL SIGNALS PLAN

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DATE IN SERVICE : 00/00/0000

Transport Roads & Maritime Services

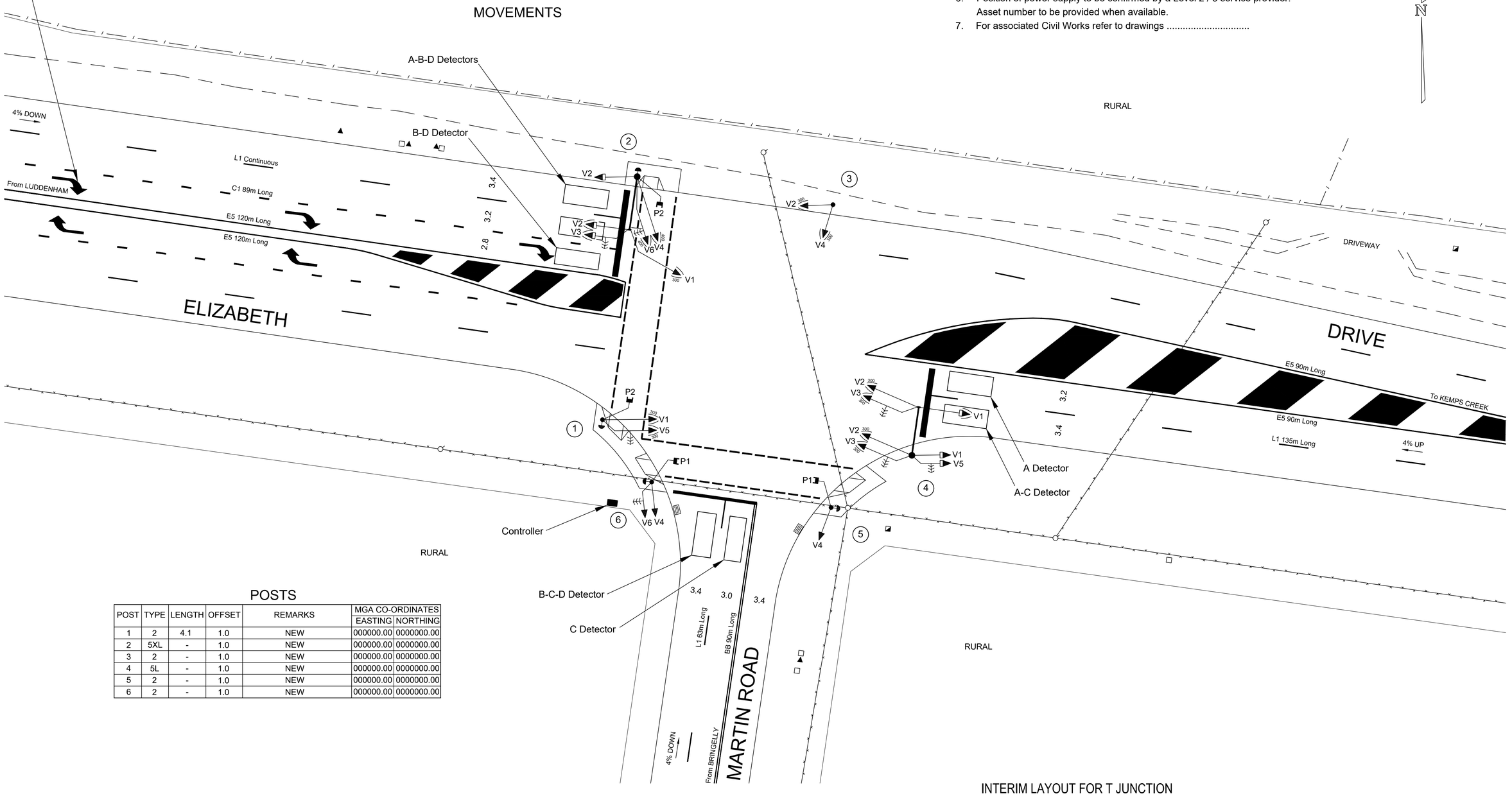
TCS 0000



MOVEMENTS

NOTES

1. This site is SCATS linked.
2. Special STOP Sign (R1-4) placed on Post 6.
3. Audio-tactile push buttons are provided on Posts 1, 2, 5 and 6.
4. Kerb ramps in accordance with standard RMS model drawing No MD.R173.B01.A.1.
5. Existing service locations to be confirmed on-site prior to the commencement of any construction works.
6. Position of power supply to be confirmed by a Level 2 / 3 service provider. Asset number to be provided when available.
7. For associated Civil Works refer to drawings .....



POSTS

POST	TYPE	LENGTH	OFFSET	REMARKS	MGA CO-ORDINATES	
					EASTING	NORTHING
1	2	4.1	1.0	NEW	000000.00	0000000.00
2	5XL	-	1.0	NEW	000000.00	0000000.00
3	2	-	1.0	NEW	000000.00	0000000.00
4	5L	-	1.0	NEW	000000.00	0000000.00
5	2	-	1.0	NEW	000000.00	0000000.00
6	2	-	1.0	NEW	000000.00	0000000.00

INTERIM LAYOUT FOR T JUNCTION

A ORIGINAL ISSUE

PRELIMINARY PLAN

PREPARED IN ACCORDANCE WITH SECTION 3.5 OF THE TRAFFIC SIGNAL DESIGN MANUAL

SIGNAL GROUP PHASE CHART, DETECTOR DIMENSIONS / NUMBERING TO BE SHOWN ON DETAILED TCS DESIGN

PUBLIC UTILITY LEGEND	
HYDRANT	
STOP VALVE	▲
GAS VALVE	#
SEWER MANHOLE	
COMMS PIT	◪
ELECT LIGHT POLE	
POWER POLE	
STAY POLE	⊘
TELEPHONE BOX	T
COMMS PILLAR	◕

REFERENCE PLANS	
SYMBOLS/ABRVS	VD003-6
STD POSN CMPT	VD001-5
INSTL STOP DET	VC005-17
VEH GROUP OP	TS-TN-019
DET LOGIC OP	TS-TN-020
PED MVT OP	TS-TN-021

SURVEYOR : .....
DATE : .....

U.B.D. Ref. Map 000 00
I.S.G. E : 000 000
CO-ORDS N : 0 000 000

DESIGNED : LISA TULAU
CHECKED : TERRY LAWRENCE
LISA TULAU
SITE CHECKED
TERRY LAWRENCE
RECOMMENDED

DESIGN APPROVAL
APPROVED
TERRY LAWRENCE
POSITION DIRECTOR
DATE 7.8.19
DESIGN PREPARED BY
TRANSPORT AND URBAN PLANNING PL

RMS RECOMMENDATION
ROAD DESIGN ENGINEERING
NAME
POSITION
DATE
NETWORK OPERATIONS
NAME
POSITION
DATE

RMS ACCEPTANCE
ACCEPTED
NAME
POSITION
DATE
ACCEPTED BY
SECTION

ROADS AND MARITIME SERVICES

LIVERPOOL COUNCIL AREA
TRAFFIC SIGNALS AT
ELIZABETH DRIVE AND MARTIN ROAD,
BADGERYS CREEK

DESIGN LAYOUT

EXISTING ☐ PROPOSED ☒

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ISSUE: A

FILE: SF0000/000000

SUPERSEDES SHEET/ISSUE: -/-

REG No. DS0000/000000

TCS No. 0000

SHEET: -

Revision 6 - July 2017

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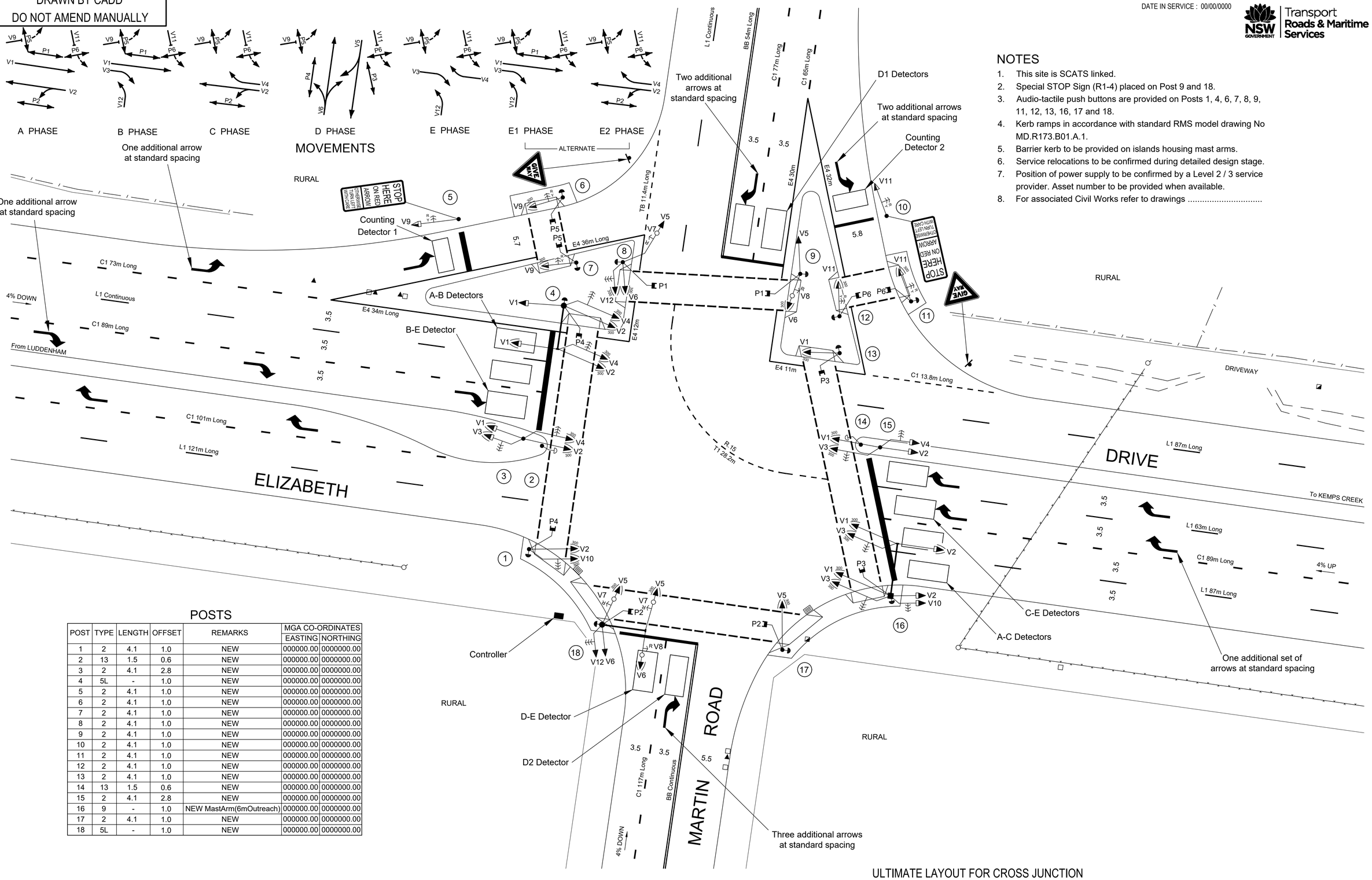
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DATE IN SERVICE : 00/00/0000

Transport Roads & Maritime Services

MOVEMENTS



NOTES

1. This site is SCATS linked.
2. Special STOP Sign (R1-4) placed on Post 9 and 18.
3. Audio-tactile push buttons are provided on Posts 1, 4, 6, 7, 8, 9, 11, 12, 13, 16, 17 and 18.
4. Kerb ramps in accordance with standard RMS model drawing No MD.R173.B01.A.1.
5. Barrier kerb to be provided on islands housing mast arms.
6. Service relocations to be confirmed during detailed design stage.
7. Position of power supply to be confirmed by a Level 2 / 3 service provider. Asset number to be provided when available.
8. For associated Civil Works refer to drawings .....

POSTS

POST	TYPE	LENGTH	OFFSET	REMARKS	MGA CO-ORDINATES	
					EASTING	NORTHING
1	2	4.1	1.0	NEW	000000.00	0000000.00
2	13	1.5	0.6	NEW	000000.00	0000000.00
3	2	4.1	2.8	NEW	000000.00	0000000.00
4	5L	-	1.0	NEW	000000.00	0000000.00
5	2	4.1	1.0	NEW	000000.00	0000000.00
6	2	4.1	1.0	NEW	000000.00	0000000.00
7	2	4.1	1.0	NEW	000000.00	0000000.00
8	2	4.1	1.0	NEW	000000.00	0000000.00
9	2	4.1	1.0	NEW	000000.00	0000000.00
10	2	4.1	1.0	NEW	000000.00	0000000.00
11	2	4.1	1.0	NEW	000000.00	0000000.00
12	2	4.1	1.0	NEW	000000.00	0000000.00
13	2	4.1	1.0	NEW	000000.00	0000000.00
14	13	1.5	0.6	NEW	000000.00	0000000.00
15	2	4.1	2.8	NEW	000000.00	0000000.00
16	9	-	1.0	NEW MastArm(6mOutreach)	000000.00	0000000.00
17	2	4.1	1.0	NEW	000000.00	0000000.00
18	5L	-	1.0	NEW	000000.00	0000000.00

ULTIMATE LAYOUT FOR CROSS JUNCTION

A ORIGINAL ISSUE

PRELIMINARY PLAN

PREPARED IN ACCORDANCE WITH SECTION 3.5 OF THE TRAFFIC SIGNAL DESIGN MANUAL

SIGNAL GROUP PHASE CHART, DETECTOR DIMENSIONS / NUMBERING TO BE SHOWN ON DETAILED TCS DESIGN

PUBLIC UTILITY LEGEND	
HYDRANT	
STOP VALVE	▲
GAS VALVE	#
SEWER MANHOLE	
COMMS PIT	◪
ELECT LIGHT POLE	
POWER POLE	
STAY POLE	⊘
TELEPHONE BOX	T
COMMS PILLAR	◪

REFERENCE PLANS	
SYMBOLS/ABRVS	VD003-6
STD POSN CMPT	VD001-5
INSTL STOP DET	VC005-17
VEH GROUP OP	TS-TN-019
DET LOGIC OP	TS-TN-020
PED MVT OP	TS-TN-021

SURVEYOR : .....
DATE : .....

U.B.D. Ref. Map 000 00
I.S.G. E : 000 000
CO-ORDS N : 0 000 000

DESIGNED : LISA TULAU
CHECKED : TERRY LAWRENCE
LISA TULAU
SITE CHECKED
TERRY LAWRENCE
RECOMMENDED

DESIGN APPROVAL
APPROVED
TERRY LAWRENCE
POSITION DIRECTOR
DATE 7.8.19
DESIGN PREPARED BY
TRANSPORT AND URBAN PLANNING PL

RMS RECOMMENDATION
ROAD DESIGN ENGINEERING
NAME .....
POSITION .....
DATE .....
NETWORK OPERATIONS
NAME .....
POSITION .....
DATE .....

RMS ACCEPTANCE
ACCEPTED
NAME .....
POSITION .....
DATE .....
ACCEPTED BY
.....
SECTION

ROADS AND MARITIME SERVICES

LIVERPOOL COUNCIL AREA
TRAFFIC SIGNALS AT
ELIZABETH DRIVE AND MARTIN ROAD,
BADGERYS CREEK

DESIGN LAYOUT

EXISTING ☐ PROPOSED ☒

CADD FILE: VV0000_-A.dgn

SCALE 5 0 (1:200) 5 10

ISSUE A

FILE SF0000/000000

SUPERSEDES SHEET/ISSUE -/-

REG No. DS0000/000000

TCS No. 0000

SHEET -

$DATE$ $TIME$ $FILE$

Revision 6 - July 2017

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APPENDIX F

CONDITIONS OF APPROVAL

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 2: Administrative conditions		
Obligation to minimise harm to the environment		
1	In addition to meeting the specific performance measures and criteria established under this approval, the Proponent must implement all reasonable and feasible measures to prevent, and if prevention is not reasonable and feasible, minimise, any material harm to the environment that may result from the construction and operation of the project, and any rehabilitation required under this approval.	No change proposed as part of Modification 3
Terms of approval		
2	The Proponent, in acting on this approval, must carry out the project:	No change proposed as part of Modification 3
	a) in compliance with the conditions of this approval;	No change proposed as part of Modification 3
	b) in accordance with all written directions of the Secretary; and	No change proposed as part of Modification 3
	c) in accordance with the project layout.	No change proposed as part of Modification 3
3	The Proponent, in acting on this approval, must carry out the project:	No change proposed as part of Modification 3
	a) generally in accordance with the EA;	a) No change proposed as part of Modification 3
	b) generally in accordance with EA (Mod 1);	b) No change proposed as part of Modification 3
	c) generally in accordance with EA (Mod 2); and	c) No change proposed as part of Modification 3
		d) generally in accordance with EA (Mod 3); and
		e) generally in accordance with RTS (Mod 3)
	d) in accordance with the Statement of Commitments	f) in accordance with the Statement of Commitments (Mod 3)
4	The conditions of this approval and directions of the Secretary prevail to the extent of any inconsistency, ambiguity or conflict between them and a document referenced in condition 3 of this Schedule. In the event of an inconsistency, ambiguity or conflict between any of the documents referenced in condition 3 of this Schedule, the most recent document prevails.	No change proposed as part of Modification 3
	Note: For the purposes of this condition, there will be an inconsistency between documents if it is not possible to comply with both documents, or in the case of a condition of approval or direction of the Secretary, and a document, if it is not possible to comply with both the condition or direction, and the document.	No change proposed as part of Modification 3
5	Consistent with the requirements of this approval, the Secretary may make written directions to the Proponent in relation to:	No change proposed as part of Modification 3
	a) the content of any strategy, study, system, plan, program, review, audit, notification, report or correspondence submitted under or otherwise made in relation to this approval, including those that are required to be, and have been, approved by the Secretary; and	No change proposed as part of Modification 3
	b) the implementation of any actions or measures contained in any such document referred to in (a) above.	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 2: Administrative conditions		
	Note: For the purposes of this condition, there will be an inconsistency between documents if it is not possible to comply with both documents, or in the case of a condition of consent or direction of the Secretary, and a document, if it is not possible to comply with both the condition or direction, and the document	No change proposed as part of Modification 3
Compliance		
6	The Proponent must ensure that all of its employees, contractors (and their sub-contractors) are made aware of, and are instructed to comply with, the conditions of this approval relevant to activities they carry out in respect of the project.	No change proposed as part of Modification 3
Applicability of guidelines		
7	References in the conditions of this approval to any guideline, protocol, Australian Standard or policy are to such guidelines, protocols, standards or policies in the form they are in as at the date of this approval. However, consistent with the conditions of this approval and without altering any limits or criteria in this approval, the Secretary may, when issuing directions under this approval in respect of ongoing monitoring and management obligations, require compliance with an updated or revised version of such a guideline, protocol, standard or policy, or a replacement of them.	No change proposed as part of Modification 3
Limits of approval		
8	The Proponent may carry out quarrying operations and brick making on the site until 27 September 2031.	The proponent may carry out quarry operations on the site for a period of 10 years from the commencement of Modification 3. **Justification:** Refer to Section 5.2.4 of the RTS.
	Note: Under this approval, the Proponent is required to decommission and rehabilitate the site and carry out additional requirements. Consequently, this approval will continue to apply in all respects other than to permit the carrying out of quarrying operations, until the rehabilitation of the site and those requirements and undertakings have been carried out to the required standard.	No change proposed as part of Modification 3.
9	The Proponent may receive, store and dispatch finished building products at the site until 4 May 2021.	The Proponent may receive, store and dispatch finished building products at the site. **Justification:**

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 2: Administrative conditions		
		CSR seeks no limit to how long they can operate the brick making facility at the site and therefore seeks no limit to receive, store and dispatch finished building products.
10	The Proponent must not:	
	a) extract more than 420,000 tonnes of clay shale from the site in any calendar year;	No change proposed as part of Modification 3.
	b) produce more than 252,000 tonnes of bricks at the site in any calendar year;	b) produce more than 300,000 tonnes of bricks at the site in any calendar year; **Justification:** Increased brick production is required at the site to accommodate other PGH Bricks and Pavers brick production capacity as some of their operations may need to close in the short to medium term due to significant urban development pressures.
	c) dispatch more than 275,000 tonnes of raw materials from the site in any calendar year; or	No change proposed as part of Modification 3.
	d) receive more than 20,000 tonnes of raw materials at the site in any calendar year.	d) receive more than 215,000 tonnes of raw materials for brick production at the site in any calendar year until extraction of Pit 3 is complete. Thereafter receive more than 360,000 tonnes of raw materials for brick production at the site in any calendar year. **Justification:** Additional raw material needs to be imported to allow for increased brick production and the change in market demand from 'common's (red bricks) to face bricks that require other raw materials to make that aren't found on the site. Raw material importation needs to increase after clay extraction in Pit 3 ceases as no more clay will be extracted in site and all raw materials for brick production needs to be imported. It takes 360,000 tonnes of raw material to make 300,000 tonnes of bricks.
11	The Proponent must not transport bricks or quarry products to or from the site, other than by road.	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 2: Administrative conditions		
12	Truck movements at the site (i.e. either arrival or dispatch), must not exceed:	No change proposed as part of Modification 3
	a) 120 per day, Monday to Friday between 6.00 am and 10.00 pm; and	a) 400 per day, Monday to Friday between 5.00 am and 10.00 pm; **Justification:** Refer to Section 2.2.2 of the RTS
	b) 40 per day on Saturday between 6.00 am and 10.00 pm. Note: Operating hours for arrival and dispatch of trucks are also controlled under condition 1 of Schedule 3.	b) 98 per day on Saturday between 6.00 am and 6.00 pm Note: Operating hours for arrival and dispatch of trucks are also controlled under condition 1 of Schedule 3. **Justification:** Please refer to Section 2.2.2 of the RTS
Structural adequacy		
13	All new buildings and structures, and any alterations or additions to existing buildings and structures, that are part of the project, must be constructed in accordance with the BCA. Notes:	No change proposed as part of Modification 3
	▪ Under Part 6 of the EP&A Act, the Proponent is required to obtain construction and occupation certificates for any proposed building works;	No change proposed as part of Modification 3
	▪ Part 8 of the EP&A Regulation sets out the requirements for the certification of the project	No change proposed as part of Modification 3
Demolition		
14	All demolition work must be carried out in accordance with the Australian Standard AS 2601-2001: The Demolition of Structures (Standards Australia, 2001).	No change proposed as part of Modification 3
Protection of public infrastructure		
15	Unless the Proponent and the applicable authority agree otherwise the Proponent must:	No change proposed as part of Modification 3
	a) repair, or pay the full costs associated with repairing, any public infrastructure that is damaged by the project; and	No change proposed as part of Modification 3
	b) relocate, or pay the full costs associated with relocating, any public infrastructure that needs to be relocated as a result of the project.	No change proposed as part of Modification 3
	Note: This condition does not apply to damage to roads caused as a result of general road usage or otherwise addressed by contributions required by condition 25 of Schedule 3.	No change proposed as part of Modification 3
Operation of plant and equipment		

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 2: Administrative conditions		
16	All plant and equipment used on the site, or to monitor the performance of the project, must be:	No change proposed as part of Modification 3
	a) maintained in a proper and efficient condition; and	No change proposed as part of Modification 3
	b) operated in a proper and efficient manner.	No change proposed as part of Modification 3
Production data		
17	The Proponent must:	No change proposed as part of Modification 3
	a) provide calendar year annual quarry production data to DRG using the standard form for that purpose; and	No change proposed as part of Modification 3
	b) include a copy of this data in the Annual Review.	No change proposed as part of Modification 3
Limits of extraction		
Identification of approved extraction limits		
18	Within 12 months of the determination of Modification 2, the Proponent must:	Within 12 months of the determination of Modification 3, the Proponent must:
	a) engage a registered surveyor to mark out the boundaries of the approved areas of extraction within the site; and	No change proposed as part of Modification 3
	b) provide the Secretary with a survey plan of such boundaries. The boundaries of the approved areas of extraction within the site must be clearly marked in a manner that allows them to be easily identified at all times during the carrying out of quarrying operations.	No change proposed as part of Modification 3
Maximum depth extraction		
19	The Proponent must not extract any extractive materials or carry out any work in the extraction area below 35 m below the pre-existing natural surface of the ground, other than construction of bores approved by DoI Water or in-pit sumps approved by the Secretary.	Update DOI Water to DPIE Water

No.	Modification 2 Condition of Approval		Proposed Modification 3 Condition of Approval	
Schedule 3: Specific environmental conditions				
Noise				
Hours of operation				
1	The Proponent must comply with the operating hours set out in Table 1.		The Proponent must comply with the operating hours set out in Table 1	
	Quarrying operations (excluding removal of overburden, truck arrival, loading and dispatch)	7.00 am to 6.00 pm Monday to Saturday	Quarrying operations (excluding removal of overburden, truck arrival, loading and dispatch)	No change proposed as part of Modification 3
		At no time on Sundays or public holidays		No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval		Proposed Modification 3 Condition of Approval	
Schedule 3: Specific environmental conditions				
	Removal of overburden (Mod 2 operations only)	7.00 am to 6.00 pm Monday to Saturday	Remove – not related to Mod 3	Delete – not related to Mod 3
		At no time on Sundays or public holidays		Delete – not related to Mod 3
	Removal of overburden (following the conclusion of Mod 2 operations) and acoustic bund construction	7.00 am to 6.00 pm Monday to Friday	Removal of overburden **Justification:** Acoustic bund no longer required.	No change proposed as part of Modification 3
		8.00 am to 1.00 pm Saturday		No change proposed as part of Modification 3
		At no time on Sundays or public holidays		No change proposed as part of Modification 3
	Brick making and storage yard activities	24 hours per day, 7 days per week	Brick making and storage yard activities	No change proposed as part of Modification 3
	Truck arrival and dispatch (excluding finished building products)	6.00 am to 10.00 pm Monday to Friday	Truck arrival and dispatch (excluding finished building products)	No change proposed as part of Modification 3
		6.00 am to 6.00 pm Saturday		No change proposed as part of Modification 3
		At no time on Sundays or public holidays		No change proposed as part of Modification 3
	Truck arrival and dispatch (finished building products only)	7.00 am to 10.00 pm Monday to Saturday	Truck arrival and dispatch (finished building products only)	5.00 am – 10.00 pm Monday to Friday **Justification:** Provided in Chapter 13 of the EA
		At no time on Sundays or public holidays		6.00 am to 6.00 pm on Saturdays **Justification:** Provided in Chapter 13 of the EA
				At no time on Sundays or public holidays.
	Maintenance	At any time, provided that these activities are not audible at any privately-owned residence outside of	Maintenance	No change proposed as part of Modification 3.

No.	Modification 2 Condition of Approval		Proposed Modification 3 Condition of Approval	
Schedule 3: Specific environmental conditions				
		permissible hours for quarrying operations		
			Sales Selection / Cash Sales	6.00 am to 6.00 pm Monday to Saturday. **Justification:** Additional operating hours for sales selection and cash sales activities for finished brick products
				At no time on Sundays or public holidays.
			Customer display centre	8.00 am to 5.00 pm Monday to Sunday. **Justification** To accommodate the new customer display centre
				At no time on public holidays.
			Construction hours	7.00 am – 6.00 pm Monday to Friday 8.00 am – 1.00 pm on Saturdays No work on Sundays or Public Holidays **Justification:** Standard construction hours have been proposed for Modification 3 construction activities

<table>
<tr><th>No.</th><th>Modification 2 Condition of Approval</th><th>Proposed Modification 3 Condition of Approval</th></tr>
<tr><td colspan="3">Schedule 3: Specific environmental conditions</td></tr>
<tr><td rowspan="5">2</td><td>The following activities may be carried out outside the hours specified in condition 1 of this Schedule:</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td>a) activities that are inaudible at residences on privately-owned land;</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td>b) the delivery or dispatch of materials as requested by the NSW Police Force or other public authorities for safety reasons; or</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td>c) emergency work to avoid the loss of life, property or to prevent material harm to the environment.</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td>In such circumstances, the Proponent must notify the Department and affected residents prior to undertaking the activities, or as soon as is practical thereafter.</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td colspan="3">Construction noise</td></tr>
<tr><td rowspan="4">3</td><td>The Proponent must ensure that noise generated during the construction of acoustic bunds does not exceed the criteria in Table 2.</td><td>Removed

Justification:
No bunds are proposed to be constructed under Modification 3</td></tr>
<tr><td>
<table>
<tr><th>Construction activity</th><th>Location</th><th>Day
$L_{Aeq\ (15min)}$</th></tr>
<tr><td>Bund 3c</td><td>Residence 9</td><td rowspan="3">55</td></tr>
<tr><td>Bund 4a</td><td>Residences 27 & 31</td></tr>
<tr><td>Bund 4b</td><td>Residence 28</td></tr>
<tr><td>Bund 4a</td><td>Residences 26, 28 & 42</td><td>60</td></tr>
<tr><td>Bund 4a</td><td>Residences 5 & 25</td><td>65</td></tr>
<tr><td>Bund 4a</td><td>Residence 9</td><td>68</td></tr>
<tr><td>Bunds 3C, 4A and 4B</td><td>All other residences</td><td>50</td></tr>
</table>
</td><td></td></tr>
<tr><td>The Proponent must ensure that the noise generated by bund construction work is managed in accordance with the requirements outlined in the Interim Construction Noise Guideline (DECC, 2009).</td><td>Removed

Justification:
No bunds are proposed to be constructed under Modification 3</td></tr>
<tr><td>Note: To identify the locations referred to in Table 2, see the figure and associated table in Appendix 2</td><td>Removed

Justification:
No bunds are proposed to be constructed under Modification 3</td></tr>
<tr><td>4</td><td>The Proponent must prepare an Acoustic Bund Construction Management Plan to the satisfaction of the Secretary. The plan must:</td><td>Removed

Justification:
No bunds are proposed to be constructed under Modification 3</td></tr>
</table>

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
	a) be approved by the Secretary prior to commencing quarrying operations in Pits 4 or 5 (see Appendix 3), unless otherwise agreed by the Secretary;	Removed **Justification:** No bunds are proposed to be constructed under Modification 3
	b) include a schedule for the construction of the acoustic bunds described in Section 5.4 of the Noise Assessment Report Addendum Report in the EA;	Removed **Justification:** No bunds are proposed to be constructed under Modification 3
	c) include detailed procedures to: ▪ keep surrounding residents informed of the proposed timing and duration of bund construction; ▪ minimise and mitigate the noise impacts generated by the works; and ▪ receive, handle and respond to complaints relating to the works; and	Removed **Justification:** No bunds are proposed to be constructed under Modification 3
	d) include a protocol to notify the Department, in writing: ▪ prior to commencing the construction of each acoustic bund; and ▪ following the completion of each acoustic bund.	Removed **Justification:** No bunds are proposed to be constructed under Modification 3
	The Proponent must implement the Acoustic Bund Construction Management Plan as approved by the Secretary.	Removed **Justification:** No bunds are proposed to be constructed under Modification 3
	Note: The construction schedule for the acoustic bunds may be amended with the written agreement of the Secretary.	Removed **Justification:** No bunds are proposed to be constructed under Modification 3
Operational noise criteria		
5	The Proponent must ensure that operational noise generated by the project (excluding acoustic bund construction) does not exceed the criteria in Table 3 at any residence on privately-owned land.	The Proponent must ensure that operational noise generated by the project does not exceed the trigger levels in tables 2.22 to 2.25 of the RTS, at any residence on privately-owned land. **Justification:** Refer to Section 2.3.3 of the RTS.

<table>
<tr><th>No.</th><th>Modification 2 Condition of Approval</th><th>Proposed Modification 3 Condition of Approval</th></tr>
<tr><td colspan="3">Schedule 3: Specific environmental conditions</td></tr>
<tr><td></td><td>
<table>
<tr><th rowspan="2">Activity</th><th rowspan="2">Location</th><th>Day
Laeq
(15min)</th><th>Evening
Laeq
(15min)</th><th colspan="2">Night</th></tr>
<tr><th>Laeq
(15min</th><th>La1
(1 min)</th></tr>
<tr><td>Quarrying</td><td rowspan="2">All residential premises</td><td>44</td><td>NA</td><td>NA</td><td>NA</td></tr>
<tr><td>Brick making and storage yard</td><td>44</td><td>38</td><td>35</td><td>45</td></tr>
</table>
</td><td></td></tr>
<tr><td></td><td>Noise generated by the project is to be measured in accordance with the relevant requirements and exemptions (including certain meteorological conditions) of the NSW Industrial Noise Policy. Appendix 8 sets out the meteorological conditions under which these criteria apply and the requirements for evaluating compliance with these criteria.</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td></td><td>However, the noise criteria in Table 3 do not apply if the Proponent has an agreement with the relevant landowner to exceed the noise criteria, and the Proponent has advised the Department in writing of the terms of this agreement.</td><td>However, the noise trigger levels do not apply if the Proponent has an agreement with the relevant landowner to exceed the noise management levels, and the Proponent has advised the Department in writing of the terms of this agreement.

Justification:
Changed to reflect noise trigger levels</td></tr>
<tr><td></td><td>Note: Should an agreement with a landowner be terminated for any reason, the Proponent must comply with the noise criteria in Table 3.</td><td>Note: Should an agreement with a landowner be terminated for any reason, the Proponent must comply with the noise trigger levels.</td></tr>
<tr><td colspan="3">Road traffic noise criteria</td></tr>
<tr><td rowspan="3">6</td><td>The Proponent must ensure that the traffic noise generated by the project does not exceed the criteria in Table 4</td><td>The Proponent must ensure that the traffic noise generated by the project does not exceed the criteria in Table 2.29 of the RTS.

Justification:
Refer to Section 2.3.3 of the RTS.</td></tr>
<tr><td>
<table>
<tr><th>Road</th><th>Day / Evening
LAeq (1hr)</th><th>Night
LAeq (1hr)</th></tr>
<tr><td>Martin Road</td><td>55</td><td>50</td></tr>
</table>
</td><td></td></tr>
<tr><td>Note: Traffic noise generated by the project is to be measured in accordance with the relevant procedures in the NSW Road Noise Policy (Department of Environment, Climate Change and Water NSW).</td><td></td></tr>
<tr><td colspan="3">Noise operating conditions</td></tr>
</table>

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
7	The Proponent must:	No change proposed as part of Modification 3
	a) take all reasonable steps to minimise the construction, operational, low frequency and road transportation noise of the project;	No change proposed as part of Modification 3
	b) take all reasonable steps to minimise the noise impacts of the project during meteorological conditions when the noise criteria in this approval do not apply (see Appendix 8);	No change proposed as part of Modification 3
	c) operate a noise management system to guide the day to day planning of quarrying operations and the implementation of noise mitigation measures to ensure compliance with the relevant conditions of this approval;	No change proposed as part of Modification 3
	d) carry out regular noise monitoring in accordance with Appendix 8 to determine whether the project is complying with the relevant conditions of this approval; and	No change proposed as part of Modification 3
	e) modify or stop operations on the site to comply with the relevant conditions of this approval.	No change proposed as part of Modification 3
	Note: Monitoring under this approval is not required at all residences and the use of representative monitoring locations can be used to demonstrate compliance with criteria, if agreed to by the Secretary.	No change proposed as part of Modification 3
Noise management plan		
8	The Proponent must prepare a Noise Management Plan for the project to the satisfaction of the Secretary. This plan must:	No change proposed as part of Modification 3
	a) be prepared in consultation with the EPA;	No change proposed as part of Modification 3
	b) be submitted to the Secretary for approval prior to commencing quarrying operations under Modification 2, unless otherwise agreed by the Secretary;	b) be submitted to the Secretary for approval prior to commencing quarrying operations under Modification 3, unless otherwise agreed by the Secretary; **Justification:** Update to reflect the Modification 3 approval.
	c) describe the measures to be implemented to ensure: ▪ compliance with the noise criteria and operating conditions of this approval; ▪ best practice management is being employed; and ▪ the noise impacts of the project are minimised during meteorological conditions under which the noise criteria in this approval do not apply (see Appendix 8);	No change proposed as part of Modification 3

<table>
<tr><th>No.</th><th>Modification 2 Condition of Approval</th><th>Proposed Modification 3 Condition of Approval</th></tr>
<tr><td colspan="3">Schedule 3: Specific environmental conditions</td></tr>
<tr><td></td><td>d) describe measures to ensure that all the commitments in the EA in relation to noise are implemented;</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td></td><td>e) include a consultation plan detailing:
▪ procedures for notifying and consulting nearby residents prior to the commencement of the construction of the noise bunds and during quarrying and brick making operations;
▪ details of a telephone complaints line (all hours) and relevant site persons responsible for following up complaints;
▪ procedures for handling and monitoring all complaints received; and
▪ contingency measures that would be implemented where complaints are received;</td><td>f) include a consultation plan detailing:
▪ procedures for notifying and consulting nearby residents <s>prior to the commencement of the construction of the noise bunds and</s> during quarrying and brick making operations;
▪ details of a telephone complaints line (all hours) and relevant site persons responsible for following up complaints;
▪ procedures for handling and monitoring all complaints received; and
▪ contingency measures that would be implemented where complaints are received;

Justification:
No bunds are proposed to be constructed under Modification 3</td></tr>
<tr><td></td><td>f) describe the proposed noise management system; and</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td></td><td>g) include a noise monitoring program that:
▪ is capable of evaluating the performance of the project;
▪ includes a protocol for determining any exceedances of the relevant conditions of this approval; and
▪ effectively supports the noise management system.</td><td>The Proponent shall implement a noise monitoring programme which would involve quarterly attended noise monitoring at a number of nearby identified receiver locations for 12 months after all Modification 3 and 4 activities are in full operation. If there are no exceedances of the project noise trigger levels during quarterly noise monitoring during the first year of monitoring then noise monitoring will cease. Additional noise monitoring would be undertaken in response to any noise complaints.

Justification:
The noise impact assessment for the project demonstrates full compliance with all project noise trigger levels during all phases and during all operating hours and it is therefore unlikely to be exceedances at receivers.</td></tr>
<tr><td></td><td>The Proponent must implement the Noise Management Plan as approved by the Secretary.</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td colspan="3">Air quality</td></tr>
<tr><td colspan="3">Air quality impact assessment criteria</td></tr>
<tr><td>9</td><td>The Proponent must ensure that particulate matter emissions generated by the project do not cause exceedances of the criteria in Table 5 at any residence on privately-owned land.
<table>
<tr><th>Pollutant</th><th>Averaging Period</th><th>Criterion</th></tr>
</table></td><td>The Proponent must ensure that particulate matter emissions generated by the project do not cause exceedances of the criteria in Tables 2.7 – 2.10 and 2.11 – 2.14 of the RTS, at any residence on privately-owned land.

Justification:</td></tr>
</table>

<table>
<tr><th>No.</th><th colspan="4">Modification 2 Condition of Approval</th><th>Proposed Modification 3 Condition of Approval</th></tr>
<tr><td colspan="6">Schedule 3: Specific environmental conditions</td></tr>
<tr><td></td><td>Particulate matter < 10 µm (PM_{10})</td><td>Annual</td><td colspan="2">[a,d] 30 µg/m^3</td><td rowspan="6">Refer to Section 10.2 of the EA and Section 2.3.2 of the RTS.</td></tr>
<tr><td></td><td>Particulate matter < 10 µm (PM_{10})</td><td>24 hour</td><td colspan="2">[b] 50 µg/m^3</td></tr>
<tr><td></td><td>Total suspended particulates (TSP)</td><td>Annual</td><td colspan="2">[a,d] 90 µg/m^3</td></tr>
<tr><td></td><td>[c] Deposited dust</td><td>Annual</td><td>[b] 2 g/m^2/month</td><td>[a,d] 4 g/m^2/month</td></tr>
<tr><td></td><td colspan="4">Notes to Table 5:
a) Cumulative impact (i.e. increase in concentrations due to the project plus background concentrations due to all other sources).
b) Incremental impact (i.e. increase in concentrations due to the project alone, with zero allowable exceedances of the criteria over the life of the project.
c) Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulate Matter - Deposited Matter - Gravimetric Method.
d) Excludes extraordinary events such as bushfires, prescribed burning, dust storms, sea fog, fire incidents or any other activity agreed by the Secretary.</td></tr>
<tr><td colspan="6">Operating conditions</td></tr>
<tr><td rowspan="4">10</td><td colspan="4">The Proponent must:</td><td></td></tr>
<tr><td colspan="4">a) implement best practice management to minimise the dust emissions of the project;</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td colspan="4">b) implement all air quality management and mitigation measures that were committed to in the EA;</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td colspan="4">c) implement real-time monitoring of 24-hour average PM_{10} and meteorological conditions;</td><td>implement monitoring of PM_{10} and meteorological conditions;

Justification:
Monitoring of particulate matter will be by the existing HVAS and deposited dust gauges, all of which will be relocated to the boundary of the site as outlined in the RTS. The air quality assessment of the preferred project demonstrates that all air quality criteria is likely to be met at all receivers</td></tr>
</table>

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
		during all phases of the project and therefore real-time monitoring and a reactive dust management program is not required.
	d) regularly assess meteorological and air quality monitoring data and relocate, modify and/or stop operations on site to ensure compliance with the air quality criteria in this approval;	No change proposed as part of Modification 3
	e) minimise the air quality impacts of the project during adverse meteorological conditions and extraordinary events (see note d under Table 5);	No change proposed as part of Modification 3
	f) monitor and report on compliance with the relevant air quality conditions in this approval; and	No change proposed as part of Modification 3
	g) minimise the area of surface disturbance and undertake progressive rehabilitation of the site, to the satisfaction of the Secretary	No change proposed as part of Modification 3
11	The Proponent must ensure compliance with stack emission limits and gaseous pollutant load limits included in any EPL applicable to the site.	No change proposed as part of Modification 3
12	Prior to commencing quarrying operations in Pit 5, the Proponent must undertake an Air Quality Audit to the satisfaction of the Secretary. The audit must:	Remove – as Pit 5 has been removed from the preferred project.
	a) be undertaken in consultation with EPA by suitably qualified and experienced persons whose appointment has been approved by the Secretary;	Remove – as Pit 5 has been removed from the preferred project.
	b) review the effectiveness of existing air quality management and control measures; and	Remove – as Pit 5 has been removed from the preferred project.
	c) describe any additional air quality control measures, including operational controls, required to ensure continuing compliance with air quality criteria during the quarrying activities associated with Pit 5.	Remove – as Pit 5 has been removed from the preferred project.
Air quality management plan		
13	The Proponent must prepare an Air Quality Management Plan for the project to the satisfaction of the Secretary. This plan must:	
	a) be prepared in consultation with the EPA;	No change proposed as part of Modification 3
	b) be submitted to the Secretary for approval prior to commencing quarrying operations under Modification 2, unless otherwise agreed by the Secretary;	b) be submitted to the Secretary for approval prior to commencing quarrying operations under Modification 3, unless otherwise agreed by the Secretary; **Justification:**

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
		The update is proposed to reflect the Modification 3 approval.
	c) describe the proposed air quality management system;	No change proposed as part of Modification 3
	d) describe the measures to be implemented to ensure: ▪ compliance with the air quality criteria and operating conditions of this approval; ▪ best practice management is being employed; and ▪ the air quality impacts of the project are minimised during adverse meteorological conditions and extraordinary events;	No change proposed as part of Modification 3
	e) describe measures to ensure that all the commitments in the EA in relation to air quality are implemented;	describe measures to ensure that all the commitments in the EA and RTS in relation to air quality are implemented;
	f) include a program to ensure surface disturbance associated with quarrying operations is minimised;	No change proposed as part of Modification 3
	g) include an air quality monitoring program that: ▪ uses a combination of real-time monitors, high volume samplers and dust deposition gauges, to evaluate the performance of the project at potential receivers and on-site; ▪ is capable of evaluating the performance of the project and informing day to day operational decisions; ▪ includes a protocol for determining any exceedances of the relevant conditions of this approval; and ▪ effectively supports the air quality management system; and	include an air quality monitoring program that: ▪ uses a combination of high volume samplers and dust deposition gauges, to evaluate the performance of the project at potential receivers and on-site; ▪ is capable of evaluating the performance of the project and informing operational decisions; ▪ includes a protocol for determining any exceedances of the relevant conditions of this approval; and ▪ effectively supports the air quality management system; and **Justification:** Monitoring of particulate matter will be by the existing HVAS and deposited dust gauges, all of which will be relocated to the boundary of the site as outlined in the RTS. The air quality assessment of the preferred project demonstrates that all air quality criteria is likely to be met at all receivers during all phases of the project and therefore real-time monitoring and a reactive dust management program is not required.
	h) include a program to: ▪ notify affected landowners of the potential health-related impacts associated with dust; and ▪ respond effectively to enquiries or complaints. The Proponent must implement the Air Quality Management Plan as approved by the Secretary	No change proposed as part of Modification 3
Meteorological monitoring		

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
14	For the life of the project, the Proponent must ensure that there is a suitable meteorological station operating in the vicinity of the site that complies with the requirements in the Approved Methods for Sampling and Analysis of Air Pollutants in New South Wales guideline. Note: Meteorological monitoring is not required during the shutdown period.	No change proposed as part of Modification 3
Odour		
15	The Proponent must ensure that no offensive odours, as defined by the POEO Act, are emitted from the site.	No change proposed as part of Modification 3
Greenhouse gas emissions		
16	The Proponent must implement all reasonable and feasible measures to minimise the release of greenhouse gas emissions from the site.	No change proposed as part of Modification 3
Soil and water		
	Note: Under the Water Act 1912 and/or the Water Management Act 2000, the Proponent is required to obtain all necessary approvals and/or water licences for the project.	No change proposed as part of Modification 3
Water supply		
17	The Proponent must ensure that it has sufficient water for all stages of the project, and if necessary, adjust the scale of operations under the approval to match its available water supply, to the satisfaction of the Secretary.	No change proposed as part of Modification 3
Water discharges		
18	The Proponent must ensure that all quarry water from the site is contained wholly within the site.	No change proposed as part of Modification 3
19	The Proponent must ensure that all surface water discharges from the site comply with the limits (both volume and quality) set in any EPL applicable to the site.	No change proposed as part of Modification 3
Riparian buffer distance		
20	The Proponent must maintain a minimum setback width of 60 metres (measured from the top of bank) between extraction areas and both Badgerys Creek and Badgerys Creek tributary.	No change proposed as part of Modification 3
	Note: This condition does not prohibit overburden emplacement or rehabilitation works in accordance with the Project Layout Plan.	No change proposed as part of Modification 3
Alluvial aquifers		

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
21	The Proponent must ensure that the project has no impact on alluvial aquifers associated with South Creek, Badgerys Creek or their tributaries.	No change proposed as part of Modification 3
22	The Proponent must prepare and implement an Alluvial Aquifer Assessment for the project to the satisfaction of the Secretary. This plan must:	
	a) be prepared in consultation with DoI Water by suitably qualified and experienced persons whose appointment has been approved by the Secretary;	a) be prepared in consultation with DPIE (Water, lands and primary industries) by suitably qualified and experienced persons whose appointment has been approved by the Secretary; **Justification:** Update to the government agency's title.
	b) be submitted to the Secretary for approval within 12 months of commencing quarrying operations under Modification 2; and	b) be submitted to the Secretary for approval within 12 months of commencing quarrying operations under Modification 3; and
	c) include: ▪ a program to monitor groundwater from boreholes to be constructed in the alluvial sediments adjacent to Badgerys and South Creeks and their tributaries, and in the Bringelly Shale bedrock aquifer; ▪ alluvial mapping to delineate the presence and extent of alluvial sediments and alluvial aquifers between Badgerys Creek and the proposed Pit 5 extraction area (see Appendix 3); ▪ mitigation and management measures to ensure alluvial sediments and alluvial aquifers are not impacted by the project, including: – appropriate buffer setback distances between the alluvial sediments and the Pit 5 extraction area; and – any resulting adjustments to the Pit 5 extraction area.	d) include: ▪ a program to monitor groundwater from boreholes to be constructed in the alluvial sediments adjacent to Badgerys and South Creeks and their tributaries, and in the Bringelly Shale bedrock aquifer; ~~▪ alluvial mapping to delineate the presence and extent of alluvial sediments and alluvial aquifers between Badgerys Creek and the proposed Pit 5 extraction area (see Appendix 3);~~ ~~▪ mitigation and management measures to ensure alluvial sediments and alluvial aquifers are not impacted by the project, including:~~ ~~– appropriate buffer setback distances between the alluvial sediments and the Pit 5 extraction area; and~~ ~~– any resulting adjustments to the Pit 5 extraction area.~~ **Justification:** Pit 5 is no longer proposed to be quarried.
Soil and water management plan		
23	The Proponent must prepare a Soil and Water Management Plan for the project to the satisfaction of the Secretary. This plan must:	
	a) be prepared by a suitably qualified and experienced person/s approved by the Secretary;	No change proposed as part of Modification 3
	b) be prepared in consultation with the EPA and DoI Water;	b) be prepared in consultation with the EPA and DPIE (Water, lands and primary industries);

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
		Justification: Update to a government agency's title.
	c) be submitted to the Secretary for approval prior to commencing quarrying operations under Modification 2, unless otherwise agreed by the Secretary; and	c) be submitted to the Secretary for approval prior to commencing quarrying operations under Modification 3, unless otherwise agreed by the Secretary; and **Justification:** Update to reflect the Modification 3 approval
	d) include a: i. Site Water Balance that includes: ▪ details of: – sources and security of water supply; – water use and management on site; – adequacy of water storage facilities to contain all surface water runoff; – any off-site water transfers; – reporting procedures; and ▪ measures to be implemented to minimise clean water use on site; ii. Surface Water Management Plan, that includes: ▪ a program for obtaining detailed baseline data on surface water flows and quality in water bodies that could potentially be affected by the project; ▪ a detailed description of the surface water management system on site including the: – clean water diversion system; – erosion and sediment controls; – dirty water management system; and – water storages, including the area, depth and capacity of any in-pit sumps; ▪ detailed plans, including design objectives and performance criteria, for: – reinstatement of drainage lines on the rehabilitated areas of the site; and – control of any potential water pollution from rehabilitated areas of the site;	Delete: Site Water Balance that includes: ▪ details of: – sources and security of water supply; – water use and management on site; – adequacy of water storage facilities to contain all surface water runoff; – any off-site water transfers; – reporting procedures; and ▪ measures to be implemented to minimise clean water use on site; And replace with: Site water balance based on Section 6.2.1 of the EA and the results of the surface water assessment

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
	▪ performance criteria for the following, including trigger levels for investigating any potentially adverse impacts on: – the water management system; – surface water quality in creeks and other water bodies that could potentially affected by the project (including Badgerys Creek and Badgerys Creek tributary); and – the stream health, vegetation health and channel stability of water bodies that could potentially affected by the project; ▪ a program to monitor and report on: – any surface water discharges; – the effectiveness of the water management system; – the quality of water discharged from the site to the environment; – surface water flows and quality in local watercourses; and – the stream health, riparian vegetation health and channel stability of creeks and other water bodies that could potentially be affected by the project; and ▪ a plan to respond to any exceedances of the performance criteria, and mitigate and/or offset any adverse surface water impacts of the project; and iii. Groundwater Management Plan that includes: • measures to ensure that the maximum extraction depth is not exceeded (see condition 19 of Schedule 2); ▪ a protocol to obtain appropriate water licence(s) to cover the volume of any unforeseen groundwater inflows into the quarry from the quarry face or floor; ▪ groundwater assessment criteria, including trigger levels for investigating any potentially adverse groundwater impacts; and ▪ a monitoring program to manage potential impacts, if any, on any alluvium and associated surface water source near the proposed extraction area that includes: – monitoring of groundwater inflows into the quarry from the quarry face or floor, or into any in-pit sumps; – monitoring the impacts of the project on baseflows to Badgerys and South Creeks and their tributaries; – identification of a methodology for determining exceedances of the assessment criteria;	

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
	– a plan to respond to any exceedances of the performance criteria; and – a program to regularly report on monitoring.	
	The Proponent must implement the Soil and Water Management Plan as approved by the Secretary	No change proposed as part of Modification 3
Transport		
Road haulage		
24	Prior to commencing Mod 2 operations, the Proponent must:	Prior to commencing Mod 3 operations, the Proponent must:
	a) erect signage on Elizabeth Drive advising of "trucks turning";	No change proposed as part of Modification 3
	b) install a wheel wash on the quarry access road to prevent material being deposited in Martin Road; and	No change proposed as part of Modification 3
	c) ensure the access driveway from Martin Road is capable of catering for all heavy vehicles associated with the project in accordance with AS2890.2, to the satisfaction of Council.	No change proposed as part of Modification 3
Road upgrade and maintenance contribution		
25	25. The Proponent must:	
	a) repair Martin Road to the satisfaction of Council by 30 June 2013 and in accordance with the agreement dated 9 April 2013 attached as Appendix 7; and	Remove condition. **Justification** It is understood that Boral undertook these repair works in 2013.
	a) prior to commencing Mod 2 operations, enter into a formal agreement with Council for the: ▪ upgrade and widening of Martin Road from the site entrance to the entrance of Australian Native Landscapes; ▪ widening of Martin Road in the reverse curves; and ▪ annual road maintenance contributions to be paid to Council, based on the weight of all laden truck movements to and from the site, for the life of the project, to the satisfaction of the Secretary.	b) prior to commencing Mod 3 operations, enter into a formal agreement with Council for the: ▪ upgrade and widening of Martin Road from the site entrance to the entrance of Australian Native Landscapes; ▪ widening of Martin Road in the reverse curves; and ▪ annual road maintenance contributions to be paid to Council, based on the weight of all laden truck movements to and from the site, for the life of the project, to the satisfaction of the Secretary. **Justification** The modification is proposed to reflect the Modification 3 approval
	The Proponent must implement the agreement to the satisfaction of the Secretary. If there is any dispute between the Proponent and Council, then either of the parties may refer the matter to the Secretary for resolution.	No change proposed as part of Modification 3
Monitoring of product transport		

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
26	The Proponent must keep accurate records of:	
	a) all laden truck movements to and from the site (including time of arrival and dispatch);	No change proposed as part of Modification 3
	b) the weight of all bricks and quarry products transported to and from the site; and	No change proposed as part of Modification 3
	c) publish a summary of these records on its website every 6 months.	No change proposed as part of Modification 3
Operating conditions		
27	The Proponent must:	
	a) ensure that all trucks carrying quarry products have their loads covered when arriving at or leaving the site;	No change proposed as part of Modification 3
	b) ensure that all laden trucks are cleaned of material that may fall from vehicles, before leaving the site; and	No change proposed as part of Modification 3
	c) use its best endeavours to ensure that appropriate signage is displayed on trucks used to transport products or raw materials to or from the project so they can be easily identified by road users.	No change proposed as part of Modification 3
Traffic management plan		
28	The Proponent must prepare a Traffic Management Plan for the project to the satisfaction of the Secretary. This plan must:	
	a) be prepared in consultation with RMS and Council;	No change proposed as part of Modification 3
	b) be submitted to the Secretary for approval prior to commencing Mod 2 operations, unless otherwise agreed by the Secretary;	b) be submitted to the Secretary for approval prior to commencing Mod 3 operations, unless otherwise agreed by the Secretary; **Justification** The modification is proposed to reflect the Modification 3 approval.
	c) describe the processes in place to control the arrival and dispatch of trucks;	No change proposed as part of Modification 3
	d) include a Drivers' Code of Conduct that details the safe and quiet driving practices that must be used by drivers travelling to and from the site;	No change proposed as part of Modification 3
	e) describe the measures to be put in place to ensure compliance with the Drivers' Code of Conduct; and	No change proposed as part of Modification 3
	f) propose measures to minimise the transmission of dust and tracking of material onto the surface of the public road from vehicles leaving the quarry.	No change proposed as part of Modification 3
	The Proponent must implement the Traffic Management Plan as approved by the Secretary	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
Aboriginal heritage		
29	The Proponent must ensure that:	
	a) archaeological salvage of site BC-01-09 is undertaken in accordance with Recommendation 1, Section 6.0 of the Aboriginal Heritage Assessment – Addendum in the EA; and	Remove condition – as Recommendation 1 reads: "Survey identified one site to be impacted by the proposed Pit 5 area. BC-01-09 consists of a single mudstone artefact. Recommendation is made to collect the site prior to works commencing". Pit 5 is no longer proposed under Modification 3.
	b) regeneration works in the area of the archaeological deposit identified adjacent to Badgerys Creek (see Appendix 5) are either avoided, or else undertaken in a manner that will minimise harm to Aboriginal objects, to the satisfaction of the Secretary.	No change proposed as part of Modification 3
		c) The heat retainer hearth and other archaeological items retrieved during the survey and test excavation will be reburied with the hearth and secured with a 10 m exclusion zone (fencing or similar). **Justification:** This COA has been proposed to reflect the recommendations of the Aboriginal Cultural heritage specialist (Chapter 9 of the EA)
30	The Applicant must prepare an Aboriginal Heritage Management Plan for the project to the satisfaction of the Secretary. The plan must:	
	a) be prepared by suitably qualified and experienced persons;	No change proposed as part of Modification 3
	b) be prepared in consultation with Registered Aboriginal Parties;	No change proposed as part of Modification 3
	c) be submitted to the Secretary for approval within 6 months of the determination of Modification 2, unless otherwise agreed by the Secretary;	c) be submitted to the Secretary for approval within 6 months of the determination of Modification 3, unless otherwise agreed by the Secretary; **Justification** The modification is proposed to reflect the Modification 3 approval
	d) include a description of the measures that would be implemented to: i. protect, monitor and manage identified Aboriginal objects and Aboriginal places on the site (including any proposed archaeological investigations and salvage measures), including specific measures to ensure that the archaeological deposit adjacent to Badgerys Creek (see Appendix 5) is not impacted during regeneration operations;	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
	ii. manage the discovery of previously unidentified Aboriginal objects or Aboriginal places on the site; and iii. facilitate ongoing consultation and involvement of Registered Aboriginal Parties in the conservation and management of Aboriginal cultural heritage on the site; and	
	e) include a protocol to be implemented in the event that skeletal remains are discovered during the project.	No change proposed as part of Modification 3
	The Proponent must implement the Aboriginal Heritage Management Plan as approved by the Secretary	No change proposed as part of Modification 3
31	If human remains are discovered on the site, then all work in the area surrounding the discovery must cease, and the area must be secured. The Proponent must immediately notify NSW Police Force and OEH, and work must not recommence in the area until authorised by NSW Police Force and OEH.	If human remains are discovered on the site, then all work in the area surrounding the discovery must cease, and the area must be secured. The Proponent must immediately notify NSW Police Force and DPIE (Biodiversity and conservation), and work must not recommence in the area until authorised by NSW Police Force and DPIE (Biodiversity and conservation). **Justification:** Update to a government Agency's title
32	If any potential Aboriginal object or Aboriginal place is identified on the site, or suspected to be on the site:	
	a) all work in the immediate vicinity of the object or place must cease immediately;	No change proposed as part of Modification 3
	b) a 10 m buffer area around the object or place must be cordoned off; and	No change proposed as part of Modification 3
	c) OEH must be contacted immediately	c) DPIE (Biodiversity and conservation) must be contacted immediately **Justification:** Update to a government Agency's title
33	Work in the immediate vicinity may only recommence if:	
	a) the object or place is confirmed by OEH upon consultation with the Registered Aboriginal Parties not to be an Aboriginal object or Aboriginal Place;	a) the object or place is confirmed by DPIE (Biodiversity and conservation) upon consultation with the Registered Aboriginal Parties not to be an Aboriginal object or Aboriginal Place; **Justification:** Update to a government Agency's title

<table>
<tr><th>No.</th><th colspan="2">Modification 2 Condition of Approval</th><th>Proposed Modification 3 Condition of Approval</th></tr>
<tr><td colspan="4">Schedule 3: Specific environmental conditions</td></tr>
<tr><td></td><td colspan="2">b) the Aboriginal Cultural Heritage Management Plan is revised to include the object or place and appropriate measures in respect of it; or</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td></td><td colspan="2">c) the Secretary is satisfied with the measures to be implemented in respect of the object or place and makes a written direction in that regard.</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td colspan="4">Rehabilitation</td></tr>
<tr><td colspan="4">Rehabilitation objectives</td></tr>
<tr><td rowspan="5">34</td><td colspan="2">The Proponent must rehabilitate the site to the satisfaction of the Secretary. This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in the EA and shown in Appendix 4, and must comply with the objectives in Table 6.</td><td></td></tr>
<tr><td>Feature</td><td>Object</td><td></td></tr>
<tr><td>All areas of the site affected by the project</td><td>▪ Safe
▪ Hydraulically and geotechnically stable
▪ Non-polluting
▪ Fit for the intended final land use(s)
▪ Final landform integrated with surrounding natural landforms as far as is reasonable and feasible, and minimising visual impacts when viewed from surrounding land.</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td>Surface infrastructure</td><td>▪ Decommissioned and removed, unless otherwise agreed by the Secretary.</td><td>No change proposed as part of Modification 3</td></tr>
<tr><td>Quarry benches</td><td>▪ Landscaped and vegetated using native tree and understorey species.</td><td>▪ Landscaped and vegetated using native tree and/or understorey species that, as far as possible, do not attract fauna to the Western Sydney Airport.

Justification:
The amendment to the COA is proposed to ensure that, as far as possible, fauna is not attracted to the project site and impact the operations of the Western Sydney Airport</td></tr>
<tr><td>Acoustic bunds</td><td>▪ Hydraulically and geotechnically stable</td><td>Remove condition – not acoustics bunds proposed in Modification 3</td></tr>
</table>

No.	Modification 2 Condition of Approval		Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions			
		▪ Vegetated.	
	Final void	▪ Return Pit 2 to natural ground level and revegetate. ▪ Minimise the size, depth and slope of the batters of the remaining final voids. ▪ Minimise the drainage catchment of the final voids.	No change proposed as part of Modification 3
35	The Proponent must rehabilitate the site progressively, that is, as soon as reasonably practicable following disturbance. All reasonable measures must be taken to minimise the total area exposed for dust generation at any time. Interim stabilisation measures must be implemented where reasonable and feasible to control dust emissions in disturbed areas that are not active and which are not ready for final rehabilitation.		No change proposed as part of Modification 3
	Note: It is accepted that parts of the site that are progressively rehabilitated may be subject to future re-disturbance		No change proposed as part of Modification 3
Rehabilitation management plan			
36	The Proponent must prepare a Rehabilitation Management Plan for the project to the satisfaction of DRG. This plan must:		
	a) be prepared by a suitably qualified and experienced person/s whose appointment has been endorsed by the Secretary;		No change proposed as part of Modification 3
	b) be prepared in consultation with the Department, DoI Water, OEH and Council;		b) be prepared in consultation with the Department, DPIE (water, lands and primary industries), DPIE (Biodiversity and conservation) and Council; **Justification:** Update to a government agencies title
	c) be submitted to DRG within 12 months of the determination of Modification 2;		c) be submitted to DRG within 12 months of the determination of Modification 3; **Justification:** Update to reflect the Modification 3 approval
	d) be prepared in accordance with any relevant DRG Guideline;		No change proposed as part of Modification 3
	e) build upon the Rehabilitation Objectives in Table 6 and the proposed rehabilitation strategy described in the EA and shown in Appendix 4;		No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
	f) investigate options for the future use of disturbed areas (including voids) following the completion of quarrying operations;	No change proposed as part of Modification 3
	g) describe and justify the proposed rehabilitation strategy for the site, including post-operations landform and use;	No change proposed as part of Modification 3
	h) describe and justify the proposed rehabilitation strategy for the site in the event that quarrying and brick making operations do not recommence following the shutdown period;	Remove condition – not relevant to Modification 3
	i) describe how the rehabilitation of the site would achieve the objectives identified in Table 6;	No change proposed as part of Modification 3
	j) include detailed performance and completion criteria for evaluating the performance of the rehabilitation of the site, and for triggering remedial action (if necessary);	No change proposed as part of Modification 3
	k) describe the measures to be implemented to ensure compliance with the relevant conditions of this approval, and address all aspects of rehabilitation including mine closure, final landform (including final voids) and final land use/s;	No change proposed as part of Modification 3
	l) include procedures for the use of interim stabilisation and temporary vegetation strategies, where reasonable to minimise the area exposed for dust generation;	No change proposed as part of Modification 3
	m) include a program to monitor, independently audit and report on the effectiveness of the measures in paragraph (k) above, and progress against the detailed performance and completion criteria in paragraph (j) above;	No change proposed as part of Modification 3
	n) to the maximum extent practicable, build on and integrate with the other management plans required under this consent; and	No change proposed as part of Modification 3
	o) include detailed scheduling for progressive rehabilitation to be initiated, undertaken and/or completed over the next three years (see condition 35 of this Schedule).	No change proposed as part of Modification 3
	The Proponent must implement the Rehabilitation Management Plan as approved by DRG.	No change proposed as part of Modification 3
Visual		
37	The Proponent must implement all reasonable and feasible measures to minimise the visual and off-site lighting impacts of the project to the satisfaction of the Secretary.	No change proposed as part of Modification 3
Waste		
38	The Proponent must:	

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
	a) manage on-site sewage treatment and disposal in accordance with the requirements of its EPL, and to the satisfaction of the EPA and Council;	No change proposed as part of Modification 3
	b) minimise the waste generated by the project;	No change proposed as part of Modification 3
	c) ensure that the waste generated by the project is appropriately stored, handled, and disposed of; and	No change proposed as part of Modification 3
	d) report on waste management and minimisation in the Annual Review, to the satisfaction of the Secretary.	No change proposed as part of Modification 3
39	Except as expressly permitted in an EPL and/or the conditions of this approval, the Proponent must not receive waste on the site for storage, treatment, processing, reprocessing or disposal.	No change proposed as part of Modification 3
Liquid storage		
40	The Proponent must ensure that all tanks and similar storage facilities (other than for water) are protected by appropriate bunding or other containment, in accordance with the relevant Australian Standards.	No change proposed as part of Modification 3
Dangerous goods		
41	The Proponent must ensure that the storage, handling, and transport of dangerous goods is done in accordance with the relevant Australian Standards, particularly AS1940 and AS1596, and the Dangerous Goods Code.	a) The Proponent must ensure that the storage, handling, and transport of dangerous goods is done in accordance with the relevant Australian Standards, particularly AS1940 and AS1596, and the Dangerous Goods Code. **Justification:** Agency requested this condition
		b) The Applicant must ensure that the quantities of dangerous goods on-site and transported to and from the site remains below the screening threshold quantities listed in the Department's *Applying SEPP 33* guideline at all times. **Justification:** Agency requested this condition
		c) The Applicant must store all chemicals, fuels and oils used on-site in accordance with: i. the requirements of all relevant Australian Standards; and ii. the NSW EPA's 'Storing and Handling of Liquids: Environmental Protection – Participants Handbook' if the chemicals are liquids.

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 3: Specific environmental conditions		
		In the event of an inconsistency between the requirements listed from (i) to (ii) above, the most stringent requirement shall prevail to the extent of the inconsistency. **Justification:** Agency requested this condition
Fire safety		
42	The Proponent must:	
	a) ensure that the project is suitably equipped to respond to any fires on site; and	No change proposed as part of Modification 3
	b) assist the emergency services to the extent practicable if there is a fire in the vicinity of the site	No change proposed as part of Modification 3
		c) The provision of water, electricity and gas shall comply with section 4.1.3 of Planning for Bush Fire Protection 2006 **Justification:** Agency requested this condition
Contamination		
43		The proponent must develop an unexpected finds procedure for contamination, through consultation with the EPA **Justification**: This COA has been included to reflect what was recommended in submissions made on the Modification 3 EA

No.	Mod 2 COA	Proposed Mod 3 COA
Schedule 4 – Additional Procedures		
Notification of landowners		
1	As soon as practicable, and no longer than 7 days, after obtaining monitoring results showing:	
	a) an exceedance of any criteria in Schedule 3, the Proponent must notify the affected landowners in writing of the exceedance, and provide regular monitoring results, at least every 3 months, to each affected landowner until the project is again complying with the relevant criteria; and	No change proposed as part of Modification 3

No.	Mod 2 COA	Proposed Mod 3 COA
Schedule 4 – Additional Procedures		
	b) an exceedance of any air quality criteria in Schedule 3, the Proponent must send a copy of the NSW Health fact sheet entitled “Mine Dust and You” (as may be updated from time to time) to the affected landowners and current tenants of the land (including the tenants of land which is not privately-owned).	No change proposed as part of Modification 3
Independent review		
2	If a landowner considers the project to be exceeding the relevant criteria in Schedule 3, they may ask the Secretary in writing for an independent review of the impacts of the project on their land.	No change proposed as part of Modification 3
	If the Secretary is not satisfied that an independent review is warranted, the Secretary will notify the landowner in writing of that decision, and the reasons for that decision, within 21 days of the request for a review.	No change proposed as part of Modification 3
	If the Secretary is satisfied that an independent review is warranted, within 3 months, or as otherwise agreed by the Secretary and the landowner, of the Secretary’s decision, the Proponent must:	No change proposed as part of Modification 3
	a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Secretary, to: ▪ consult with the landowner to determine his/her concerns; ▪ conduct monitoring to determine whether the project is complying with the relevant criteria in Schedule 3; and ▪ if the project is not complying with these criteria, then identify measures that could be implemented to ensure compliance with the relevant criteria;	No change proposed as part of Modification 3
	a) give the Secretary and landowner a copy of the independent review; and	No change proposed as part of Modification 3
	b) comply with any written requests made by the Secretary to implement any findings of the review.	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
Environmental management		
Environmental management strategy		

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
1	The Proponent must prepare an Environmental Management Strategy for the project to the satisfaction of the Secretary. This strategy must:	
	a) be submitted to the Secretary for approval within 6 months of the determination of Modification 2, unless otherwise agreed by the Secretary;	a) be submitted to the Secretary for approval within 6 months of the determination of Modification 3, unless otherwise agreed by the Secretary; **Justification:** Update proposed to reflect the Modification 3 approval
	b) provide the strategic framework for environmental management of the project;	No change proposed as part of Modification 3
	c) identify the statutory approvals that apply to the project;	No change proposed as part of Modification 3
	d) describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the project;	No change proposed as part of Modification 3
	e) describe the procedures to be implemented to: ▪ keep the local community and relevant agencies informed about the operation and environmental performance of the project; ▪ receive, record, handle and respond to complaints; ▪ resolve any disputes that may arise during the course of the project; ▪ respond to any non-compliance; and ▪ respond to emergencies; and	No change proposed as part of Modification 3
	f) include: ▪ references to any strategies, plans and programs approved under the conditions of this approval; and ▪ a clear plan depicting all the monitoring to be carried out under the conditions of this approval.	No change proposed as part of Modification 3
	The Proponent must implement any Environmental Management Strategy as approved by the Secretary.	No change proposed as part of Modification 3
Evidence of consultation		
2	Where the conditions of this approval require consultation with an identified party, the Proponent must:	
	a) consult with the relevant party prior to submitting the subject document to the Secretary for approval; and	No change proposed as part of Modification 3
	b) provide details of the consultation undertaken, including:	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
	▪ the outcome of that consultation, matters resolved and unresolved; and ▪ details of any disagreement remaining between the party consulted and the Proponent and how the Proponent has addressed any unresolved matters.	
	However, if the Secretary agrees, a strategy, plan or program may be prepared without consultation being undertaken with an identified party required under a condition of this approval.	No change proposed as part of Modification 3
Management plan requirements		
3	The Proponent must ensure that the management plans required under this approval are prepared in accordance with any relevant guidelines, and include:	
	a) a summary of relevant background or baseline data;	No change proposed as part of Modification 3
	b) a description of: ▪ the relevant statutory requirements (including any relevant approval, licence or lease conditions); ▪ any relevant limits or performance measures/criteria; and ▪ the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures;	No change proposed as part of Modification 3
	c) a description of the measures to be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	No change proposed as part of Modification 3
	d) a program to monitor and report on the: ▪ impacts and environmental performance of the development; and ▪ effectiveness of any management measures (see (c) above);	No change proposed as part of Modification 3
	e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	No change proposed as part of Modification 3
	f) a program to investigate and implement ways to improve the environmental performance of the project over time;	No change proposed as part of Modification 3
	g) a protocol for managing and reporting any: ▪ incidents; ▪ complaints; and	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
	▪ non-compliances with statutory requirements; NSW Government 19 Department of Planning and Environment	
	h) a protocol for periodic review of the plan; and	No change proposed as part of Modification 3
	i) a document control table that includes version numbers, dates when the management plan was prepared and reviewed, names and positions of the person/s who prepared and reviewed the management plan, a description of any revisions made and the date of the Secretary's approval.	No change proposed as part of Modification 3
	Note: The Secretary may waive some of these requirements if they are unnecessary or unwarranted for particular management plans	No change proposed as part of Modification 3
Application of existing strategies, plans and programs		
4	The Proponent must continue to apply existing management plans, strategies or monitoring programs approved prior to the approval of Modification 2, until the approval of a similar plan, strategy or program following the approval of Modification 2.	The Proponent must continue to apply existing management plans, strategies or monitoring programs approved prior to the approval of Modification 3, until the approval of a similar plan, strategy or program following the approval of Modification 3 **Justification:** Update proposed to reflect Modification 3
Revision of strategies, plans and programs		
5	Within 3 months of:	No change proposed as part of Modification 3
	a) the submission of an incident report under condition 10 below;	
	b) the submission of an Annual Review under condition 12 below;	
	c) the submission of an Independent Environmental Audit report under condition 14 below; and	
	d) the approval any modifications to this approval,	
	the Proponent must review the suitability of all strategies, plans and programs required under this approval, to the satisfaction of the Secretary. Where this review leads to revisions in any such document, then within 6 weeks of the review the revised document must be submitted for the approval of the Secretary.	
	Notes: ▪ The purpose of this condition is to ensure that strategies, plans and programs are regularly updated to incorporate any measures recommended to improve environmental performance of the project.	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
	▪ In the event of an inconsistency between condition 5(d) above and any condition in Schedule 3 of this approval, the latter prevails	
Updating and staging of strategies, plans or programs		
6	With the approval of the Secretary, the Proponent may:	
	a) prepare and submit any strategy, plan or program required by this approval on a staged basis (if a clear description is provided as to the specific stage and scope of the project to which the strategy, plan or program applies, the relationship of the stage to any future stages and the trigger for updating the strategy, plan or program);	No change proposed as part of Modification 3
	b) combine any strategy, plan or program required by this approval (if a clear relationship is demonstrated between the strategies, plans or programs that are proposed to be combined); and	No change proposed as part of Modification 3
	c) update any strategy, plan or program required by this approval (to ensure the strategies, plans and programs required under this approval are updated on a regular basis and incorporate additional measures or amendments to improve the environmental performance of the project).	No change proposed as part of Modification 3
Adaptive management		
7	The Proponent must assess and manage project-related risks to ensure that there are no exceedances of the criteria and/or performance measures in Schedule 3. Any exceedance of these criteria and/or performance measures constitutes a breach of this approval and may be subject to penalty or offence provisions under the EP&A Act or EP&A Regulation.	No change proposed as part of Modification 3
	Where any exceedance of these criteria and/or performance measures has occurred, the Proponent must as soon as becoming aware of any exceedance:	No change proposed as part of Modification 3
	a) take all reasonable and feasible steps to ensure that the exceedance ceases and does not reoccur;	No change proposed as part of Modification 3
	b) consider all reasonable and feasible options for remediation (where relevant);	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
	c) within 14 days of the exceedance occurring, submit a report to the Secretary describing these remediation options and any preferred remediation measures or other course of action; and	No change proposed as part of Modification 3
	d) implement remediation measures as directed by the Secretary; to the satisfaction of the Secretary.	No change proposed as part of Modification 3
Community consultative committee		
	The Proponent must establish and operate a Community Consultative Committee (CCC) for the project to the satisfaction of the Secretary. The CCC must be established prior to recommencing quarrying operations and be operated in general accordance with the Department's Community Consultative Committee Guidelines, November 2016 (or later version).	No change proposed as part of Modification 3
8	Notes: NSW Government 20 Department of Planning and Environment ▪ The CCC is an advisory committee. The Department and other relevant agencies are responsible for ensuring that the Proponent complies with this approval. ▪ In accordance with the guidelines, the Committee should comprise an independent chair and appropriate representation from the Proponent, Council and the local community. ▪ The Proponent may, with the approval of the Secretary, combine the function of this CCC with the functions of other CCCs in the area.	No change proposed as part of Modification 3
Reporting		
Incident reporting		
9	The Proponent must immediately notify the Secretary (using the contact name, email address and phone number provided by the Department from time to time) and any other relevant agencies of any incident.	No change proposed as part of Modification 3
10	Within 7 days of the date of the incident, the Proponent must provide the Secretary and any relevant agencies with a detailed report on the incident, and such further reports as may be requested. This report must include the time and date of the incident, details of the incident, measures implemented to prevent re-occurrence and must identify any non-compliance with this approval.	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
Regular reporting		
11	The Proponent must provide regular reporting on the environmental performance of the project on its website, in accordance with the reporting arrangements in any plans or programs approved under the conditions of this approval.	No change proposed as part of Modification 3
Annual review		
12	Prior to recommencing quarrying operations, and annually thereafter, the Proponent must submit a review to the Department reviewing the environmental performance of the project to the satisfaction of the Secretary. This review must:	No change proposed as part of Modification 3
	a) describe the project (including any progressive rehabilitation) that was carried out in the previous calendar year, and the project that is proposed to be carried out over the current calendar year;	No change proposed as part of Modification 3
	b) include a comprehensive review of the monitoring results and complaints records of the project over the previous calendar year, which includes a comparison of these results against the: ▪ relevant statutory requirements, limits or performance measures/criteria; ▪ requirements of any plan or program required under this approval; ▪ monitoring results of previous years; and ▪ relevant predictions in the documents listed in condition 3 of Schedule 2;	No change proposed as part of Modification 3
	c) evaluate and report on: ▪ the effectiveness of the air quality and noise management systems; and ▪ compliance with the performance measures, criteria and operating conditions in this approval.	No change proposed as part of Modification 3
	d) identify any non-compliance over the past calendar year, and describe what actions were (or are being) taken to ensure compliance;	No change proposed as part of Modification 3
	e) identify any trends in the monitoring data over the life of the project;	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
	f) identify any discrepancies between the predicted and actual impacts of the project, and analyse the potential cause of any significant discrepancies; and	No change proposed as part of Modification 3
	g) describe what measures will be implemented over the current calendar year to improve the environmental performance of the project.	No change proposed as part of Modification 3
	The Proponent must ensure that copies of the Annual Review are submitted to Council and are available to the Community Consultative Committee (see condition 8 of Schedule 5) and any interested person upon request.	No change proposed as part of Modification 3
Independent environmental audit		
13	Within 12 months of recommencing quarrying operations, and every 3 years thereafter, unless the Secretary directs otherwise, the Proponent must commission, commence and pay the full cost of an Independent Environmental Audit of the project. This audit must:	No change proposed as part of Modification 3
	a) be led and conducted by a suitably qualified, experienced and independent team of experts whose appointment has been endorsed by the Secretary;	No change proposed as part of Modification 3
	b) include consultation with the relevant agencies and the CCC;	No change proposed as part of Modification 3
	c) assess the environmental performance of the project and whether it is complying with the relevant requirements in this approval and any relevant EPL or necessary water licences for the project (including any assessment, strategy, plan or program required under these approvals);	No change proposed as part of Modification 3
	d) review the adequacy of strategies, plans or programs required under the abovementioned approvals;	No change proposed as part of Modification 3
	e) recommend appropriate measures or actions to improve the environmental performance of the project, and/or any assessment, strategy, plan or program required under the abovementioned approvals; and NSW Government 21 Department of Planning and Environment	No change proposed as part of Modification 3
	f) be conducted and reported to the satisfaction of the Secretary	No change proposed as part of Modification 3
14	Within 12 weeks of commencing this audit, or as otherwise agreed by the Secretary, the Proponent must submit a copy of the audit report to the Secretary and any other NSW agency that requests it, together with its response to any recommendations contained in the	No change proposed as part of Modification 3

No.	Modification 2 Condition of Approval	Proposed Modification 3 Condition of Approval
Schedule 5 – Environmental management, reporting and auditing		
	audit report, and a timetable for the implementation of these recommendations as required. The Proponent must implement these recommendations, to the satisfaction of the Secretary.	
Access to information		
15	Within 3 months of the determination of Modification 2, until the completion of all works, including rehabilitation and remediation the Proponent must:	Within 3 months of the determination of Modification 3, until the completion of all works, including rehabilitation and remediation the Proponent must: **Justification:** Update proposed to reflect the Modification 3 approval
	(a) make the following information publicly available on its website: ▪ the documents listed in condition 3 of Schedule 2; ▪ current statutory approvals for the project; ▪ all approved strategies, plans and programs required under the conditions of this approval; ▪ regular reporting on the environmental performance of the development in accordance with the reporting arrangements in any plans or programs approved under the conditions of this approval; ▪ a comprehensive summary of the monitoring results of the project, reported in accordance with the specifications in any conditions of this approval, or any approved plans and programs; ▪ summary of the current stage and progress of the project; ▪ contact details to enquire about the project or to make a complaint; ▪ a complaints register, updated at least monthly; ▪ the Annual Reviews of the project; ▪ any Independent Environmental Audit as described in condition 13 above, and the Proponent's response to the recommendations in any audit; and ▪ any other matter required by the Secretary; and	No change proposed as part of Modification 3
	(b) keep this information up-to-date, to the satisfaction of the Secretary.	No change proposed as part of Modification 3



APPENDIX G

FIRE ENGINEERING BRIEF QUESTIONNAIRE

Fire & Rescue NSW

Fire Engineering Brief Questionnaire (FEBQ)

1 Document control

Applicant reference number JN19-00144 **FRNSW reference number** BFS19/1165

Ver.	Author	Organisation	Status	Date
01	Blair Stratton (C10 BPB 1877)	RED Fire Engineers Pty Ltd	Initial submission	27/06/2019

2 Applicant

2.1 Agreement

As the applicant, I confirm the following:

- I agree to pay Fire and Rescue NSW (FRNSW) the charges set out in Clause 46 of the *Fire Brigades Regulation 2014* (see Section 10).
- I agree to forward with this application the following documentation for FRNSW to review and provide advice on the assessment methods and acceptance criteria proposed for the given alternative solution:
  - ☑ Copy of proposed building plans and specifications (e.g. relevant floor plans, elevations, site plan, section views, hydrant plan and schematic)
  - ☑ BCA report or letter from an accredited certifier that identifies all non-compliances (if available)
  - ☑ CFD/zone modelling inputs form (if applicable)
  - ☑ Report extract of the trial design requirements/proposed fire safety measures (optional).

Name of applicant	PGH Bricks and Pavers Pty Ltd
Role of applicant	Development owner
Applicant phone number	0439117613
Applicant email address	jabrown@pghbricks.com.au

2.2 Remittance advice information

Invoices will be issued based on the information provided below:

Company / vendor name	PGH Bricks and Pavers Pty Ltd		
Australian business number	6816879482	Trading name	PGH Bricks and Pavers Pty Ltd
Remittance contact name	Jason Brown		
Remittance street address	59-67 Cecil Rd, Cecil Park, NSW, 2178		
Remittance postal address	59-67 Cecil Rd, Cecil Park, NSW, 2178		
Remittance email address	jabrown@pghbricks.com.au		
Remittance phone number	0439117613	Remittance fax number	N/A
Purchase order ref. no.	If applicable	Project code ref. no.	If applicable

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3 Consultation

3.1 Stakeholders

Role	Name and BPB number	Organisation and phone	Email address
Fire safety engineer	Blair Stratton C10 BPB 1877	RED Fire Engineers Pty Ltd 0434 481 676	blair@redfireengineers.com.au
BCA consultant	Nickolas Hontas BPB 0832	SW partners (02) 9283 6555	nhontas@swpartners.com.au
Certifying authority	Steve Watson	Steve Watson and Partners ABC17 (02) 9283 6555	swatson@swpartners.com.au
FRNSW reviewers	FRNSW use only FRNSW use only	Fire and Rescue NSW 02 9742 7434	firesafety@fire.nsw.gov.au

3.2 Meeting details

In conjunction with the written comments provided in response to this FEBQ, FRNSW may hold a meeting with the applicant to discuss aspects of the proposed alternative solution. The meeting will be at the discretion of FRNSW.

Type of meeting preferred ☐ No meeting ☐ Telephone meeting ☑ Face-to-face meeting

4 Project details

4.1 Premises

Premises name	PGH Badgerys Creek
Primary street address	235 Martin Road
Secondary street address	Secondary street address (if applicable)
Premises suburb	Badgerys Creek
Lot and DP numbers	Lot1 DP 1035249, Lot3 DP 373863

4.2 Proposed works

☐ New building
☑ Refurbishment of an existing building
☑ Extension of an existing building
☐ Change in use within an existing building
☐ Other: (provide details)

Applicable NCC: NCC 2019

For existing buildings:
Approximate year of construction: 1975/76
Building code when constructed: Ordinance 70

How many alternative solution issues are proposed in this FEBQ? 6

Note: The number of alternative solution issues must address all identified non-compliances.

Have all departures from the deemed-to-satisfy (DtS) provisions of the *National Construction Code* (*NCC*) been identified for this proposed design (i.e. a BCA report or letter from an accredited certifier)? Yes

Note: Any advice given is subject to all non-compliances being identified. Any new DtS departures identified, including any from the certifying authority determining the application for construction certificate, may affect FRNSW advice in respect to this alternative solution.

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Identify if any previous alternative solution applies to the building:

No, no previous alternative solution applies to the building.

Identify if any application has been/will be submitted under Clause 188 of the *Environmental Planning and Assessment Regulation 2000*:

N/A

Identify if the premises is or will be subject to any development application (DA) conditions or special regulatory approvals (e.g. BPB conditions, ministerial conditions, crown building works):

Note: FRNSW will not comment on existing buildings subject to voluntary upgrade or change of use prior to the issuing of any DA conditions of consent, or conditions of an existing consent have been modified (i.e section 4.55 of *Environmental Planning and Assessment Act 1979*). Comment will also not be provided if an order has been issued unless the Council agrees. The Council may seek advice during the DA review.

DA has been submitted, however, not yet approved.

Will the premises be subject to a fire safety study, risk assessment or dangerous goods study? No, refer attached dangerous goods manifest. The quantities of goods do not cause need for a fire safety study to be carried out.

Note: Any study/risk assessment should be completed prior to submitting this FEBQ and should be attached to this application.

4.3 Description of building occupancy

Main occupancy class	8	Other occupancy classes	Office and admin areas are deemed ancillary as < 10 % of floor area
Type of construction	C – large isolated building	Largest fire compartment (m^2)	23,000
Effective height (m)	0 m	Ground floor area (m^2)	23,000
Rise in storeys	1	Total floor area (m^2)	23,000
Levels contained	1	Total volume (m^3)	230,000 approx

Outline any additional building characteristics:

The proposed building is to consist of the development and extension of a semi-automated brick works with high temperature curing and kiln facilities. The works also involve large hardstands area for storage of bricks and associated access roads in and around the site.

Future Battery store is not part of this building project.

List key occupant characteristics for the building:

The estimated population load and building occupant characteristics are detailed in Table 1.

Table 1: Occupant characteristics

Characteristic	Factory, workshop and office areas
Number and distribution	• Office:20 occupants • Factory/Operations: 80 occupants
State	We expect that occupants will be alert, awake and able to respond to evacuation signals at all times that the building is occupied. PGH has a drug and alcohol policy and as such occupants will be assumed to not be under the influence of drugs or alcohol..
Level of assistance required	We expect that the majority of the occupants in the building will not require physical assistance to egress out of the building in an emergency. Due to the nature of the facility, we expect occupants with disabilities will not be present in production areas, unless they are able to egress without assistance from others.

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Characteristic	Factory, workshop and office areas
Emergency training	We expect that members of staff will have a degree of fire and evacuation training, such that they are aware of exit locations and appropriate responses to alarm systems. An Emergency Management Organisation will be established for the site, with wardens and staff provided with induction and refresher training in accordance with AS 3745.

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5 Hazards

Outline any hazards unique to the building:

The area will contain high temperature curing and kiln facilities.

The building will contain hazardous chemicals and dangerous goods. Chemicals and goods will be generally stored in professionally made cabinets and gas bottles will be stored in cages when not in forklifts. Diesel tank (17,900 litre) is located outside the building below the factory staff parking

The building will also contain packing consumables. The consumables will not exceed 1,000 m^3 and will not be stored at a height above 4 m.

The subject building will not contain special hazards in a quantity that would require additional provision in accordance with BCA Clause E1.10 and E1.3. Dangerous goods will be stored in accordance with AS 1940-2004.

- ☐ Combustible external cladding
- ☐ Combustible waste (i.e. waste facility)
- ☑ Hazardous chemicals / dangerous goods
- ☑ Electricity supply system (e.g. substations)
- ☐ Battery system (e.g. BSS, BESS, ESS)
- ☐ Alternative electrical generation (e.g. solar, tri-gen)
- ☐ Insulated sandwich panels
- ☐ Podium type building
- ☐ A basement level
- ☐ An atrium (Part G3 of BCA)
- ☐ Car stacker
- ☑ Other: High temperature curing oven and brick kiln facilities.

Note: Clauses E1.10 and E2.3 of the NCC should be addressed when special hazards exist (e.g. car stacker, hazardous chemicals/dangerous goods).

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6 Preventative and protective measures

Identify fire safety measures that are, or will be, provided throughout the building, including anything undecided, which should be mentioned as part of the FEBQ review. Additional information may be added to the comments section below to better describe any systems or indicate systems that may be subject to alternative solution.

Occupant warning system	**Signage**	**Facilities for emergency services**
☑ Building occupant warning	☑ Emergency lighting	☐ Emergency lifts
☐ EWIS	☑ Exit and direction signs	☑ Fire control centre
☐ SSISEP	☑ Warning and operational signs	☐ Fire control room
☑ Break glass unit	**Hydrant system**	☑ Perimeter vehicular access
☑ Visual / tactile alarm devices*	☐ AS 2419.1-2017	☐ Standby power supply system
Smoke hazard management	☑ AS 2419.1-2005	**Firefighting equipment**
☐ Zone smoke control	☐ AS 2419.1-1994 (existing building)	☑ Portable fire extinguishers
☐ Purge system (existing building)	☐ Ordinance 70 (existing building)	☑ Fire hose reels
☐ Smoke and heat vents	☑ External hydrants	**Water supply**
☐ Smoke exhaust	☐ Internal hydrants	☐ Grade 1
☐ Smoke baffles	☐ Internal dry-riser (for FPAA101D)	☐ Grade 2
☑ Ridge vents	☐ Street hydrant coverage only	☐ Grade 3
☐ Stair pressurisation	☑ Hydrant booster assembly	☑ Onsite storage tank
☐ Impulse / jet fans (in carpark)	☑ Pumpset	☐ Dual supply
☐ Other: (provide details)	☐ Other: (provide details)	**Protection** of openings
Detection system	**Suppression system**	☑ Fire doors
☐ AS 3786:2014	☐ CA16 (existing building)	☐ Smoke doors
☐ AS 3786-1993 (existing building)	☐ AS 2118.1-2017	☐ Solid core doors
☑ AS 1670.1:2018	☐ AS 2118.1-2006	☐ Fire windows
☐ AS 1670.1:2015 (existing building)	☐ AS 2118.1-1999 (existing building)	☐ Fire shutters
☐ AS 1668.1:2015	☐ AS 2118.2-2010 (wall-wetting)	☐ Wall-wetting sprinklers
☐ AS 1670.3-2018 (monitored)	☐ AS 2118.3-2010 (deluge)	☐ Fire curtain
☐ AS 1670.3-2004 (existing building)	☐ AS 2118.4-2012 (residential)	☐ Smoke curtain
☐ Smoke alarms	☐ AS 2118.5-2006 (domestic)	☐ Safety curtain for openings
☐ Heat alarms	☐ AS 2118.6-2012 (combined)	☑ Fire dampers
☑ Smoke detectors	☐ FPAA101D (class 2 or 3)	☐ Smoke dampers
☐ Heat detectors	☐ FPAA101H (class 2 or 3)	☐ Fire seals (intumescent)
☐ Flame detectors	☐ Fast response heads	☐ Hot smoke seals (>200ºC)
☐ CO detectors	☐ ESFR	☐ Medium temp. smoke seals
☐ Multi-criteria fire detectors	☐ Storage mode sprinklers	
☐ Aspirated smoke detection	☐ Gaseous suppression system	
☑ Beam detection	☐ Water mist system	
☐ Other: (provide details)	☐ Other: (provide details)	

Additional information:

* Visual / tactile alarm devices to high noise areas only

- A Building Occupant Warning System (BOWS) is to be provided in accordance with Clause 6 of Specification E2.2a of the BCA. Activation of the smoke detection systems shall operate the BOWS throughout the building.
- Break glass alarms are to be located at the exits from the building.
- Turning areas in accordance with Clause 5.2 of FRNSW Policy No 4 Guidelines for emergency vehicle access is to be provided

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- Mechanical smoke exhaust capable of achieving one air change per hour will be provided to enable FRNSW to initiate smoke clearance following fire. However, this system will not be automatic, subject to satisfactory fire life safety and fire brigade intervention being proven.
- Exit signs having large pictorial elements (at least 200 mm high) are to be installed in accordance to AS/NZS 2293.1-2018, except they are to be hung above 2.7 m from the floor level. Exit signs will mounted at the sides of the kiln, at a maximum height of 5 m from the floor level and a maximum distance between signs of 30 m. Exit signs are to be installed in accordance to AS/NZS 2293.1-2005 above exit doors.
- We have assumed in our assessment that staff will have a level of fire and evacuation training. Therefore, an Emergency Management Organisation must be established in accordance with AS 3745-2010.
- Management procedures shall also be implemented to ensure that the essential services measures are maintained and regularly inspected in accordance with the AS 1851-2012. In addition, all Essential Safety items that do not comply with the BCA or relevant standard must be rectified whether or not this non-compliance was identified as part of the building's commissioning.
- All maintenance personnel and visitors to be provided with induction to site and evacuation procedures.
- A copy of the latest FER is to be kept on site and a plain English Performance Solution Summary is to be provided at the FIP.
- Good housekeeping and regular fire prevention practices are to be carried out to minimise the risk of unnecessary fuel loads and sources of ignition.

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7 Departures from the Deemed-to-Satisfy provisions

Issue number: 1 **Title:** Vehicular access

Details of departures from DtS provisions:

The building is a large isolated building, however it is not provided with perimeter vehicular access and open space around the entire building in accordance with BCA Clause C2.4(b) as prescribed by BCA Clause C2.3 and C2.4 of the BCA.

Perimeter vehicular access and hardstand area is to be provided as indicated in Figure 1.

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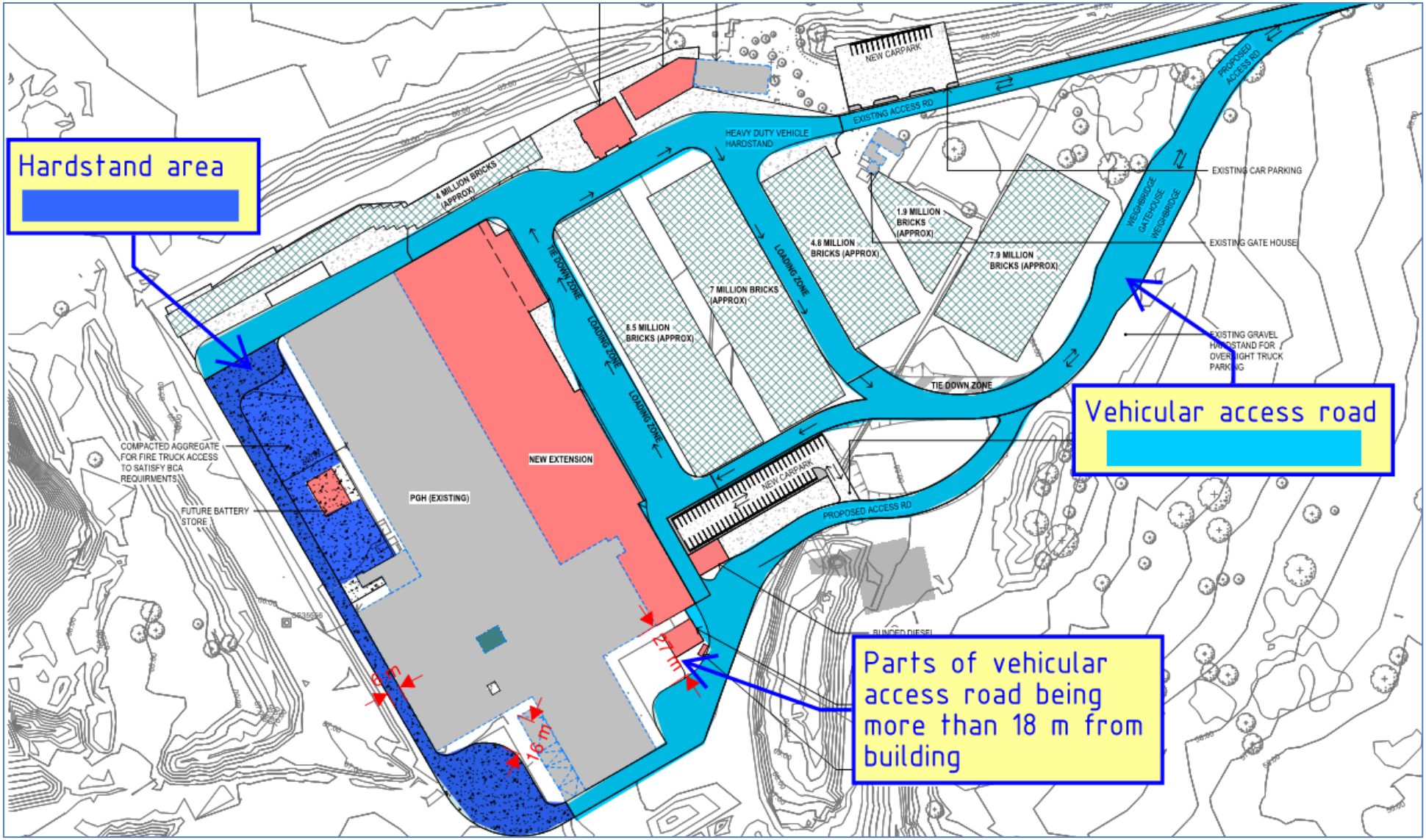


Figure 1: Vehicular access to building

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Applicable DtS provisions:	C2.3 and C2.4	Performance requirements:	CP2 and CP9

List key fire safety measures:

Hardstand area will be provided on all sides of the building providing access to the fire brigade general appliance and an aerial appliance as well as on-foot access.

The building is to be provided with an automatic smoke detection and alarm system in accordance with BCA Specification E2.2a and AS 1670.1-2015. The smoke detection system is to be monitored in accordance with BCA Clause 8 of Specification E2.2a.

Mechanical smoke exhaust capable of achieving one air change per hour will be provided to enable FRNSW to initiate smoke clearance following fire. However, this system will not be automatic, subject to satisfactory fire life safety and fire brigade intervention being proven.

Turning areas in accordance with Clause 5.2 of FRNSW Policy No 4 Guidelines for emergency vehicle access is to be provided as follows –

- Any carriageway not leading directly to an exit (i.e. dead end) should be provided with a turnaround area which prevents the need to perform multi-point turns; and
- The minimum turning radius of turn around areas should not be less than 11.3 m for general appliances and 16.4 m for aerial appliances.

Proposed alternative solution:

The key hazard for this DtS departure relates to the fire brigade not being able to intervene and provide an initial attack on a developing fire from all sides of the building. The Guide to the BCA clarifies that for large isolated buildings, the reason for providing the fire brigade with perimeter vehicular access to large isolated buildings is to enable the brigade to intervene to fight the fire, assist with evacuation, and stop the spread of a fire to another building. The vehicular access also provides other emergency services personnel, such as ambulance officers, with the ability to access the building as necessary.

This departure will be assessed by qualitative discussion regarding the proposed vehicular access, the ground surface around the building and the building characteristics. Potential impact on fire brigade intervention and fire spread to adjacent properties will be described qualitatively.

The proposed Perimeter vehicular access, consisting of an access road and hardstand areas, will be more than 18 meters from the building in the southeast corner and will not be kept clear of storage (finished products on pallets) and the area has other existing structures built upon it. The area around the building will generally be engineered road base surfaces capable of supporting fully laden prime movers. As such, it would accommodate both general appliance and an aerial appliance that will need additional width to extend stabilizers. Future battery store marked in red in Figure 1 on the west side of the building is not part of this building project. The battery store will be listed as a potential hazardous storage location and will comply with relevant underwriters laboratory guidelines for the type and quantity of the battery stored, according to their UL listing.

The building has multiple on-foot entry points from the perimeter access road on all sides of the building, and general access to and around the site is good. The hardstand areas will also allow for full access to all areas without the need to reverse out of dead-ends. The size of the hardstand area will be able to provide space for an appliances to turn around if needed. As such, the building provides other emergency services personnel, such as ambulance officers, with the ability to access the building as necessary. We therefore expect that the brigade will be able to intervene to fight the fire.

Access to firefighting equipment (e.g. booster, pumps) will be available from access road. monitored.

The ridge vent and low-level openings for makeup air are expected to naturally ventilate heat and smoke and limit the risk of flashover.

The building does not contain an ‘occupancy of excessive fire hazard’. Indeed, due to the nature of the process (moulding and firing/curing clay into bricks) there is limited combustible fuel load and the fire hazard is low compared to other DtS compliant buildings with perimeter vehicular access. The risk of delayed/disrupted fire brigade access to and around the site is not expected to be worse than that of a DtS building.

Performance solution:

☑ A2.2(1)(a) - Comply with all relevant performance requirements
☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

☑ A2.2(2)(a) - Evidence of suitability
☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
☐ A2.2(2)(c) - Expert judgement
☑ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative ☑ Qualitative ☑ Deterministic
☑ Absolute ☑ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control
☑ B – Smoke development and spread and control
☑ C – Fire spread and impact and control
☑ D – Fire detection, warning and suppression
☐ E – Occupant evacuation and control
☑ F – Fire services intervention

Acceptance criteria and factor of safety:

The design will be deemed acceptable if it can be shown that sufficient vehicular and on-foot access is provided to the responding fire brigade. It is to be demonstrated that risk of fire spread between buildings has been mitigated to the degree necessary considering nature of the subject building.

Access to the main entries to the building and firefighting equipment (e.g. booster and external hydrants) to be available from the access road.

Fire scenarios and design fire parameters:

Fires will be generally described qualitatively in the assessment of the partial vehicular access.

A fire will also be described quantitatively by considering a fire in a stack of idle pallets as an emitter in the radiation calculations. This would represent a worst-case fire located 6 m from the building.

Describe how fire brigade intervention will be addressed or considered:

Potential impact on fire brigade intervention and fire spread to adjacent properties (located >18 m from this building) will be described qualitatively

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☑ None

Conservative input data are to be assumed throughout the assessment for the radiation calculations.

Provide details on proposed modelling/assessment tools:

The Thermal Radiation Analysis (TRA) computer software is used to calculate thermal radiation between surfaces and provides a visual output. It is focused on fire engineering design and analyses radiation between hot emitter surface such as fires or compartment fire windows to cool receiver surfaces such as boundary walls or evacuation routes.

The theory or equation between surfaces used in the TRA computer software is as shown below which is widely used to determine the radiant heat intensity from a single opening of a building to a point some distance away (Spearpoint, 2008). It takes into account of the configuration factor (shape factor or geometric factor) which determines the intensity of radiation received by a surface remote from an emitter.

$$q_r'' = F_{1-2} \times \varepsilon \times \sigma \times \left(T_{emitter}^4 - T_{receiver}^4\right)$$

Where:

q_r''	radiant heat flux received by receiver [kW/m^2]
F_{1-2}	configuration factor [-]
ε	emissivity [-]
σ	Stefan Boltzmann constant (5.67 x 10^{-8}) [W/(m^2 K^4)]
$T_{emitter}$	temperature of emitter [K]
$T_{receiver}$	temperature of receiver [K]

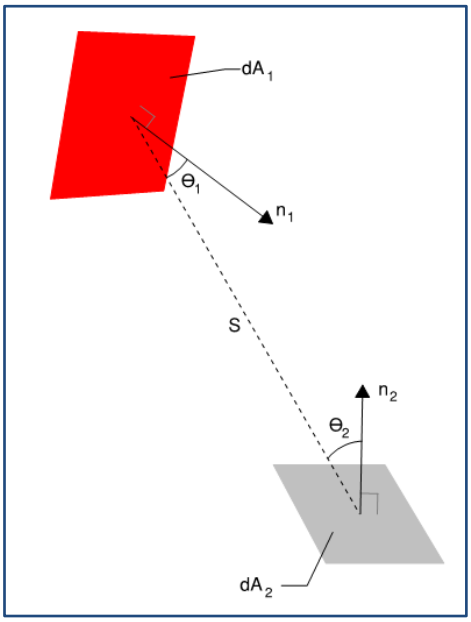


Figure 2: Configuration factor between surface A_1 and A_2

To determine both the average and maximum radiation in the TRA software, key parameters such as the temperature and emissivity are input. Emitting and receiving surfaces are described using four coordinates. The software performs numerical integration to calculate the radiation levels.

The TRA software can be purchased via the following website: http://www.fire-engineering-software.com/tra.html

Issue number: 2 Title: Omission of automatic sprinkler and mechanical smoke exhaust system

Details of departures from DtS provisions:

The building is deemed to be a large isolated building as the fire compartment sizes exceed the volume identified in BCA Table C2.2. The building is not proposed to be provided with an automatic sprinkler system and mechanical smoke exhaust system.

Applicable DtS provisions:	C2.3, E2.2, Table E2.2a, Spec E2.2	Performance requirements:	CP1, CP2, EP1.4, EP2.2

List key fire safety measures:

The building will not be provided with an automatic sprinkler or automatic mechanical smoke exhaust system.

Hardstand area will be provided on all sides of the building providing access to the fire brigade general appliance and an aerial appliance as well as on-foot access.

The building is to be provided with an automatic smoke detection and alarm system in accordance with BCA Clause 4 of Specification E2.2a and AS 1670.1-2015. The smoke detection system is to be monitored in accordance with BCA Clause 8 of Specification E2.2a.

Mechanical smoke exhaust capable of achieving one air change per hour will be provided to enable FRNSW to initiate smoke clearance following fire. However, this system will not be automatic, subject to satisfactory fire life safety and fire brigade intervention being proven.

Proposed alternative solution:

The key hazard with the omission of an automatic sprinkler system is that a fire could grow uncontrolled within the building and smoke could fill the building and make evacuation and firefighting difficult. Another key hazard is the potential risk of larger fire and fire spread between buildings due the omission of the sprinkler system.

In accordance with the DtS Provisions of the BCA the building only requires an automatic sprinkler system due to its size exceeding the maximum sizes outlined in Table C2.2. The subject building does not exceed any of the other prerequisites that would trigger the need for sprinklers, such as an excessive fire hazard under Table E1.5.

In the same manner, the building is only prescribed an automatic smoke exhaust system due to its size exceeding the floor area and volumes outlined in Table E2.2a.

The building will contain limited quantities of hazardous chemicals and dangerous goods. Chemicals and goods will be generally stored in approved DG cabinets or cages to store gas bottles when not installed on forklifts. Larger amounts like diesel tank (17,900 litres) will be stored outside the building. The building will also contain packing consumables. The consumables will not exceed 1,000 m² or be stored at a height above 4 m.

The proposed building is intended for a semi-automated brick factory with high temperature curing and kiln facilities. This means, with the exception of above, the fuel load in the building will be very low and fire ignition is unlikely due to the controlled storage of materials. Furthermore, although the volume of the building exceeds 108,000 m^3 and the floor area exceeds 18,000 m^2, much of this space is not utilised for processing or storage and is indeed empty void space. Hence, the fire load, the potential fire hazard and fire intensity of a fire in the building is equal or less than that of a DtS building that does not exceed the volume in BCA Table C2.2. Therefore, we do not expect fire to grow uncontrolled within the building. With the same reasoning, fire brigade intervention or occupant egress is not expected to be affected by the omission of a sprinkler system.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☑ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☑ Comparative ☑ Qualitative ☑ Deterministic
☑ Absolute ☐ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control
☑ B – Smoke development and spread and control
☑ C – Fire spread and impact and control
☑ D – Fire detection, warning and suppression
☑ E – Occupant evacuation and control
☑ F – Fire services intervention

Acceptance criteria and factor of safety:

The omission of a sprinkler is acceptable if it can be demonstrated that a fire within the building is unlikely and the risk of fire spreading is less than or at least equivalent to a BCA DtS design.

Occupants and fire brigade to have the same or higher level of safety compared to a DtS-compliant building

Fire scenarios and design fire parameters:

A worst-credible fire based on the fuel load in the building will be described qualitatively.

Describe how fire brigade intervention will be addressed or considered:

Fire brigade will be aided by the hydrant system and their ability to intervene will be considered.

Verification/validation analyses:

☑ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☐ None

A scenario with an uncontrolled fire is to be discussed.

Provide details on proposed modelling/assessment tools:

N/A

Issue number: 3 **Title:** Egress provisions

Details of departures from DtS provisions:

a) Distance of travel to a point of choice is up to approximately 30 m instead of 20 m.

b) Distance to travel to an exit from a dead end from within the kiln in the event of a pallet malfunction/breakdown halfway down the line is 75 m instead of 40 m.

c) Distance of travel to an exit is up to approximately 115 m instead of 40 m.

d) Distance of travel between alternative exists when measured through the point of choice of exits is approximately 160 m instead of 60 m.

Applicable DtS provisions:	D1.4, D1.5	Performance requirements:	DP4, EP2.2

List key fire safety measures:

The building is to be provided with an automatic smoke detection and alarm system in accordance with BCA Clause 4 of Specification E2.2a and AS 1670.1-2015. The smoke detection system is to be monitored in accordance with BCA Clause 8 of Specification E2.2a.

A Building Occupant Warning System (BOWS) is to be provided in accordance with Clause 6 of Specification E2.2a of the BCA. Activation of the smoke detection systems shall operate the BOWS throughout the building

Break glass alarms are to be located at the exits from the building.

Personnel are familiar with the building and provided with training for emergency situations.

Proposed alternative solution:

The key hazard with these departures relates to the extended evacuation time as due to the extended travel distances, resulting in occupants becoming exposed to untenable conditions from a fire during evacuation.

Qualitative discussion regarding the subject building characteristics and occupants' characteristics within the building.

Fire and smoke modelling will be performed to demonstrate that the occupants will be able to evacuate prior to the onset of untenable conditions, i.e., Available Safe Evacuation Time (ASET) vs Required Safe Evacuation Time (RSET). The ASET of the proposed design will be determined using Fire Dynamic Simulator (FDS). FDS is a computational fluid dynamics (CFD) model of fire driven fluid flow.

RSET

The RSET will be determined based on hand-calculations. Smoke detector activation time will be calculated using in-house detection and suppression spreadsheet developed by RED Fire Engineers, which is based on the same principles as "DETACT" (Evans, 1985). The evacuation time, when used in this report, is defined as the time for all occupants to reach a place of safety from their point of origin.

- A place of safety is a place which people can reach safely via the escape route, and which will be relative safe from the effect of fire. For the purpose of this assessment, the outdoor areas are considered places of safety.

The RSET is generally consisting of the following main components:

- Alarm/Detection Time,
- Pre-movement Time,
- Movement Time.

The proposed increase in travel distance will mostly impact the movement time whilst the alarm/detection and pre-movement time is assumed to be the same as determined in Table 2.

Table 2: Assumptions and background to egress calculations

RSET variable	Occupants can see fire/smoke	Occupants cannot see fire/smoke (1st percentile)	Occupants cannot see fire/smoke (99th percentile)
Cue Period (P_c)	Based on calculated detection time due to large factory.	Based on calculated detection time.	Based on calculated detection time.
Response and Delay Period (P_r + P_d)	30 seconds	30 seconds	2.5 minutes

(These pre-movement times are based on PD 7974 part 6 (BSI, 2004))				
Travel Speed (These speeds are based on the SFPE Handbook, for persons with full mobility and occupants with a mobility disability (Proulx, 2008))	Horizontal Travel	95 % of occupants: 1.0 m/s 5 % of occupants: 0.85 m/s All occupants will conservatively be assumed to have a minor mobility impairment with a travel speed of 0.85 m/s in the calculations.		
	Vertical travel	95 % of occupants: 0.7 m/s 5 % of occupants: 0.33 m/s		

Movement time is the time needed for all of the occupants to go from a point of origin to some destination, generally considered to be reaching a place of safety and it can be divided into two parts:

- the time it takes for occupants to move to an exit (travel time); and
- the time it takes for occupants to pass through an exit (queuing time).

ASET

The ASET in the building is the time between the fire start and the onset of untenable conditions.

ASET vs RSET

To determine whether occupants in the building can escape safely in a fire event, the ASET is compared to RSET.

The acceptance criterion is that the ASET must be greater than RSET with a safety factor incorporated.

The safety factors are as follow:

- Sensitivity design scenario: SF = 1.0
- Base case scenarios: SF = 1.5

Refer to Table 3 for Life Safety Criteria.

Performance solution:

☑ A2.2(1)(a) - Comply with all relevant performance requirements
☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

☑ A2.2(2)(a) - Evidence of suitability
☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
☐ A2.2(2)(c) - Expert judgement
☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative ☑ Qualitative ☑ Deterministic
☑ Absolute ☑ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control
☑ B – Smoke development and spread and control
☐ C – Fire spread and impact and control
☑ D – Fire detection, warning and suppression
☑ E – Occupant evacuation and control
☑ F – Fire services intervention

Acceptance criteria and factor of safety:

The ASET shall exceed the RSET with a safety factor of 1.5 for the base case. The ASET shall exceed the RSET with a safety factor of 1 for sensitivity cases.

Occupants are to be able to evacuate prior to untenable conditions occur.

The critical criteria for untenable conditions depend on whether the smoke layer height is above or below occupant head-height (taken as 2.1 m). These parameters are taken from the Fire Engineering Design Guide (Spearpoint, 2008).

Table 3: Life safety criteria

Measurement	Criteria 1: Smoke layer above 2.1 m	Criteria 2: Smoke layer below 2.1 m
Upper layer temperature	Not to exceed 200 °C	Not to exceed 60 °C
Lower layer temperature	Not to exceed 60 °C	Not to exceed 60 °C
Radiant heat	Not to exceed 2.5 kW/m^2 at 2.1 m above floor level.	Not to exceed 2.5 kW/m^2 at 2.1 m above floor level.
Visibility	-	Visibility not to fall below: • 10 m generally. • 5 m in small rooms. • 5 m where occupants are standing in queues for a short period of time.
Toxicity	-	Toxicity is conservatively estimated by considering whether visibility is maintained. As above, visibility should not fall below: • 10 m generally. • 5 m in small rooms. • 5 m where occupants are standing in queues for a short period of time.

Fire scenarios and design fire parameters:

Fire scenarios will be determined based on likely fuel loads and ventilation within the building.

A t² fire with fast growth rate up to 5 MW will be assessed as a worst-credible scenario, given the limited combustibles. A 5 MW fire represents a stack of wooden pallets burning.

As a sensitivity analysis, a more severe fire will be assessed with a higher maximum heat release rate of 10 MW.

Describe how fire brigade intervention will be addressed or considered:

Fire brigade intervention is not expected to be affected by this departure. Given the smoke clearance system the conditions in the building is expected to be equivalent to that of a DtS large isolated building.

Verification/validation analyses:

☑ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☐ None

The following sensitivity scenarios will be evaluated:

- A more severe fire
- Blocked Exit

Provide details on proposed modelling/assessment tools:

CFD modelling inputs form attached.

Issue number: 4 **Title:** Reduced egress width

Details of departures from DtS provisions:

Egress widths to be up to 600 mm instead of 1000 mm in equipment/machinery areas.

Applicable DtS provisions:	D1.6	Performance requirements:	DP6, EP2.2

List key fire safety measures:

N/A

Proposed alternative solution:

The key hazard of this departure is that the reduced clear width of the egress width may delay the safe evacuation of the building occupants.

Qualitative discussion regarding the key body measurements of occupants and fire fighters based on international studies will be performed.

Main egress routes through the factory will have an egress width of 1000 mm in accordance with the DtS provisions. Egress width will be minimum of 600 'pinch point' in few confined areas. . These areas will only be occupied for maintenance reasons

Research into key body dimensions for the UK (Alder, 1999) show that the 95th percentile for males has a shoulder width of 510 mm. Furthermore, the NFPA 'ready reference on human behaviour in fires' (NFPA, 2003) states that the major axis across the shoulders of a body ellipse used to develop egress systems is 609 mm.

Based on the anthropometric data, the sway width for adult male at shoulder height is between 510 mm to 760 mm (NFPA, 2012). Therefore, a reduced egress width of 600 mm will not accommodate all body dimensions. However, the occupant load in the area where the reduced egress occur is expected to be very low and restricted to maintenance staff only. Therefore, occupants are not expected to be unduly delayed in their evacuation.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☑ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative	☑ Qualitative	☑ Deterministic
☑ Absolute	☐ Quantitative	☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control	☐ D – Fire detection, warning and suppression
☐ B – Smoke development and spread and control	☑ E – Occupant evacuation and control
☐ C – Fire spread and impact and control	☑ F – Fire services intervention

Acceptance criteria and factor of safety:

The reduced egress width will be considered acceptable if it is not expected to unduly delay evacuation from the building.

Fire fighters are not to be hindered from applying water to a fire or conducting search and rescue due to the reduced width

Fire scenarios and design fire parameters:

Fire anywhere within the subject building requiring occupant evacuation and/or fire brigade intervention.

Describe how fire brigade intervention will be addressed or considered:

Key body measurements of fire fighters based on international studies will be taken into consideration so fire fighters are not hindered from fighting a fire or conducting search and rescue due to the reduced width.

In relation to fire brigade intervention, it is expected that occupants have evacuated before the fire brigade arrive or start their fire brigade intervention and there will be no issue with counter flow. Research presented in the journal Human Factors (Hsiao, et al., 2014) publish measurements of expected width of fire fighters with gear on. The 95th percentile shows that the bideltoid breadth (shoulder width) for male fire fighters is 796 mm.

The reduced width in the subject building will still generally be sufficient for fire fighters to access through. In a few locations, there will be squeeze point not allowing the fire brigade to access through. As these locations will only occur in isolated and confined areas in around equipment and cars of bricks, the brigade will be able to apply water to a potential fire without having to enter the area. Therefore, the impact of reducing the paths' widths is not expected to introduce any additional risk to the intervening fire brigade.

Verification/validation analyses:

☑ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☐ None

The 95th percentile sway width for males as well as the 95th percentile shoulder width for male fire fighters will be used. As the male sway width is larger than females, the female widths have not been taken into consideration.

Provide details on proposed modelling/assessment tools:

N/A

Issue number: 5 **Title:** Egress stairs

Details of departures from DtS provisions:

Egress stairs over plant equipment to be designed to AS 1657:2013 instead of conventional stairs.

Applicable DtS provisions:	D2.18	Performance requirements:	DP2, EP2.2

List key fire safety measures:

Egress stairs to be design to AS 1657:2013.

An Emergency Management Organisation must be established in accordance with AS 3745-2010.

All maintenance personnel and visitors to be provided with induction to site and evacuation procedures, or escorted by trained personnel at all times.

Proposed alternative solution:

A qualitative and absolute assessment is undertaken to evaluate the risk of a fire exposing egressing personnel working within the area for limited time. The analysis will review occupant characteristics within the plant room and production areas, the egress provisions and the risk of fire and smoke therein.

The occupants allowed in the plant room and production areas, are staff members or maintenance personnel, consequently, they are trained and familiar with space and the egress route. Also, the plant room and production areas, is only to be accessed as part of maintenance and services and will be semi-automated. Therefore, the areas will be infrequently occupied.

Tenable conditions are expected to be maintained on the egress path to at least the same extent as in a DtS building.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☑ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative	☑ Qualitative	☑ Deterministic
☑ Absolute	☐ Quantitative	☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control	☐ D – Fire detection, warning and suppression
☐ B – Smoke development and spread and control	☑ E – Occupant evacuation and control
☐ C – Fire spread and impact and control	☑ F – Fire services intervention

Acceptance criteria and factor of safety:

Occupants are not to be trapped and unable to evacuate in the event of a fire due to the non-conventional stairs.

Fire scenarios and design fire parameters:

A worst-credible fire scenario will be described qualitatively.

Describe how fire brigade intervention will be addressed or considered:

Fire brigade use of the egress stairs will be discussed in the solution.

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☑ None

N/A

Provide details on proposed modelling/assessment tools:

N/A

Issue number: 6 **Title:** Exit Signs

Details of departures from DtS provisions:

Exit signs to be mounted higher than 2.7 m above the ground.

Applicable DtS provisions:	E4.5, E4.6, E4.8, AS 2293.1	Performance requirements:	DP2, EP2.2, EP4.2

List key fire safety measures:

Exit signs having large pictorial elements (at least 200 mm high) are to be installed in accordance to AS/NZS 2293.1-2018, except they are to be hung above 2.7 m from the floor level. Exit signs will mounted at the sides of the kiln, at a maximum height of 5 m from the floor level and a maximum distance between signs of 30 m. Exit signs are to be installed in accordance to AS/NZS 2293.1-2005 above exit doors.

We have assumed in our assessment that staff will have a level of fire and evacuation training. Therefore, an Emergency Management Organisation must be established in accordance with AS 3745-2010.

Proposed alternative solution:

The key hazard for this DtS departure relates to occupants being unable to find their way along an exit path of travel during an emergency due to exit signage outside their visual catchment area.

Qualitative discussion about the evacuation and wayfinding. It is to be shown that the signage is within the visual catchment area (Xie, et al., 2007) and that when occupants reach a sign the next sign can be seen from this location. The impact of early warning by the smoke detection system and smoke exhaust will also be discussed as well the height of the building and the height of the signs.

It is also to be demonstrated that exit signs are visible for the duration of the evacuation based upon the visibility results from the CFD modelling. It is to be demonstrated that the visibility at 5 m height is maintained above 10 m during the evacuation.

In the proposed building, we expect that staff will have a degree of fire and evacuation training as part of their staff induction, such that they are aware of and familiar with exit locations and appropriate responses to alarm systems. An emergency management organisation in accordance with AS 3745 must be established. Therefore, we expect staff are able to find their way through to the exit and assist the visitors to find their way towards the exits.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative	☑ Qualitative	☑ Deterministic
☑ Absolute	☐ Quantitative	☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control	☑ D – Fire detection, warning and suppression
☑ B – Smoke development and spread and control	☑ E – Occupant evacuation and control
☐ C – Fire spread and impact and control	☑ F – Fire services intervention

Acceptance criteria and factor of safety:

It is to be demonstrated that the exit signs are within the visual catchment area given the height and size of the signs and that the visibility at 5 m height is maintained above 10 m during the evacuation.

Fire scenarios and design fire parameters:

A fully developed fire located within the factory with high heat release rate and fast fire growth based on Society of Fire Safety's Practice note for Design will be discussed (SFS, 2012).

Describe how fire brigade intervention will be addressed or considered:

Fire brigade intervention is not expected to be affected by this departure.

Verification/validation analyses:

☐ Sensitivity studies ☑ Redundancy studies ☐ Uncertainty studies ☑ None

Redundancy is provided with staff familiarity of the building and training.

Provide details on proposed modelling/assessment tools:

CFD modelling inputs form attached.

8 Construction, commissioning, management, use and maintenance

What considerations does the alternative solution require during the construction phase?

The Fire Engineering Report and associated fire safety measures must be implemented into the design and identified on the fire safety schedule for the building. They must be maintained and certified in accordance with the Environmental Planning and Assessment Regulations 2000 and the relevant Australian Standards.

How will the alternative solution affect commissioning of the systems (e.g. listed on fire safety schedule as essential or critical measure, combined new and old installations)?

New systems shall be combined with existing installations. Design team members, including RED Fire Engineers and any other relevant stakeholder, as necessary, are to witness testing and commissioning of systems to check compliance with the FER and other applicable design documentation.

How will the alternative solution be addressed for ongoing building management and use (e.g. details to be provided in a 'fire safety management plan' for the building manager)?

The Required Fire Safety Measures to be listed in the Fire Engineering Report are to be included in the Fire Safety Schedule/Fire Safety Management Plan and are to be adhered to accordingly. A 'plain English' summary will be posted adjacent the Fire Indicator Panel with a copy kept in the Fire Safety Management Plan.

How will any restrictions on fuel load/use/populations within the alternative solution be managed and enforced (e.g. details to be provided in 'fire safety management plan')?

Any fuel load and population restrictions will be part of the site's Management in use Plan.

How will the alternative solution be addressed for maintenance (e.g. details included on fire safety schedule, location of fire engineering report on site, plain English summary adjacent to FIP)?

The Required Fire Safety Measures listed in the Fire Engineering Report are to be included in the Fire Safety Schedule and implemented into the design. A 'plain English' summary will be posted adjacent the Fire Indicator Panel with a copy kept in the Fire Safety Management Plan.

9 Additional comments

N/A

Note: Any in principle support extended for alternative solution issues through consultation is contingent upon all assumptions, analyses and conclusions in the fire engineering report being fully justified, and referenced as appropriate, to demonstrate how the relevant performance requirements have been satisfied to the extent required by the agreed acceptance criteria.

10 Scheduled charges

FRNSW charge for the provision of services performed in connection with statutory fire safety as per the schedule of charges identified in clause 46 and schedule 3 of the *Fire Brigades Regulation 2014*.

The charge applicable is $2,600 for each day (or part of a day) spent by the Commissioner or a fire brigade member providing advisory, assessment or consultancy services.

Note: For a full description of the charges applicable including terms, payment options, applying for a waiver or reduction of the charges, please refer to the FRNSW website at firesafety.fire.nsw.gov.au.

11 Submission of this form

This completed form is to be emailed to firesafety@fire.nsw.gov.au.

All plans and specifications required by FRNSW for assessment are to be attached to the email (or sent separately if necessary due to file size). Refer to Submitting plans and specifications to FRNSW for further information.

12 Contact us

For further information contact the Fire Safety Branch on (02) 9742 7434 or email firesafety@fire.nsw.gov.au.

13 References

AED Fire Pty Ltd. (2018). *Dincel Wall System: Generic Performance (Alternative) Solution for Combustibility.* Sydney.

AFAC. (2004). *Fire Brigade Intervention Model. Version 2.2.* Australasian Fire Authorities Council.

Alder, D. (1999). *Metric Handbook: Planning and Design Data* (2nd ed.). Architectural Press.

BSI. (2004). *PD 7974-6:2004 The Application of fire safety engineering principles to fire safety design of buildings – Part 6: Human factors: Life safety strategies – Occupant evacuation, behaviour and condition (Sub-system 6).* London: British Standards Insititute.

FWPA. (2010). *Building with Timber in Bushfire-prone Areas.* Melbourne: Forest & Wood Products Australia Limited.

Ghosh, B. (2009). *Assessment of the benefits of fire extinguishers as fire safety precautions in New Zealand buildings.* Christchurch: University of Canterbury.

Hsiao, H., Whitestone, J., Kau, T.-Y., Whisler, R., Routley, J., & Wilbur, M. (2014). Sizing Firefighers: Method and Implications. *Human Factors, 56*(5), 873-910.

NFPA. (2012). *NFPA 101: Life safety code* (2009 ed.). Quincy, MA: National Fire Protection Association.

Proulx, G. (2008). Evacuation Time. In P. J. DiNenno (Ed.), *SFPE handbook of fire protection engineering* (4 ed., pp. 3-355 - 3-372). Quincy, Mass.: National Fire Protection Association.

SFS. (2012). *Practice note for Design Fires.* Society of Fire Safety.

SFS PN. (2012). *Practice Note for Design Fires.* Sydney: Society of Fire Safety.

SFSU. (2010). *FRNSW's Policy No.4 Guidelines for Emergency Vehicle Access.*

Spearpoint, M. (Ed.). (2008). *Fire Engineering Design Guide* (3rd Edition ed.). Christchurch: New Zealand Centre for Advanced Engineering.

Xie, H., Filippidis, L., Gwynne, S., Galea, E. R., Blackshields, D., & Lawrence, P. J. (2007). Signage Legibility Distances as a Function of Observation Angle. *Journal of FIre Protection Engineering*, 17;41.

Fire & Rescue NSW

CFD/zone modelling inputs form

Complete this form and submit with the corresponding application form when computational fluid dynamics (CFD) or zone modelling is being undertaken as the verification method for any assessment criteria

1 Premises

Premises name (if applicable)	PGH Badgerys Creek
Primary street address	235 Martin Road
Premises suburb	Badgerys Creek

2 Model/program details

Type of modelling	CFD modelling
Name of program	Fire Dynamics Simulator (FDS, NIST)
Version	FDS 6.5.3

Pyrosim 2018 (Thunderhead Engineering) used as GUI.

3 General/domain parameters

3.1 CFD modelling only

Number of meshes	To be confirmed
Type of mesh (e.g. cartesian)	Cartesian
Mesh size	Mesh size will be determined based on size of fire i.e. D*/dx For base scenario grid size varying between 125 x 125 x 125 mm (fire mesh), 250 x 250 x 250 mm (near-fire mesh), to 500 x 500 x 500 mm (far-fire mesh) For sensitive assessment with higher heat release, grid size varying between 250 x 250 x 250 mm (fire- and near-fire mesh), to 500 x 500 x 250 mm (far-fire mesh)
Material properties	With exception of VENTs e.g. fire, exhaust, etc., surfaces are set to INERT. This is considered an acceptable simplification give that the relatively small fire in a large space.
Boundary conditions	Boundary vents OPEN
Major geometrical or other simplifications or assumptions	All as per the architect drawings. Building geometry and obstructions have been simplified to fit the mesh cell sizes outlined above.
Steady-state or transient?	Transient
Simulation time	1800 s

3.2 Zone modelling only

Total floor area volume	Enter details
Floor area and volume of each compartment	Enter details
Openings between compartments	Enter details

Material properties	Enter details
Boundary conditions	Enter details
Major geometrical or other simplifications or assumptions	Enter details
Simulation time	Enter details

4 Fire parameters

Radiative fraction	0.3
Reaction/combustion properties (material, heat of combustion)	Heat of combustion: 20 MJ/kg. Chemical compound: • Carbon (C) 4.56; • Hydrogen 6.56; • Oxygen 2.34; • Nitrogen 0.4.
Soot yield (value and means of including in model)	Soot yield: y_s=0.10
Visibility factor (or parameters used to obtain visibility output)	The Visibility factor value is taken as 3 in this CFD modelling, corresponding to the value for light-reflecting signs where required
Heat release rate per unit area (HRRPUA)	Approximately 1000 kW/m²
Means of achieving fire growth rate (ramp, multiple fire objects)	Fast growth rate achieved by multiple fire objects The building will have rack storage however fire has been modelled horizontally growing as this means more air entrainment resulting in more smoke production. This is conservative when assessing occupant safety.
Fire locations (including height above floor)	Base of fire has been located 0.5 m above the floor level A fire in the centre of the building will be modelled as well as a fire in the corner of the building in the vicinity of an exit as this is the worst-credible scenario.

5 Scenario parameters

Ambient temperature	20 °C
Wind	-
Others	-

6 Fire safety system/device parameters

Mechanical smoke exhaust	-
Mechanical supply air	-
Jet fans	-
Natural vents	Ridge vents
Natural make-up air	Low-level vents open to simulate building leakage and eventual opening of low-level openings by fire brigade upon arrival
Assumed building leakage	See above
Sprinklers (spacing, location, RTI, distance to fire, rating etc.)	N/A

Detectors (spacing, location, RTI, distance to fire, rating, activation obscuration etc.)	-
Other systems/devices	-

7 Outputs

Actual heat release rate curve produced should be compared to specified design fire	Noted. This will be provided in the FER
Sufficient outputs should be provided to justify any results used in the FER	Slice files looking at: • Temperature • Visibility • Velocity For: • 2.0 m above floor level • Cross sectional (Y plane) at a number of locations, including fire • Longitudinal (X plane) at a number of locations, including fire
Others	Enter details

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W: www.redfireengineers.com.au

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Parkwood WA 6147
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Ref: 190624_JN19-00144_PGH Brick_Trial Concept Design.docx

CONSULT ADVICE NOTE

URGENT ☐
PLEASE COMMENT ☒

NUMBER	001
DATE	24 June 2019
TO	Jason Brown
FROM	Blair Stratton
PROJECT NUMBER	JN19-00144
PROJECT	PGH Brick
SUBJECT	Trial Concept Design

Introduction

Our trial concept design detailed in this section is to support the proposed Performance Solution that has been formulated to address the BCA DtS departures identified in the Executive Summary. Our design does not account for any other departures from DtS Provisions related to fire safety.

The following Fire Safety Measures are required to support the fire safety engineering assessment of the proposed Performance Solution and required to achieve compliance with the relevant Performance Requirements of the BCA. They might be subject to change following stakeholder comments, and as a result of the fire engineering analysis.

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Fire Resisting Construction and Compartmentation

A summary of the BCA DtS floor area and volume limitations for the building or any fire compartment in the building are outlined in Table 1.

Table 1: Fire compartment size limitations (from the BCA)

Classification		Max size		
General limitations		Type A	Type B	Type C
Class 7b, 8	**Area**	5 000 m^2	3 500 m^2	2 000 m^2
	Volume	30 000 m^3	21 000 m^3	12 000 m^3

The building is deemed to be a large isolated building as the fire compartment sizes exceed the floor areas identified in BCA DtS Table C2.2. This is acceptable subject to perimeter vehicular access complying with BCA Clause C2.4 and where the building exceeds 18 000 m^2 or 108 000 m^3:

- Sprinkler protection to be provided, and
- Smoke exhaust or smoke and heat vents.

Note that it is proposed not to install sprinklers or smoke exhaust.

It is proposed that perimeter vehicular access consisting of an access road and hardstand areas, will be more than 18 meters from the building in the southeast corner and will not be kept clear of storage (finished products on pallets) and the area has other existing structures built upon it, refer to Figure 1.

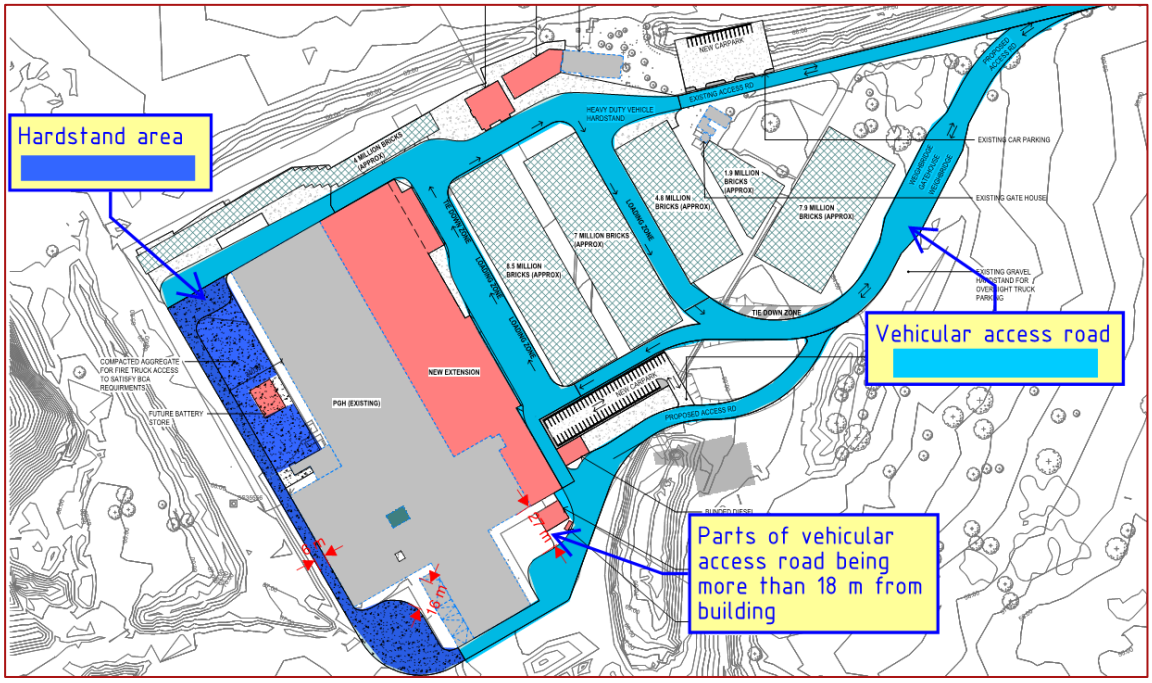


Figure 1: Vehicular access to building

Hardstand area will be provided on all sides of the building providing access to the fire brigade general appliance and an aerial appliance as well as on-foot access from the road to the building, external fire hydrants and other equipment such as fire pumps, booster assembly and the Fire Indicator Panel.

Turning areas in accordance with Clause 5.2 of FRNSW Policy No 4 Guidelines for emergency vehicle access are to be provided as follows –

- Any carriageway not leading directly to an exit (i.e. dead end) should be provided with a turnaround area which prevents the need to perform multi-point turns; and
- The minimum turning radius of turn around areas should not be less than 11.3 m for general appliances and 16.4 m for aerial appliances.

Access and Egress

The building is to have the following extended travel distance that is to be addressed in a Performance Solution –

- Distance of travel to a point of choice is up to approximately 30 m instead of 20 m.
- Distance to travel to an exit from a dead end from within the kiln in the event of a pallet malfunction/breakdown halfway down the line is 75 m instead of 40 m.
- Distance of travel to an exit is up to approximately 115 m instead of 40 m.
- Distance of travel between alternative exists when measured through the point of choice of exits is approximately 160 m instead of 60 m.

Egress widths to be up to 600 mm instead of 1000 mm in equipment/machinery areas. The reduced egress width is only to be pinch points in a few confined areas that are occupied for maintenance reasons.

Egress stairs over plant equipment to be designed to AS 1657:2013 instead of conventional stairs.

Fire Services & Equipment

The building will not be provided with an automatic sprinkler system. The building will also not be provided with smoke exhaust systems or Heat and Smoke Vents. These departures will be addressed in a Performance Solution.

An automatic smoke detection and alarm system complying with Specification E2.2a of the BCA is to be installed to AS 1670.1:2018.

A building occupant warning system (BOWS) is to be provided in accordance with Clause 6 of Specification E2.2a of the BCA. Activation of the smoke detection systems shall operate the BOWS throughout the building. Visual / tactile alarm devices are to be provided to high noise areas only.

Break glass alarms are to be located at the exits from the building.

Mechanical smoke exhaust capable of achieving one air change per hour will be provided to enable FRNSW to initiate smoke clearance following fire. However, this system will not be automatic, subject to satisfactory fire life safety and fire brigade intervention being proven.

Exit signs having large pictorial elements (at least 200 mm high) are to be installed in accordance to AS/NZS 2293.1-2018, except they are to be hung above 2.7 m from the floor level. Exit signs will mounted at the sides of the kiln, at a maximum height of 5 m from the floor level and a maximum distance between signs of 30 m. Exit signs are to be installed in accordance to AS/NZS 2293.1-2005 above exit doors.

Fire hydrant coverage shall be provided in accordance with BCA Clause E1.3 and AS 2419-2005. This may include the provision of internal fire hydrants to suit the operational needs of FRNSW.

Maintenance and Management in Use

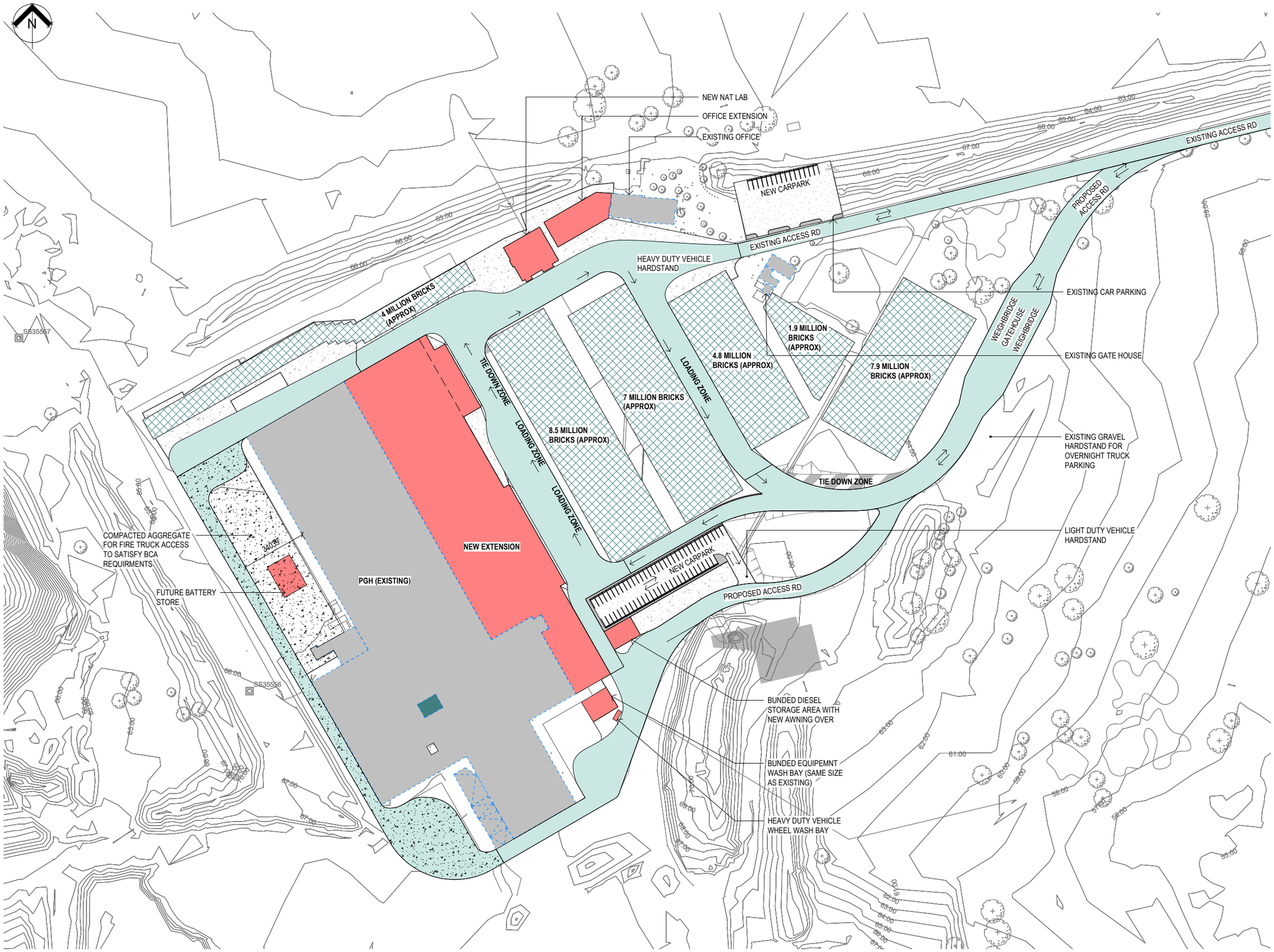
We have assumed in our assessment that staff will have a level of fire and evacuation training. Therefore, an Emergency Management Organisation must be established in accordance with AS 3745-2010.

Management procedures shall also be implemented to ensure that the essential services measures are maintained and regularly inspected in accordance with the AS 1851-2012. In addition, all Essential Safety items that do not comply with the BCA or relevant standard must be rectified whether or not this non-compliance was identified as part of the building's commissioning.

All staff, maintenance personnel and visitors are to be provided with induction to site and evacuation procedures.

A copy of the latest FER is to be kept on site and a plain English Summary of the Performance Solution is to be provided at the FIP.

Good housekeeping and regular fire prevention practices are to be carried out to minimise the risk of unnecessary fuel loads and sources of ignition.



1 / - PGH FEBQ FIRETRUCK CIRCULATION

1 : 1000

GENERAL NOTES

1. IF THE CONTRACTOR FINDS ANY INCONSISTENCY, ERROR OR OMISSION IN THE DOCUMENTS, OR BETWEEN DOCUMENTS, THE ARCHITECT MUST BE NOTIFIED.
2. THE CONTRACTOR IS TO READ ALL DRAWINGS TO COORDINATE FIXTURES, FITTINGS AND DIMENSIONS.
3. GRIDS ARE PROVIDED FOR REFERENCE ONLY.
4. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE BEFORE FABRICATION.
5. MATERIAL PERFORMANCE TO COMPLY WITH ALL ASPECTS OF NCC / BCA AND RELEVANT AUSTRALIAN STANDARDS.
6. APPLY PROPRIETARY MATERIALS AND COMPONENTS TO THE MANUFACTURER'S EXPRESS WRITTEN INSTRUCTIONS.
7. DO NOT SCALE DRAWINGS
8. ALL DIMENSIONS ARE IN MILLIMETRES

NOTES

1. REFER TO DRAWING 2449285-DRG-33080-AA-0301 FOR LEGENDS, NOTES AND MATERIAL FINISHES.
2. BACKGROUND EQUIPMENT LAYOUT SHOWN INDICATIVE. LAYOUT SUBJECT TO CHANGE DEPENDING ON APPROVED VENDOR LAYOUT.
3. FOR OFFICE AND AMENITIES DETAILS AND NOTES, REFER TO DRAWING 2449285-DRG-33080-AA-7101

SITE LEGEND

- PGH EXISTING BUILDING FOORPRINT
- PGH NEW BUILDINGS/EXTENSION
- MONIER SITE LOCATION
- ROAD ACCESS TO SITE
- NEW FOOTPATH
- NEW HEAVY DUTY HARDSTAND
- NEW LIGHT DUTY HARDSTAND
- BRICK PALLET STACKING ZONE
- FEBQ TRUCK ACCESS
- COMPACTED AGGREGATE FOR FEBQ TRUCK ACCESS
- CSR SITE BOUNDARY
- EXISTING APPROVED PROJECT BOUNDARY

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	ISSUE FOR INFORMATION	CK	TW	LG	5.06.19

Drawing Originator: Beca

Original Scale (A1)	Design	T.W.WANG 05.12.2018
As indicated	Drawn	C.KILLALEA 05.06.2019
Reduced Scale (A3)	Dsg Verifier	M.WARNE 05.12.2018
Half A1	Dwg Check	D.MCNAMARA 05.06.2019

Client: CSR

Project: PGH - BADGERYS CREEK DEVELOPMENT
235 MARTIN ROAD, BADGERYS CREEK, NSW

Title: FEBQ FIRETRUCK CIRCULATION

Discipline: FIRE ENGINEERING

Drawing No.: 4744-0250- DWG-FE-0002

Rev.: A

DO NOT SCALE

IF IN DOUBT ASK.

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Document No. C:\Users\Public\Documents\BecaCAD\Rev\#2449285-PGH-AA-2018_connor.killalea.rvt

Fire & Rescue NSW

Fire Engineering Brief Questionnaire (FEBQ)

1 Document control

Applicant reference number JN19-00144 **FRNSW reference number** BFS19/1165

Ver.	Author	Organisation	Status	Date
01	Blair Stratton (C10 BPB 1877)	RED Fire Engineers Pty Ltd	Initial submission	27/06/2019

2 Applicant

2.1 Agreement

As the applicant, I confirm the following:

- I agree to pay Fire and Rescue NSW (FRNSW) the charges set out in Clause 46 of the *Fire Brigades Regulation 2014* (see Section 10).
- I agree to forward with this application the following documentation for FRNSW to review and provide advice on the assessment methods and acceptance criteria proposed for the given alternative solution:
  - ☑ Copy of proposed building plans and specifications (e.g. relevant floor plans, elevations, site plan, section views, hydrant plan and schematic)
  - ☑ BCA report or letter from an accredited certifier that identifies all non-compliances (if available)
  - ☑ CFD/zone modelling inputs form (if applicable)
  - ☑ Report extract of the trial design requirements/proposed fire safety measures (optional).

Name of applicant	Monier Pty Ltd
Role of applicant	Development owner
Applicant phone number	0419 474 789
Applicant email address	DLZarb@csr.com.au

2.2 Remittance advice information

Invoices will be issued based on the information provided below:

Company / vendor name	CSR Building Products Pty Ltd		
Australian business number	55 008 631 356	Trading name	CSR Monier
Remittance contact name	Daniel Zarb		
Remittance street address	10 Grand Ave, Rosehill NSW 2142, Australia		
Remittance postal address	PO Box 147, Parramatta NSW 2124		
Remittance email address	DLZarb@csr.com.au		
Remittance phone number	0419 474 789	Remittance fax number	N/A
Purchase order ref. no.	If applicable	Project code ref. no.	If applicable

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3 Consultation

3.1 Stakeholders

Role	Name and BPB number	Organisation and phone	Email address
Fire safety engineer	Blair Stratton C10 BPB 1877	RED Fire Engineers Pty Ltd 0434 481 676	blair@redfireengineers.com.au
BCA consultant	Nickolas Hontas BPB 0832	SW partners (02) 9283 6555	nhontas@swpartners.com.au
Certifying authority	Steve Watson	Steve Watson and Partners ABC17 (02) 9283 6555	swatson@swpartners.com.au
FRNSW reviewers	FRNSW use only FRNSW use only	Fire and Rescue NSW 02 9742 7434	firesafety@fire.nsw.gov.au

3.2 Meeting details

In conjunction with the written comments provided in response to this FEBQ, FRNSW may hold a meeting with the applicant to discuss aspects of the proposed alternative solution. The meeting will be at the discretion of FRNSW.

Type of meeting preferred ☐ No meeting ☐ Telephone meeting ☑ Face-to-face meeting

4 Project details

4.1 Premises

Premises name	CSR Monier
Primary street address	235 Martin Road
Secondary street address	Secondary street address (if applicable)
Premises suburb	Badgerys Creek
Lot and DP numbers	Lot 54 DP 3050, Lo t55 DP 3050, Lot 56 DP 3050

4.2 Proposed works

☑ New building
☐ Refurbishment of an existing building
☐ Extension of an existing building
☐ Change in use within an existing building
☐ Other: (provide details)

Applicable NCC: NCC 2019

For existing buildings:
Approximate year of construction: N/A
Building code when constructed: **Select**

How many alternative solution issues are proposed in this FEBQ? 5

Note: The number of alternative solution issues must address all identified non-compliances.

Have all departures from the deemed-to-satisfy (DtS) provisions of the *National Construction Code* (*NCC*) been identified for this proposed design (i.e. a BCA report or letter from an accredited certifier)? Yes, refer BCA report

Note: Any advice given is subject to all non-compliances being identified. Any new DtS departures identified, including any from the certifying authority determining the application for construction certificate, may affect FRNSW advice in respect to this alternative solution.

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Identify if any previous alternative solution applies to the building:

No, no previous alternative solution applies to the building.

Identify if any application has been/will be submitted under Clause 188 of the *Environmental Planning and Assessment Regulation 2000*:

N/A

Identify if the premises is or will be subject to any development application (DA) conditions or special regulatory approvals (e.g. BPB conditions, ministerial conditions, crown building works):

Note: FRNSW will not comment on existing buildings subject to voluntary upgrade or change of use prior to the issuing of any DA conditions of consent, or conditions of an existing consent have been modified (i.e section 4.55 of *Environmental Planning and Assessment Act 1979*). Comment will also not be provided if an order has been issued unless the Council agrees. The Council may seek advice during the DA review.

DA has been submitted, however, not yet approved.

Will the premises be subject to a fire safety study, risk assessment or dangerous goods study? No, refer attached dangerous goods manifest. The quantities of goods do not cause need for a fire safety study to be carried out.

Note: Any study/risk assessment should be completed prior to submitting this FEBQ and should be attached to this application.

4.3 Description of building occupancy

Main occupancy class	8	Other occupancy classes	5
Type of construction	C – large isolated building	Largest fire compartment (m^2)	5,800
Effective height (m)	3 m	Ground floor area (m^2)	5,400
Rise in storeys	2	Total floor area (m^2)	5,800
Levels contained	2	Total volume (m^3)	Approx. 40,000

Outline any additional building characteristics:

The proposed building is to consist of a new two storey roofing manufacturing factory and two smaller ancillary warehouse and wind tunnel facilities. The building will consist of a semi-automated roof tile factory with an office area. The roof tile production area will contain high temperature curing and kiln facilities. The works also involve large hardstand areas for storage of pallets and associated car parking, access roads in and around the site.

List key occupant characteristics for the building:

The estimated population load and building occupant characteristics are detailed in Table 1.

Table 1: Occupant characteristics

Characteristic	Factory, workshop and office areas
Number and distribution	• Office: 30 occupants* • Operations/Factory: 80 occupants
State	We expect that occupants will be alert, awake and able to respond to evacuation signals at all times that the building is occupied. CSR has a drug and alcohol policy and as such we will assumed occupants to not be under the influence of drugs or alcohol.
Level of assistance required	We expect that the majority of the occupants in the building will not require physical assistance to egress out of the building in an emergency. Due to the nature of the facility, we expect occupants with disabilities will not be present in production areas, unless they are able to egress without assistance from others.
Emergency training	We expect that members of staff will have a degree of fire and evacuation training, such that they are aware of exit locations and appropriate responses to alarm systems. An Emergency Management Organisation will be established for the site, with wardens and staff provided with induction and refresher training in accordance with AS 3745.

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5 Hazards

Outline any hazards unique to the building:

The roof tile area will contain high temperature curing and kiln facilities.

The building will contain hazardous chemicals and dangerous goods. Chemicals and goods will be generally stored in professionally made cabinets and gas bottles will be stored in cages when not in forklifts. Diesel tank (1000 litres) is located outside the building.

The building will also contain packing consumables. The consumables will not exceed 1,000 m^3 and will not be stored at a height above 4 m.

The subject building will not contain special hazards in a quantity that would require additional provision in accordance with BCA Clause E1.10 and E1.3. Dangerous goods will be stored in accordance with AS 1940-2004.

- ☐ Combustible external cladding
- ☐ Combustible waste (i.e. waste facility)
- ☑ Hazardous chemicals / dangerous goods
- ☑ Electricity supply system (e.g. substations)
- ☐ Battery system (e.g. BSS, BESS, ESS)
- ☐ Alternative electrical generation (e.g. solar, tri-gen)
- ☐ Insulated sandwich panels
- ☐ Podium type building
- ☐ A basement level
- ☐ An atrium (Part G3 of BCA)
- ☐ Car stacker
- ☑ Other: High temperature curing and kiln facilities.

Note: Clauses E1.10 and E2.3 of the NCC should be addressed when special hazards exist (e.g. car stacker, hazardous chemicals/dangerous goods).

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6 Preventative and protective measures

Identify fire safety measures that are, or will be, provided throughout the building, including anything undecided, which should be mentioned as part of the FEBQ review. Additional information may be added to the comments section below to better describe any systems or indicate systems that may be subject to alternative solution.

Occupant warning system	**Signage**	**Facilities for emergency services**
☑ Building occupant warning	☑ Emergency lighting	☐ Emergency lifts
☐ EWIS	☑ Exit and direction signs	☐ Fire control centre
☐ SSISEP	☑ Warning and operational signs	☐ Fire control room
☑ Break glass unit	**Hydrant system**	☑ Perimeter vehicular access
☑ Visual / tactile alarm devices*	☐ AS 2419.1-2017	☐ Standby power supply system
Smoke hazard management	☑ AS 2419.1-2005	**Firefighting equipment**
☐ Zone smoke control	☐ AS 2419.1-1994 (existing building)	☑ Portable fire extinguishers
☐ Purge system (existing building)	☐ Ordinance 70 (existing building)	☑ Fire hose reels
☐ Smoke and heat vents	☑ External hydrants	**Water supply**
☐ Smoke exhaust	☐ Internal hydrants	☐ Grade 1
☐ Smoke baffles	☐ Internal dry-riser (for FPAA101D)	☐ Grade 2
☑ Ridge vents	☐ Street hydrant coverage only	☐ Grade 3
☐ Stair pressurisation	☑ Hydrant booster assembly	☑ Onsite storage tank
☐ Impulse / jet fans (in carpark)	☑ Pumpset	☐ Dual supply
☐ Other: (provide details)	☐ Other: (provide details)	**Protection** of openings
Detection system	**Suppression system**	☑ Fire doors
☐ AS 3786:2014	☐ CA16 (existing building)	☐ Smoke doors
☐ AS 3786-1993 (existing building)	☐ AS 2118.1-2017	☐ Solid core doors
☐ AS 1670.1:2018	☐ AS 2118.1-2006	☐ Fire windows
☐ AS 1670.1:2015 (existing building)	☐ AS 2118.1-1999 (existing building)	☐ Fire shutters
☐ AS 1668.1:2015	☐ AS 2118.2-2010 (wall-wetting)	☐ Wall-wetting sprinklers
☐ AS 1670.3-2018 (monitored)	☐ AS 2118.3-2010 (deluge)	☐ Fire curtain
☐ AS 1670.3-2004 (existing building)	☐ AS 2118.4-2012 (residential)	☐ Smoke curtain
☐ Smoke alarms	☐ AS 2118.5-2006 (domestic)	☐ Safety curtain for openings
☐ Heat alarms	☐ AS 2118.6-2012 (combined)	☐ Fire dampers
☑ Smoke detectors	☐ FPAA101D (class 2 or 3)	☐ Smoke dampers
☐ Heat detectors	☐ FPAA101H (class 2 or 3)	☐ Fire seals (intumescent)
☐ Flame detectors	☐ Fast response heads	☐ Hot smoke seals (>200ºC)
☐ CO detectors	☐ ESFR	☐ Medium temp. smoke seals
☐ Multi-criteria fire detectors	☐ Storage mode sprinklers	
☐ Aspirated smoke detection	☐ Gaseous suppression system	
☑ Beam detection	☐ Water mist system	
☐ Other: (provide details)	☐ Other: (provide details)	

Additional information:

* Visual / tactile alarm devices to high noise areas only

- A Building Occupant Warning System (BOWS) is to be provided in accordance with Clause 6 of Specification E2.2a of the BCA. Activation of the smoke detection systems shall operate the BOWS throughout the building.
- Break glass alarms are to be located at the exits from the building.
- Perimeter vehicular access, consisting of an access road, will be more than 18 meters from the building in some locations and will not be kept clear of storage (finished products on pallets) and the area has other existing structures built upon it. The area around the building will generally be engineered road base surfaces capable of supporting fully laden prime movers.

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- Turning areas in accordance with Clause 5.2 of FRNSW Policy No 4 Guidelines for emergency vehicle access is to be provided.
- Exit signs having large pictorial elements (at least 200 mm high) are to be installed in accordance to AS/NZS 2293.1-2018, except they are to be hung above 2.7 m from the floor level. Exit signs will be mounted at the sides of the kiln, at a maximum height of 5 m from the floor level and a maximum distance between signs of 30 m. Exit signs are to be installed in accordance to AS/NZS 2293.1-2005 above exit doors.
- We have assumed in our assessment that staff will have a level of fire and evacuation training. Therefore, an Emergency Management Organisation must be established in accordance with AS 3745-2010.
- Management procedures shall also be implemented to ensure that the essential services measures are maintained and regularly inspected in accordance with the AS 1851-2012. In addition, all Essential Safety items that do not comply with the BCA or relevant standard must be rectified whether or not this non-compliance was identified as part of the building's commissioning.
- All maintenance personnel and visitors to be provided with induction to site and evacuation procedures.
- A copy of the latest FER is to be kept on site and a plain English Performance Solution Summary is to be provided at the FIP.
- Good housekeeping and regular fire prevention practices are to be carried out to minimise the risk of unnecessary fuel loads and sources of ignition.

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7 Departures from the Deemed-to-Satisfy provisions

Issue number: 1 **Title:** Vehicular access and omission of automatic sprinkler system

Details of departures from DtS provisions:

The building is a large isolated building, however it is not provided with perimeter vehicular access and open space around the entire building in accordance with BCA Clause C2.4(b) as prescribed by BCA Clause C2.3 and C2.4 of the BCA. The building is not proposed to be provided with an automatic sprinkler system.

Perimeter vehicular access and hardstand area is to be provided as indicated in Figure 1.

.

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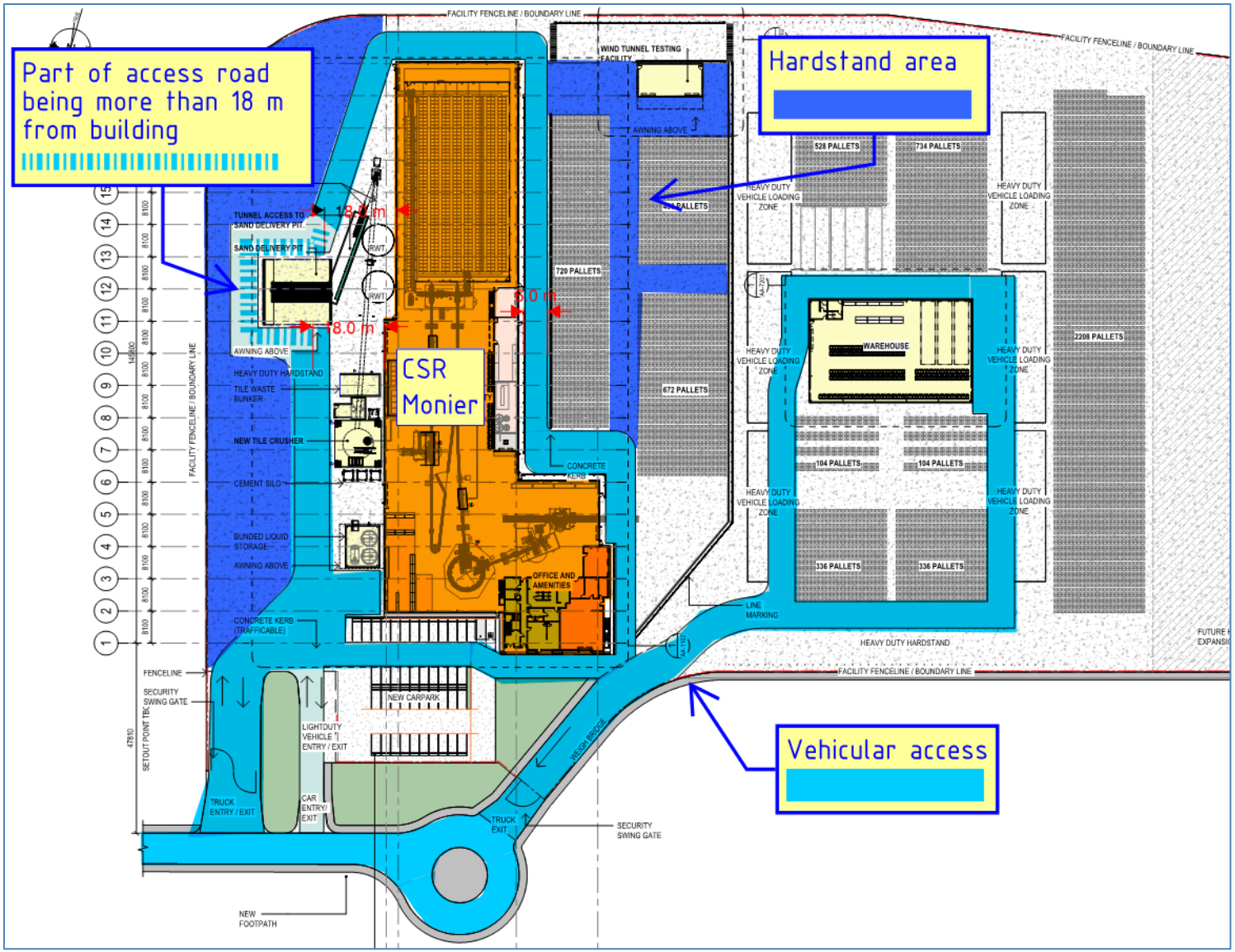


Figure 1: Vehicular access to building

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Applicable DtS provisions:	C2.3, C2.4 and E1.5	Performance requirements:	CP2,CP9, EP1.4

List key fire safety measures:

The building will not be provided with an automatic sprinkler system.

Hardstand area will be provided on all sides of the building providing access to the fire brigade general appliance and an aerial appliance as well as on-foot access.

Turning areas in accordance with Clause 5.2 of FRNSW Policy No 4 Guidelines for emergency vehicle access is to be provided as follows –

- Any carriageway not leading directly to an exit (i.e. dead end) should be provided with a turnaround area which prevents the need to perform multi-point turns; and
- The minimum turning radius of turn around areas should not be less than 11.3 m for general appliances and 16.4 m for aerial appliances.

Proposed alternative solution:

The key hazard for this DtS departure relates to the fire brigade not being able to intervene and provide an initial attack on a developing fire from all sides of the building and that a fire could grow uncontrolled within the building. Another key hazard is the potential risk of larger fire and fire spread between buildings due the omission of the sprinkler system. The Guide to the BCA clarifies that for large isolated buildings, the reason for providing the fire brigade with perimeter vehicular access to large isolated buildings is to enable the brigade to intervene to fight the fire, assist with evacuation, and stop the spread of a fire to another building. The vehicular access also provides other emergency services personnel, such as ambulance officers, with the ability to access the building as necessary. This departure will be assessed by qualitative discussion regarding the proposed vehicular access, the ground surface around the building and the building characteristics. Potential impact on fire brigade intervention and fire spread to adjacent properties will be described qualitatively.

The proposed Perimeter vehicular access, consisting of an access road, will be more than 18 meters from the building in some locations and will not be kept clear of storage (finished products on pallets) and the area has other existing structures built upon it. The area around the building will generally be engineered road base surfaces capable of supporting fully laden prime movers. As such, it would accommodate both general appliance and aerial appliances that will need additional width to extend stabilizers.

The building has multiple on-foot entry points from the perimeter access road on all sides of the building, and general access to and around the site is good. The hardstand areas will also allow for full access to all areas without the need to reverse out of dead-ends. The size of the hardstand area will be able to provide space for an appliance to turn around if needed. As such, the building provides other emergency services personnel, such as ambulance officers, with the ability to access the building as necessary. We therefore expect that the brigade will be able to intervene to fight the fire.

Access to firefighting equipment (e.g. booster, pumps, hydrants) will be available from access road.

The ridge vent and low-level openings for makeup air are expected to naturally ventilate heat and smoke and limit the risk of flashover.

Due to the nature of the process (moulding and firing/curing clay into roof tiles) there is limited combustible fuel load and the fire hazard is low compared to other DtS buildings. The risk of delayed/disrupted fire brigade access to and around the site is not expected to be worse than that of a DtS building.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☑ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☑ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☑ Comparative ☑ Qualitative ☑ Deterministic
☑ Absolute ☑ Quantitative ☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control
☑ B – Smoke development and spread and control
☑ C – Fire spread and impact and control
☑ D – Fire detection, warning and suppression
☐ E – Occupant evacuation and control
☑ F – Fire services intervention

Acceptance criteria and factor of safety:

The design will be deemed acceptable if it can be shown that sufficient vehicular and on-foot access is provided to the responding fire brigade. It is to be demonstrated that risk of fire spread between buildings has been mitigated to the degree necessary considering nature of the subject building.

The omission of a sprinkler is acceptable if it can be demonstrated that a fire within the building is unlikely and the risk of fire spreading is less than or at least equivalent to a BCA DtS design.

Access to the main entries to the building and firefighting equipment (e.g. booster and external hydrants) to be available from the access road.

Fire scenarios and design fire parameters:

Fires will be generally described qualitatively in the assessment.

A fire will also be described quantitatively by considering a fire in a stack of idle pallets as an emitter in the radiation calculations. This would represent a worst-case fire located 6 m from the building.

Describe how fire brigade intervention will be addressed or considered:

Potential impact on fire brigade intervention and fire spread to adjacent properties (located >>18 m from this building) will be described qualitatively.

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☑ None

Conservative input data are to be assumed throughout the assessment for the radiation calculations.

Provide details on proposed modelling/assessment tools:

The Thermal Radiation Analysis (TRA) computer software is used to calculate thermal radiation between surfaces and provides a visual output. It is focused on fire engineering design and analyses radiation between hot emitter surface such as fires or compartment fire windows to cool receiver surfaces such as boundary walls or evacuation routes.

The theory or equation between surfaces used in the TRA computer software is as shown below which is widely used to determine the radiant heat intensity from a single opening of a building to a point some distance away (Spearpoint, 2008). It takes into account of the configuration factor (shape factor or geometric factor) which determines the intensity of radiation received by a surface remote from an emitter.

$$q_r'' = F_{1-2} \times \varepsilon \times \sigma \times \left(T_{emitter}^4 - T_{receiver}^4\right)$$

Where:

q_r''	radiant heat flux received by receiver [kW/m^2]
F_{1-2}	configuration factor [-]
ε	emissivity [-]
σ	Stefan Boltzmann constant (5.67 x 10^{-8}) [W/(m^2 K^4)]
$T_{emitter}$	temperature of emitter [K]
$T_{receiver}$	temperature of receiver [K]

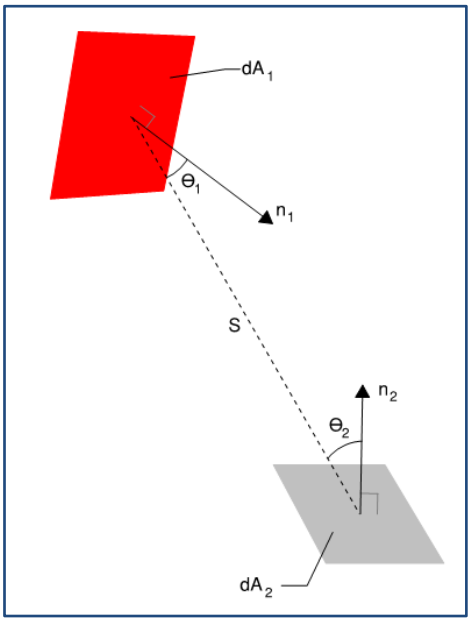


Figure 2: Configuration factor between surface A_1 and A_2

To determine both the average and maximum radiation in the TRA software, key parameters such as the temperature and emissivity are input. Emitting and receiving surfaces are described using four coordinates. The software performs numerical integration to calculate the radiation levels.

The TRA software can be purchased via the following website: http://www.fire-engineering-software.com/tra.html

Issue number: 2 **Title:** Egress provisions

Details of departures from DtS provisions:

Distance of travel between alternative exists when measured through the point of choice of exits is approximately 80 m instead of 60 m.

Applicable DtS provisions:	D1.4, D1.5	Performance requirements:	DP4, EP2.2

List key fire safety measures:

A Building Occupant Warning System (BOWS) is to be provided in accordance with Clause 6 of Specification E2.2a of the BCA. Activation of the smoke detection systems shall operate the BOWS throughout the building

Break glass alarms are to be located at the exits from the building.

Personnel are familiar with the building and provided with training for emergency situations.

Proposed alternative solution:

The key hazard with these departures relates to the extended evacuation time as due to the extended travel distances, resulting in occupants becoming exposed to untenable conditions from a fire during evacuation.

Qualitative discussion regarding the subject building characteristics and occupants' characteristics within the building.

Fire and smoke modelling will be performed to demonstrate that the occupants will be able to evacuate prior to the onset of untenable conditions, i.e., Available Safe Evacuation Time (ASET) vs Required Safe Evacuation Time (RSET). The ASET of the proposed design will be determined using Fire Dynamic Simulator (FDS). FDS is a computational fluid dynamics (CFD) model of fire driven fluid flow.

RSET

The RSET will be determined based on hand-calculations.

- The evacuation time, when used in this report, is defined as the time for all occupants to reach a place of safety from their point of origin.
- A place of safety is a place which people can reach safely via the escape route, and which will be relative safe from the effect of fire. For the purpose of this assessment, the outdoor areas are considered places of safety.

The RSET is generally consisting of the following main components:

- Alarm/Detection Time,
- Pre-movement Time,
- Movement Time.

The proposed increase in travel distance will mostly impact the movement time whilst the alarm/detection and pre-movement time is assumed to be the same as determined in Table 2.

Table 2: Assumptions and background to egress calculations

RSET variable	Occupants can see fire/smoke	Occupants cannot see fire/smoke (1st percentile)	Occupants cannot see fire/smoke (99th percentile)
Cue Period (P_c)	Occupants assumed to be aware of the fire when smoke is below 5 % of ceiling height (Eaton, 1991)	Based on calculated time for occupant who can see the fire walking to and activating manual call points.	Based on calculated detection time based on when manual call points are activated.
Response and Delay Period (P_r + P_d) (These pre-movement times are based on PD 7974 part 6 (BSI, 2004))	30 seconds	30 seconds	2.5 minutes

Travel Speed (These speeds are based on the SFPE Handbook, for persons with full mobility and occupants with a mobility disability (Proulx, 2008))	Horizontal Travel	95 % of occupants: 1.0 m/s 5 % of occupants: 0.85 m/s All occupants will conservatively be assumed to have a minor mobility impairment with a travel speed of 0.85 m/s in the calculations.
	Vertical travel	95 % of occupants: 0.7 m/s 5 % of occupants: 0.33 m/s

Movement time is the time needed for all of the occupants to go from a point of origin to some destination, generally considered to be reaching a place of safety and it can be divided into two parts:

- the time it takes for occupants to move to an exit (travel time); and
- the time it takes for occupants to pass through an exit (queuing time).

ASET

The ASET in the building is the time between the fire start and the onset of untenable conditions.

ASET vs RSET

To determine whether occupants in the building can escape safely in a fire event, the ASET is compared to RSET.

The acceptance criterion is that the ASET must be greater than RSET with a safety factor incorporated.

The safety factors are as follows:

- Sensitivity design scenario: SF = 1.0
- Base case scenarios: SF = 1.5

Refer to Table 3 for Life Safety Criteria.

Performance solution:

☑ A2.2(1)(a) - Comply with all relevant performance requirements
☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

☐ A2.2(2)(a) - Evidence of suitability
☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
☐ A2.2(2)(c) - Expert judgement
☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative	☑ Qualitative	☑ Deterministic
☑ Absolute	☑ Quantitative	☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control	☑ D – Fire detection, warning and suppression
☑ B – Smoke development and spread and control	☑ E – Occupant evacuation and control
☐ C – Fire spread and impact and control	☑ F – Fire services intervention

Acceptance criteria and factor of safety:

The ASET shall exceed the RSET with a safety factor of 1.5 for the base case. The ASET shall exceed the RSET with a safety factor of 1 for sensitivity cases.

Occupants are to be able to evacuate prior to untenable conditions occur.

The critical criteria for untenable conditions depend on whether the smoke layer height is above or below occupant head-height (taken as 2.1 m). These parameters are taken from the Fire Engineering Design Guide (Spearpoint, 2008).

Table 3: Life safety criteria

Measurement	Criteria 1: Smoke layer above 2.1 m	Criteria 2: Smoke layer below 2.1 m
Upper layer temperature	Not to exceed 200 °C	Not to exceed 60 °C
Lower layer temperature	Not to exceed 60 °C	Not to exceed 60 °C
Radiant heat	Not to exceed 2.5 kW/m^2 at 2.1 m above floor level.	Not to exceed 2.5 kW/m^2 at 2.1 m above floor level.
Visibility	-	Visibility not to fall below: • 10 m generally. • 5 m in small rooms. • 5 m where occupants are standing in queues for a short period of time.
Toxicity	-	Toxicity is conservatively estimated by considering whether visibility is maintained. As above, visibility should not fall below: • 10 m generally. • 5 m in small rooms. • 5 m where occupants are standing in queues for a short period of time.

Fire scenarios and design fire parameters:

Fire scenarios will be determined based on likely fuel loads and ventilation within the building. No vehicles except for gas/electric driven will be present in the building.

A t2 fire with fast growth rate up to 5 MW will be assessed as a worst-credible scenario, given the limited combustibles. A 5 MW fire represents a stack of wooden pallets burning.

As a sensitivity analysis, a more severe fire will be assessed with a higher maximum heat release rate of 10 MW.

Describe how fire brigade intervention will be addressed or considered:

Fire brigade intervention is not expected to be affected by this departure. Given the smoke clearance system the conditions in the building is expected to be equivalent to that of a DtS large isolated building.

Verification/validation analyses:

☑ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☐ None

The following sensitivity scenarios will be evaluated:

- A more severe fire
- Blocked Exit

Provide details on proposed modelling/assessment tools:

CFD modelling inputs form attached.

Issue number: 3 **Title:** Reduced egress width

Details of departures from DtS provisions:

Egress widths to be up to 600 mm instead of 1000 mm in the curing chamber.

Applicable DtS provisions:	D1.6	Performance requirements:	DP6, EP2.2

List key fire safety measures:

N/A

Proposed alternative solution:

The key hazard of this departure is that the reduced clear width of the egress width may delay the safe evacuation of the building occupants.

Qualitative discussion regarding the key body measurements of occupants and fire fighters based on international studies will be performed.

Main egress routes through the factory will have an egress width of 1000 mm in accordance with the DtS provisions. Egress width will be minimum of 600 'pinch point' in few confined areas. . These areas will only be occupied for maintenance reasons

Research into key body dimensions for the UK (Alder, 1999) show that the 95th percentile for males has a shoulder width of 510 mm. Furthermore, the NFPA 'ready reference on human behaviour in fires' (NFPA, 2003) states that the major axis across the shoulders of a body ellipse used to develop egress systems is 609 mm.

Based on the anthropometric data, the sway width for adult male at shoulder height is between 510 mm to 760 mm (NFPA, 2012). Therefore, a reduced egress width of 600 mm will not accommodate all body dimensions. However, the occupant load in the area where the reduced egress occur is expected to be very low and restricted to maintenance staff only. Therefore, occupants are not expected to be unduly delayed in their evacuation.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☑ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative	☑ Qualitative	☑ Deterministic
☑ Absolute	☐ Quantitative	☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control	☐ D – Fire detection, warning and suppression
☐ B – Smoke development and spread and control	☑ E – Occupant evacuation and control
☐ C – Fire spread and impact and control	☑ F – Fire services intervention

Acceptance criteria and factor of safety:

The reduced egress width will be considered acceptable if it is not expected to unduly delay evacuation from the building.

Fire fighters are not to be hindered from applying water to a fire or conducting search and rescue due to the reduced width.

Fire scenarios and design fire parameters:

Fire anywhere within the subject building requiring occupant evacuation and/or fire brigade intervention.

Describe how fire brigade intervention will be addressed or considered:

Key body measurements of fire fighters based on international studies will be taken into consideration so fire fighters are not hindered from fighting a fire or conducting search and rescue due to the reduced width.

In relation to fire brigade intervention, it is expected that occupants have evacuated before the fire brigade arrive or start their fire brigade intervention and there will be no issue with counter flow. Research presented in the journal Human Factors (Hsiao, et al., 2014) publish measurements of expected width of fire fighters with gear on. The 95th percentile shows that the bideltoid breadth (shoulder width) for male fire fighters is 796 mm.

The reduced width in the subject building will still generally be sufficient for fire fighters to access through. In a few locations, there will be squeeze point not allowing the fire brigade to access through. As these locations will only occur in isolated and confined areas in around equipment, the brigade will be able to apply water to a potential fire without having to enter the area.. Therefore, the impact of reducing the paths' widths is not expected to introduce any additional risk to the intervening fire brigade.

Verification/validation analyses:

☑ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☐ None

The 95th percentile sway width for males as well as the 95th percentile shoulder width for male fire fighters will be used. As the male sway width is larger than females, the female widths have not been taken into consideration.

Provide details on proposed modelling/assessment tools:

N/A

Issue number: 4 **Title:** Egress stairs

Details of departures from DtS provisions:

Egress stairs over plant equipment to be designed to AS 1657:2013 instead of conventional stairs.

Applicable DtS provisions:	D2.18	Performance requirements:	DP2, EP2.2

List key fire safety measures:

Egress stairs to be design to AS 1657:2013.

An Emergency Management Organisation must be established in accordance with AS 3745-2010.

All maintenance personnel and visitors to be provided with induction to site and evacuation procedures

Proposed alternative solution:

A qualitative and absolute assessment is undertaken to evaluate the risk of a fire exposing egressing personnel working within the area for limited time. The analysis will review occupant characteristics within the plant room and production areas, the egress provisions and the risk of fire and smoke therein.

The occupants allowed in the plant room and production areas, are staff members or maintenance personnel, consequently, they are trained and familiar with space and the egress route. Also, the plant room and production areas, are only to be accessed as part of maintenance and services and will be semi-automated. Therefore, the areas will be infrequently occupied.

Tenable conditions are expected to be maintained on the egress path to at least the same extent as in a DtS building.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☑ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative	☑ Qualitative	☑ Deterministic
☑ Absolute	☐ Quantitative	☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control	☐ D – Fire detection, warning and suppression
☐ B – Smoke development and spread and control	☑ E – Occupant evacuation and control
☐ C – Fire spread and impact and control	☑ F – Fire services intervention

Acceptance criteria and factor of safety:

Occupants are not to be trapped and unable to evacuate in the event of a fire due to the non-conventional stairs.

Fire scenarios and design fire parameters:

A worst-case fire scenario will be described qualitatively.

Describe how fire brigade intervention will be addressed or considered:

Fire brigade use of the egress stairs will be discussed in the solution.

Verification/validation analyses:

☐ Sensitivity studies ☐ Redundancy studies ☐ Uncertainty studies ☑ None

N/A

Provide details on proposed modelling/assessment tools:

N/A

Issue number: 5 **Title:** Exit Signs

Details of departures from DtS provisions:

Exit signs to be mounted higher than 2.7 m above the ground.

Applicable DtS provisions:	E4.5, E4.6, E4.8, AS 2293.1	Performance requirements:	DP2, EP2.2, EP4.2

List key fire safety measures:

Exit signs having large pictorial elements (at least 200 mm high) are to be installed in accordance to AS/NZS 2293.1-2018, except they are to be hung above 2.7 m from the floor level. Exit signs will mounted at the sides of the kiln, at a maximum height of 5 m from the floor level and a maximum distance between signs of 30 m. Exit signs are to be installed in accordance to AS/NZS 2293.1-2005 above exit doors.

We have assumed in our assessment that staff will have a level of fire and evacuation training. Therefore, an Emergency Management Organisation must be established in accordance with AS 3745-2010.

Proposed alternative solution:

The key hazard for this DtS departure relates to occupants being unable to find their way along an exit path of travel during an emergency due to exit signage outside their visual catchment area.

Qualitative discussion about the evacuation and wayfinding. It is to be shown that the signage is within the visual catchment area (Xie, et al., 2007) and that when occupants reach a sign the next sign can be seen from this location. The impact of early warning by the smoke detection system and smoke exhaust will also be discussed as well the height of the building and the height of the signs.

It is also to be demonstrated that exit signs are visible for the duration of the evacuation based upon the visibility results from the CFD modelling. It is to be demonstrated that the visibility at 5 m height is maintained above 10 m during the evacuation.

In the proposed building, we expect that staff will have a degree of fire and evacuation training as part of their staff induction, such that they are aware of and familiar with exit locations and appropriate responses to alarm systems. An emergency management organisation in accordance with AS 3745 must be established. Therefore, we expect staff are able to find their way through to the exit and assist the visitors to find their way towards the exits.

Performance solution:

- ☑ A2.2(1)(a) - Comply with all relevant performance requirements
- ☐ A2.2(1)(b) - Be at least equivalent to the DtS provisions

Assessment methods:

- ☐ A2.2(2)(a) - Evidence of suitability
- ☐ A2.2(2)(b)(i) - Verification methods provided in the NCC
- ☑ A2.2(2)(b)(ii) - Other verification methods accepted by the appropriate authority
- ☐ A2.2(2)(c) - Expert judgement
- ☐ A2.2(2)(d) - Comparison with the DtS provisions

Assessment approach:

☐ Comparative	☑ Qualitative	☑ Deterministic
☑ Absolute	☐ Quantitative	☐ Probabilistic

IFEG sub-systems used in the analysis:

☑ A – Fire initiation and development and control	☑ D – Fire detection, warning and suppression
☑ B – Smoke development and spread and control	☑ E – Occupant evacuation and control
☐ C – Fire spread and impact and control	☐ F – Fire services intervention

Acceptance criteria and factor of safety:

It is to be demonstrated that the exit signs are within the visual catchment area given the height and size of the signs and that the visibility at 5 m height is maintained above 10 m during the evacuation.

Fire scenarios and design fire parameters:

A fully developed fire located within the factory with high heat release rate and fast fire growth based on Society of Fire Safety's Practice note for Design will be discussed (SFS, 2012).

Describe how fire brigade intervention will be addressed or considered:

Fire brigade intervention is not expected to be affected by this departure.

Verification/validation analyses:

☐ Sensitivity studies ☑ Redundancy studies ☐ Uncertainty studies ☑ None

Redundancy is provided with staff familiarity of the building and training.

Provide details on proposed modelling/assessment tools:

CFD modelling inputs form attached.

8 Construction, commissioning, management, use and maintenance

What considerations does the alternative solution require during the construction phase?

The Fire Engineering Report and associated fire safety measures must be implemented into the design and identified on the fire safety schedule for the building. They must be maintained and certified in accordance with the Environmental Planning and Assessment Regulations 2000 and the relevant Australian Standards.

How will the alternative solution affect commissioning of the systems (e.g. listed on fire safety schedule as essential or critical measure, combined new and old installations)?

New systems shall be combined with existing installations. Design team members, including RED Fire Engineers and any other relevant stakeholder, as necessary, are to witness testing and commissioning of systems to check compliance with the FER and other applicable design documentation.

How will the alternative solution be addressed for ongoing building management and use (e.g. details to be provided in a 'fire safety management plan' for the building manager)?

The Required Fire Safety Measures to be listed in the Fire Engineering Report are to be included in the Fire Safety Schedule/Fire Safety Management Plan and are to be adhered to accordingly. A 'plain English' summary will be posted adjacent the Fire Indicator Panel with a copy kept in the Fire Safety Management Plan.

How will any restrictions on fuel load/use/populations within the alternative solution be managed and enforced (e.g. details to be provided in 'fire safety management plan')?

Any fuel load and population restrictions will be part of the site's Management in use Plan.

How will the alternative solution be addressed for maintenance (e.g. details included on fire safety schedule, location of fire engineering report on site, plain English summary adjacent to FIP)?

The Required Fire Safety Measures listed in the Fire Engineering Report are to be included in the Fire Safety Schedule and implemented into the design. A 'plain English' summary will be posted adjacent the Fire Indicator Panel with a copy kept in the Fire Safety Management Plan.

9 Additional comments

N/A

Note: Any in principle support extended for alternative solution issues through consultation is contingent upon all assumptions, analyses and conclusions in the fire engineering report being fully justified, and referenced as appropriate, to demonstrate how the relevant performance requirements have been satisfied to the extent required by the agreed acceptance criteria.

10 Scheduled charges

FRNSW charge for the provision of services performed in connection with statutory fire safety as per the schedule of charges identified in clause 46 and schedule 3 of the *Fire Brigades Regulation 2014*.

The charge applicable is $2,600 for each day (or part of a day) spent by the Commissioner or a fire brigade member providing advisory, assessment or consultancy services.

Note: For a full description of the charges applicable including terms, payment options, applying for a waiver or reduction of the charges, please refer to the FRNSW website at firesafety.fire.nsw.gov.au.

11 Submission of this form

This completed form is to be emailed to firesafety@fire.nsw.gov.au.

All plans and specifications required by FRNSW for assessment are to be attached to the email (or sent separately if necessary due to file size). Refer to Submitting plans and specifications to FRNSW for further information.

12 Contact us

For further information contact the Fire Safety Branch on (02) 9742 7434 or email firesafety@fire.nsw.gov.au.

13 References

AED Fire Pty Ltd. (2018). *Dincel Wall System: Generic Performance (Alternative) Solution for Combustibility.* Sydney.

AFAC. (2004). *Fire Brigade Intervention Model. Version 2.2.* Australasian Fire Authorities Council.

Alder, D. (1999). *Metric Handbook: Planning and Design Data* (2nd ed.). Architectural Press.

BSI. (2004). *PD 7974-6:2004 The Application of fire safety engineering principles to fire safety design of buildings – Part 6: Human factors: Life safety strategies – Occupant evacuation, behaviour and condition (Sub-system 6).* London: British Standards Insititute.

Eaton, C. (1991). *Microeconomic Reform: Fire Regulation.* Canberra: Building Regulation Review Task Force.

FWPA. (2010). *Building with Timber in Bushfire-prone Areas.* Melbourne: Forest & Wood Products Australia Limited.

Ghosh, B. (2009). *Assessment of the benefits of fire extinguishers as fire safety precautions in New Zealand buildings.* Christchurch: University of Canterbury.

Hsiao, H., Whitestone, J., Kau, T.-Y., Whisler, R., Routley, J., & Wilbur, M. (2014). Sizing Firefighers: Method and Implications. *Human Factors, 56*(5), 873-910.

NFPA. (2012). *NFPA 101: Life safety code* (2009 ed.). Quincy, MA: National Fire Protection Association.

Proulx, G. (2008). Evacuation Time. In P. J. DiNenno (Ed.), *SFPE handbook of fire protection engineering* (4 ed., pp. 3-355 - 3-372). Quincy, Mass.: National Fire Protection Association.

SFS. (2012). *Practice note for Design Fires.* Society of Fire Safety.

SFS PN. (2012). *Practice Note for Design Fires.* Sydney: Society of Fire Safety.

SFSU. (2010). *FRNSW's Policy No.4 Guidelines for Emergency Vehicle Access.*

Spearpoint, M. (Ed.). (2008). *Fire Engineering Design Guide* (3rd Edition ed.). Christchurch: New Zealand Centre for Advanced Engineering.

Xie, H., Filippidis, L., Gwynne, S., Galea, E. R., Blackshields, D., & Lawrence, P. J. (2007). Signage Legibility Distances as a Function of Observation Angle. *Journal of FIre Protection Engineering*, 17;41.

Fire & Rescue NSW

CFD/zone modelling inputs form

Complete this form and submit with the corresponding application form when computational fluid dynamics (CFD) or zone modelling is being undertaken as the verification method for any assessment criteria

1 Premises

Premises name (if applicable)	CSR Monier
Primary street address	235 Martin Road
Premises suburb	Badgerys Creek

2 Model/program details

Type of modelling	CFD modelling
Name of program	Fire Dynamics Simulator (FDS, NIST)
Version	FDS 6.5.3

Pyrosim 2018 (Thunderhead Engineering) used as GUI.

3 General/domain parameters

3.1 CFD modelling only

Number of meshes	To be confirmed
Type of mesh (e.g. cartesian)	Cartesian
Mesh size	Mesh size will be determined based on size of fire i.e. D*/dx For base scenario grid size varying between 125 x 125 x 125 mm (fire mesh), 250 x 250 x 250 mm (near-fire mesh), to 500 x 500 x 500 mm (far-fire mesh) For sensitive assessment with higher heat release, grid size varying between 250 x 250 x 250 mm (fire- and near-fire mesh), to 500 x 500 x 250 mm (far-fire mesh)
Material properties	With exception of VENTs e.g. fire, exhaust, etc., surfaces are set to INERT. This is considered an acceptable simplification give that the relatively small fire in a large space.
Boundary conditions	Boundary vents OPEN
Major geometrical or other simplifications or assumptions	All as per the architect drawings. Building geometry and obstructions have been simplified to fit the mesh cell sizes outlined above.
Steady-state or transient?	Transient
Simulation time	1800 s

3.2 Zone modelling only

Total floor area volume	Enter details
Floor area and volume of each compartment	Enter details
Openings between compartments	Enter details

Material properties	Enter details
Boundary conditions	Enter details
Major geometrical or other simplifications or assumptions	Enter details
Simulation time	Enter details

4 Fire parameters

Radiative fraction	0.3
Reaction/combustion properties (material, heat of combustion)	Heat of combustion: 20 MJ/kg. Chemical compound: • Carbon (C) 4.56; • Hydrogen 6.56; • Oxygen 2.34; • Nitrogen 0.4.
Soot yield (value and means of including in model)	Soot yield: y_s=0.10
Visibility factor (or parameters used to obtain visibility output)	The Visibility factor value is taken as 3 in this CFD modelling, corresponding to the value for light-reflecting signs where required
Heat release rate per unit area (HRRPUA)	Approximately 1000 kW/m²
Means of achieving fire growth rate (ramp, multiple fire objects)	Fast growth rate achieved by multiple fire objects The building will have rack storage however fire has been modelled horizontally growing as this means more air entrainment resulting in more smoke production. This is conservative when assessing occupant safety.
Fire locations (including height above floor)	Base of fire has been located 0.5 m above the floor level A fire in the centre of the building will be modelled as well as a fire in the corner of the building in the vicinity of an exit as this is the worst-credible scenario.

5 Scenario parameters

Ambient temperature	20 °C
Wind	-
Others	-

6 Fire safety system/device parameters

Mechanical smoke exhaust	-
Mechanical supply air	-
Jet fans	-
Natural vents	Ridge vents
Natural make-up air	Low-level vents open to simulate building leakage and eventual opening of low-level openings by fire brigade upon arrival
Assumed building leakage	See above
Sprinklers (spacing, location, RTI, distance to fire, rating etc.)	N/A

Detectors (spacing, location, RTI, distance to fire, rating, activation obscuration etc.)	-
Other systems/devices	-

7 Outputs

Actual heat release rate curve produced should be compared to specified design fire	Noted. This will be provided in the FER
Sufficient outputs should be provided to justify any results used in the FER	Slice files looking at: • Temperature • Visibility • Velocity For: • 2.0 m above floor level • Cross sectional (Y plane) at a number of locations, including fire • Longitudinal (X plane) at a number of locations, including fire
Others	Enter details

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St Kilda VIC 3182
Phone: +61 3 9079 4143

New South Wales
Suite 6.04, Level 6,
299 Sussex St
Sydney NSW 2000
Phone: +61 2 8096 2220

Queensland
Suite 8, Level 2,
35 Astor Tce
Spring Hill QLD 4000
Phone: +61 7 3832 0660

Western Australia
PO Box 251
Parkwood WA 6147
Phone: +61 3 9079 4143

Ref: 190624_JN19-00144_CSR Monier_Trial Concept Design.docx

CONSULT ADVICE NOTE

URGENT ☐
PLEASE COMMENT ☒

NUMBER	001
DATE	24 June 2019
TO	Daniel Zarb
FROM	Blair Stratton
PROJECT NUMBER	JN19-00144
PROJECT	CSR Monier
SUBJECT	Trial Concept Design

Introduction

Our trial concept design detailed in this section is to support the proposed Performance Solution that has been formulated to address the BCA DtS departures identified in the Executive Summary. Our design does not account for any other departures from DtS Provisions related to fire safety.

The following Fire Safety Measures are required to support the fire safety engineering assessment of the proposed Performance Solution and required to achieve compliance with the relevant Performance Requirements of the BCA. They might be subject to change following stakeholder comments, and as a result of the fire engineering analysis.

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Fire Resisting Construction and Compartmentation

A summary of the BCA DtS floor area and volume limitations for the building or any fire compartment in the building are outlined in Table 1.

Table 1: Fire compartment size limitations (from the BCA)

Classification		Max size		
General limitations		Type A	Type B	Type C
Class 7b, 8	Area	5 000 m^2	3 500 m^2	2 000 m^2
	Volume	30 000 m^3	21 000 m^3	12 000 m^3

The building is deemed to be a large isolated building as the fire compartment sizes exceed the floor area and volume limitations identified in BCA DtS Table C2.2. This is acceptable subject to perimeter vehicular access complying with BCA Clause C2.4. Note that it is proposed not to install an automatic sprinkler system in the building.

It is proposed that Perimeter vehicular access consisting of an access road and hardstand areas, will be more than 18 meters from the building in some locations and will not be kept clear of storage (finished products on pallets) and the area has other existing structures built upon it, refer to Figure 1.

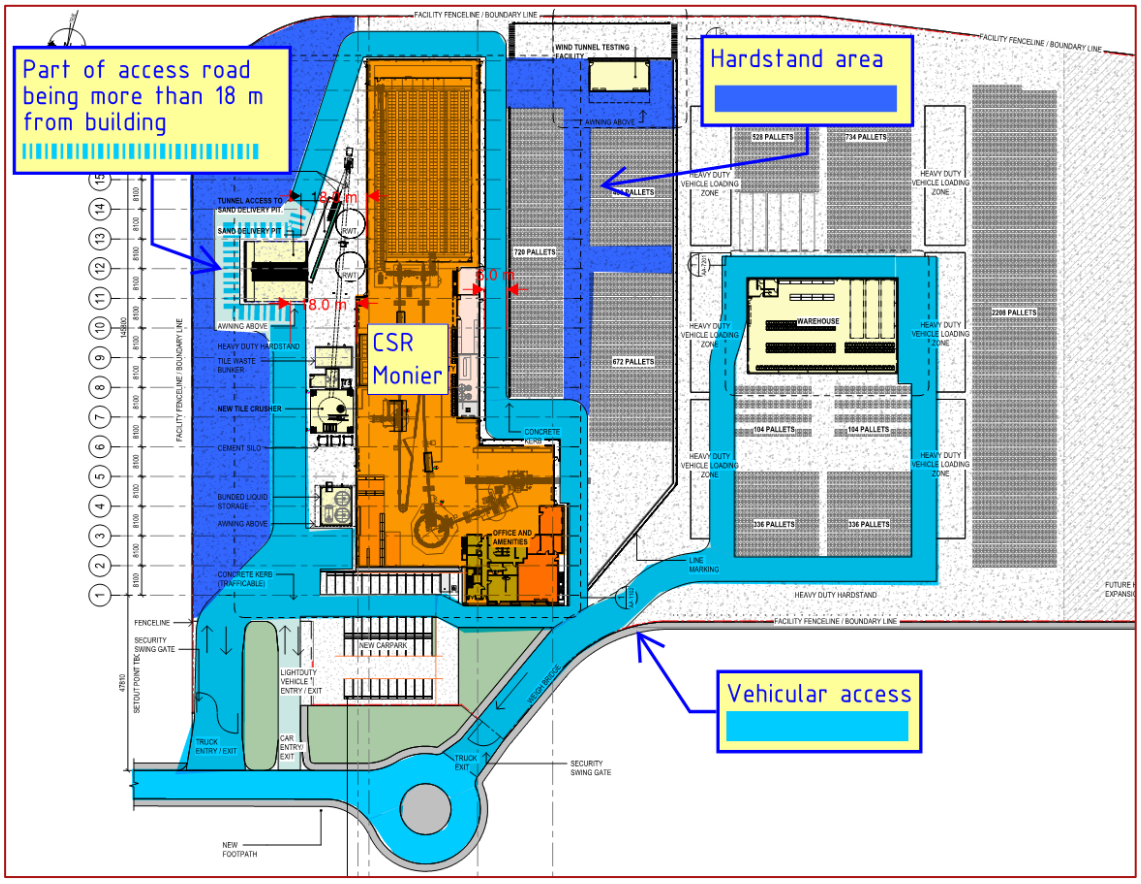


Figure 1: Vehicular access to building

Hardstand area will be provided on all sides of the building providing access to the fire brigade general appliance and an aerial appliance as well as on-foot access from the road to the building, external fire hydrants and other equipment such as fire pumps, booster assembly and the Fire Indicator Panel.

Turning areas in accordance with Clause 5.2 of FRNSW Policy No 4 Guidelines for emergency vehicle access are to be provided as follows –

- Any carriageway not leading directly to an exit (i.e. dead end) should be provided with a turnaround area which prevents the need to perform multi-point turns; and
- The minimum turning radius of turn around areas should not be less than 11.3 m for general appliances and 16.4 m for aerial appliances.

Access and Egress

Distance of travel between alternative exists when measured through the point of choice of exits is approximately 80 m instead of 60 m.

Egress widths to be up to 600 mm instead of 1000 mm in equipment/machinery areas. The reduced egress width is only to be pinch points in a few confined areas that are occupied for maintenance reasons.

Egress stairs over plant equipment to be designed to AS 1657:2013 instead of conventional stairs.

Fire Services & Equipment

Note that this building is not required to be provided with automatic sprinkler system as the building has an area of is less than 18,000 m², a volume less than 108,000 m³, is not a Class 5, 6 or 9 building and does not contain more than 2 storeys. The building is also not an occupancy of excessive hazard as defined by BCA Table E1.5.

A building occupant warning system (BOWS) is to be provided in accordance with Clause 6 of Specification E2.2a of the BCA. Activation of the smoke detection systems shall operate the BOWS throughout the building. Visual alarm devices are to be provided to high noise areas only.

Break glass alarms are to be located at the exits from the building.

Exit signs having large pictorial elements (at least 200 mm high) are to be installed in accordance to AS/NZS 2293.1-2018, except they are to be hung above 2.7 m from the floor level. Exit signs will mounted at the sides of the kiln, at a maximum height of 5 m from the floor level and a maximum distance between signs of 30 m. Exit signs are to be installed in accordance to AS/NZS 2293.1-2005 above exit doors.

Fire hydrant coverage shall be provided in accordance with BCA Clause E1.3 and AS 2419-2005. This may include the provision of internal fire hydrants to suit the operational needs of FRNSW.

Maintenance and Management in Use

We have assumed in our assessment that staff will have a level of fire and evacuation training. Therefore, an Emergency Management Organisation must be established in accordance with AS 3745-2010.

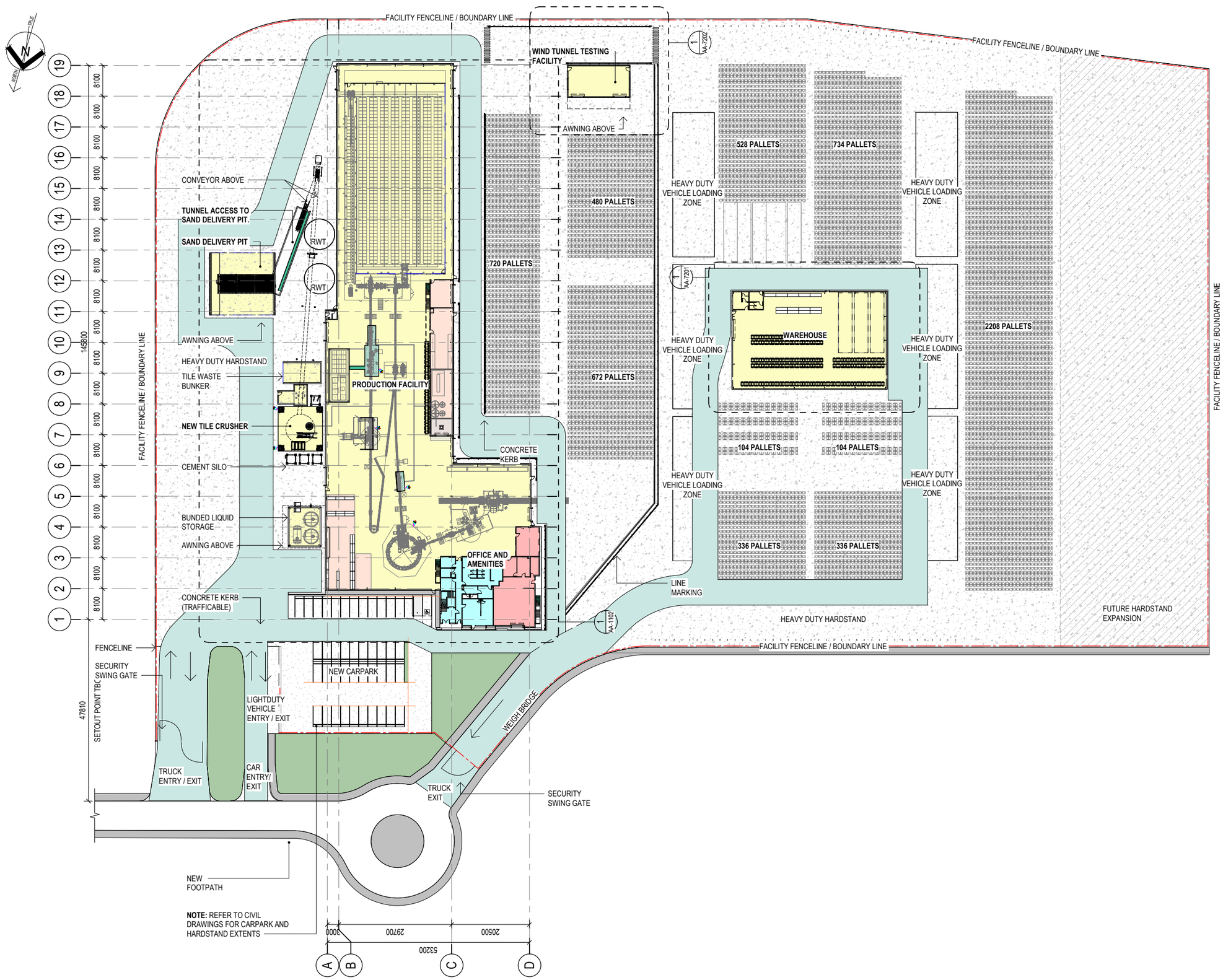
Management procedures shall also be implemented to ensure that the essential services measures are maintained and regularly inspected in accordance with the AS 1851-2012. In addition, all Essential Safety items that do not comply with the BCA or relevant standard must be rectified whether or not this non-compliance was identified as part of the building's commissioning.

All staff, maintenance personnel and visitors are to be provided with induction to site and evacuation procedures.

A copy of the latest FER is to be kept on site and a plain English Summary of the Performance Solution is to be provided at the FIP.

Good housekeeping and regular fire prevention practices are to be carried out to minimise the risk of unnecessary fuel loads and sources of ignition.

Drawing Plotted: 5/06/2019 2:51:05 PM



GENERAL NOTES

1. IF THE CONTRACTOR FINDS ANY INCONSISTENCY, ERROR OR OMISSION IN THE DOCUMENTS, OR BETWEEN DOCUMENTS, THE ARCHITECT MUST BE NOTIFIED.
2. THE CONTRACTOR IS TO READ ALL DRAWINGS TO COORDINATE FIXTURES, FITTINGS AND DIMENSIONS.
3. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE BEFORE FABRICATION.
4. ALL DIMENSIONS ARE TO FACE POF STRUCTURE OF WALLS UNLESS NOTED OTHERWISE.
5. APPLY PROPRIETARY MATERIALS AND COMPONENTS TO THE MANUFACTURER'S EXPRESS WRITTEN INSTRUCTIONS.
6. DO NOT SCALE DRAWINGS
7. ALL DIMENSIONS ARE IN MILLIMETRES
8. BACKGROUND EQUIPMENT LAYOUT SHOWN INDICATIVE. EQUIPMENT LAYOUT SUBJECT TO CHANGE DEPENDING ON APPROVED VENDOR LAYOUT.
9. LANDSCAPING SHOWN INDICATIVE ONLY, SUBJECT TO LANDSCAPE CONSULTANTS DESIGN.

LEGEND

- PRODUCTION AND WAREHOUSE FACILITY
- OFFICE AND AMENITIES
- WORKSHOP AND BUILDING SERVICES
- TECHNOLOGY CENTRE
- FACILITY BOUNDARY AND FENCE
- ROAD ACCESS TO SITE
- FOOTPATH
- HEAVY DUTY HARDSTAND
- LIGHT DUTY HARDSTAND
- LANDSCAPE ZONE
- STAGING PALLETS ZONE
- FUTURE HARDSTAND EXPANSION ZONE
- FEBQ TRUCK ACCESS

NOTE:
1. REFER TO CIVIL ENGINEERS DRAWINGS FOR ALL EXTERNAL SITE LEVELS AND DRAINAGE.
2. REFER TO LANDSCAPE ARCHITECTS DRAWINGS FOR PAVEMENT AND FEATURE FINISHES AROUND THE EXTERIOR OF THE BUILDING.

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ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
A	ISSUE FOR INFORMATION	CK	TW	LG	05.06.19

Drawing Originator: Beca

Original Scale (A1): As indicated
Reduced Scale (A3): Half A1

Design	T.W.WANG	05.12.18
Drawn	C.KILLALEA	05.06.19
Dsg Verifier	M.WARNE	05.12.18
Dwg Check	D.MCNAMARA	05.06.19

Client: CSR

Project: MONIER - BADGERYS CREEK DEVELOPMENT
235 Martin Road Badgerys Creek NSW

Title: FEBQ FIRETRUCK CIRCULATION

Discipline: FIRE ENGINEERING

Drawing No.: 4744 - 0250- DWG-FE-0001

Rev.: A

Document No. C:\Users\Public\Documents\BecaCAD\Revit\244928\5-Monier-AA-2018_connor.killalea.rvt

DO NOT SCALE

IF IN DOUBT ASK.

Fire & Rescue NSW

FRNSW meeting application

1 Purpose

☑ Concept review	☐ Fire safety exemption (clause 188)
☐ Initial fire safety report*	☐ Final fire safety report*
☐ Comment/opinion on a proposal	☐ Other Provide details

***Note**: Fire & Rescue NSW (FRNSW) will only discuss conditions within a furnished initial or final fire safety report with the relevant certifying authority. Fire safety engineers who wish to discuss the corresponding fire engineering report should seek separate consultation with FRNSW.

2 Applicant

2.1 Role of applicant

☐ Local government authority*	☐ Building owner/manager	☐ Hydraulic engineer
☐ Other consent authority*	☐ BCA consultant/surveyor	☐ Dangerous goods consultant
☐ Regulatory authority	☑ Fire engineer	☐ Risk analyst
☐ Certifying authority	☐ Other Provide details	

***Note**: Local government authorities and other consent authorities will not incur charges for this service.

2.2 Agreement

As the applicant, I confirm the following:

- I agree to pay FRNSW the charges set out in clause 46 of the *Fire Brigades Regulation 2014* (see section 6).
- I acknowledge that during any meeting held FRNSW will only offer advice and that any advice given may be subject to change following formal assessment or determination by the relevant authority, including formal assessment on the matter by FRNSW following the meeting.
- I agree that any meeting is solely at the discretion of FRNSW, which is determined from the information and/or documentation forwarded with this application (see section 5).

Name of applicant	Blair Stratton
Applicant's phone number	0434 481 676
Applicant's email address	blair@redfireengineers.com.au

2.3 Remittance advice information

Invoices will be issued based on the information provided below.

Company / vendor name	PGH Bricks and Pavers Pty Ltd		
Australian business number	6816879482	Trading name	PGH Bricks and Pavers Pty Ltd
Remittance contact name	Jason Brown		
Remittance street address	59-67 Cecil Rd, Cecil Park, NSW, 2178		
Remittance postal address	59-67 Cecil Rd, Cecil Park, NSW, 2178		
Remittance email address	jabrown@pghbricks.com.au		
Remittance phone number	0439117613	Remittance fax number	N/A

3 Premises

Premises name	PGH Badgerys Creek and CSR Monier
Primary street address	235 Martin Road
Secondary address	Secondary street address (if applicable)
Premises suburb	Badgerys Creek

4 Meeting details

Preferred meeting date	9/07/2019	Preferred time	13.00
Name of contact	Blair Stratton	Phone no.	0434 481 676

Note: The preferred meeting date should be between two (2) working days and three (3) weeks after submitting this application. FRNSW will confirm the meeting details with you, and attendance should not be assumed until this confirmation has been made.

5 Reason for meeting

Has there been any previous contact with FRNSW concerning this premises or matter?	Yes
If yes, please provide our file reference number (provided on our correspondence)	BFS19/1165

To discuss the proposed concept design for the re-developing of two Class 8 buildings with semi-automated process plant for PGH bricks and Monier roof tiles, respectively. The buildings are to be large isolated buildings and have Type C construction. The buildings are not proposed to be provided with automatic sprinkler system.

The following documents have been issued to FRNSW for the two premises PGH Brick and CSR Monier:

- BCA Statements
- FEBQ
- CFD modelling input
- Trial Concept Design
- Site Plans
- Floor Plans
- Elevations

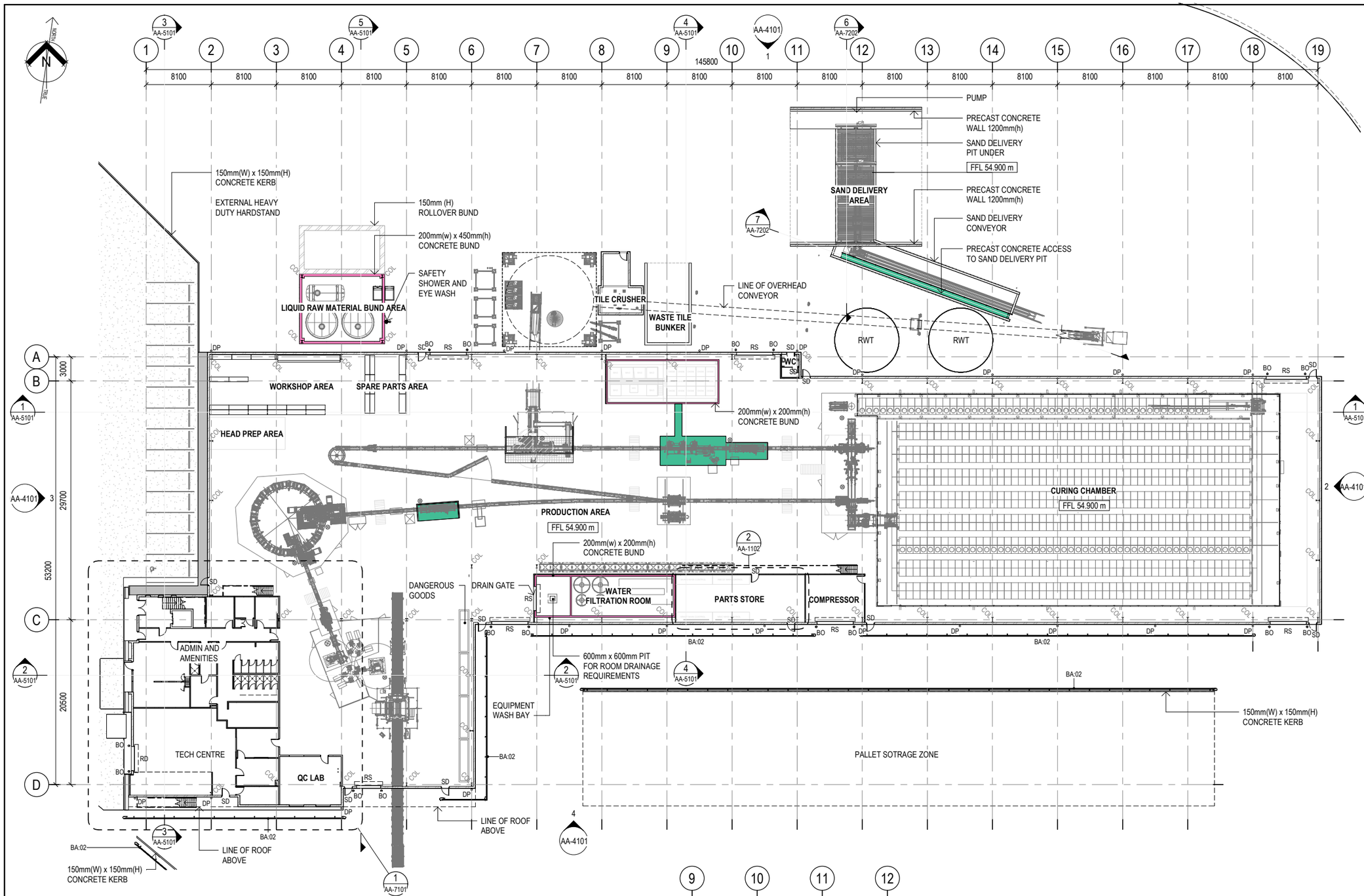
6 Scheduled charges

FRNSW charge for the provision of services performed in connection with statutory fire safety as per the schedule of charges identified in clause 46(4) of the *Fire Brigades Regulation 2014*.

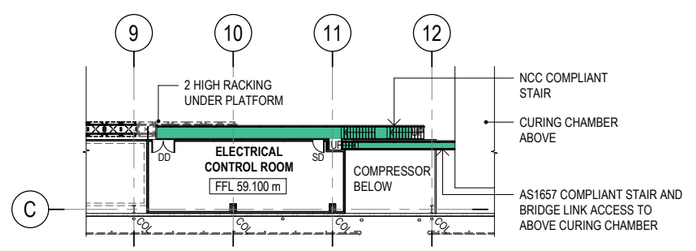
The charge applicable is $200 for each hour, or part of an hour, for attendance by a fire brigade member at a fire safety meeting in connection with a development or proposed development. The charge is applied for each FRNSW member in attendance. A minimum of two members will attend a face-to-face meeting.

Note: For a full description of the charges applicable including terms, payment options, applying for a waiver or reduction of the charges, please refer to the FRNSW website at firesafety.fire.nsw.gov.au.

Drawing Plotted: 14/12/2018 4:19:09 PM



1 GROUND FLOOR PLAN
AA-0501 1 : 250



2 ELECTRICAL ROOM
AA-1102 1 : 250

GENERAL NOTES

1. IF THE CONTRACTOR FINDS ANY INCONSISTENCY, ERROR OR OMISSION IN THE DOCUMENTS, OR BETWEEN DOCUMENTS, THE ARCHITECT MUST BE NOTIFIED.
2. THE CONTRACTOR IS TO READ ALL DRAWINGS TO COORDINATE FIXTURES, FITTINGS AND DIMENSIONS.
3. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE BEFORE FABRICATION.
4. ALL DIMENSIONS ARE TO FACE POF STRUCTURE OF WALLS UNLESS NOTED OTHERWISE.
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9. LANDSCAPING SHOWN INDICATIVE ONLY, SUBJECT TO LANDSCAPE CONSULTANTS DESIGN.

NOTES

1. REFER TO DRAWING 2449285-DRG-33080-AA-0301 FOR LEGENDS, NOTES ABBREVIATIONS.
2. REFER TO DRAWING 2449285-DRG-33080-AA-0301 FOR MATERIAL AND FINISHES SCHEDULE
3. BACKGROUND EQUIPMENT LAYOUT SHOWN INDICATIVE. EQUIPMENT LAYOUT SUBJECT TO CHANGE DEPENDING ON APPROVED VENDOR LAYOUT.
4. FOR OFFICE AND AMENITIES DETAILS AND NOTES, REFER TO DRAWING 2449285-DRG-33080-AA-7101

LEGEND

LV	LOUVRE
DD	DOUBLE DOOR
RS	ROLLER SHUTTER
SD	SINGLE DOOR
WD	WINDOW
BO	200ø EXTERNAL BOLLARD
DP	DOWNPIPE
COL	NEW COLUMN
BA:01	BALUSTRADE
BA:02	TRAFFIC BARRIER
	HEAVY DUTY STEEL PLATED FLOOR FINISH
	STEEL GRATE OVER 600mm DEEP PIT
	CONCRETE BUND
	METAL WALL CLADDING WITH STEEL FRAME

NOTE:
1. REFER TO CIVIL ENGINEERS DRAWINGS FOR ALL EXTERNAL SITE LEVELS AND DRAINAGE.

ORIGINAL DRAWING IN COLOUR

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
C	FINAL ISSUE FOR STAGE 1	UQ	TW	LG	12.12.18
B	UPDATED INFORMATION FOR BUILDING SURVEYOR	UQ	TW	LG	05.12.18
A	ISSUE FOR BUILDING SURVEYOR REVIEW	UQ	TW	LG	19.11.18

Drawing Originator: Beca

Design	T.W.WANG	05.12.18
Drawn	U.QAISER	05.12.18
Dsg Verifier	M.WARNE	05.12.18
Dwg Check	S.COLES	12.12.18

Original Scale (A1): As indicated
Reduced Scale (A3): Half A1

Client: CSR

Project: MONIER - BADGERYS CREEK DEVELOPMENT
235 Martin Road Badgerys Creek NSW

Title: MASTER GROUND FLOOR PLAN

Discipline: ARCHITECTURAL
Drawing No.: 2449285- DRG-33080-AA-1102
Rev.: C

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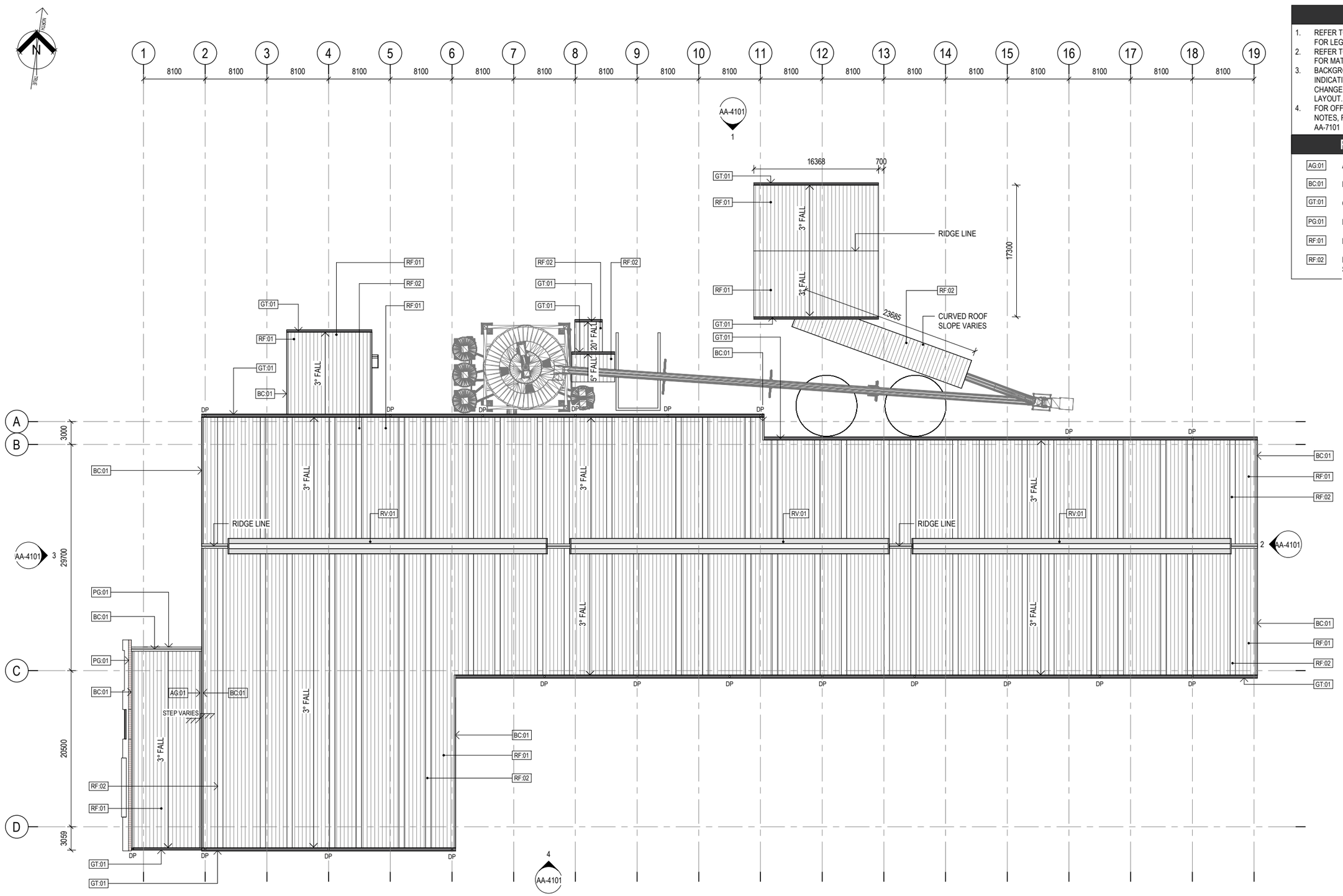
Document No. C:\Users\Public\Documents\Beca\CAD\Rev#\2449285-Monier-AA-2018_UQ1.rvt

NOTES

1. REFER TO DRAWING 2449285-DRG-33080-AA-0301 FOR LEGENDS, NOTES ABBREVIATIONS.
2. REFER TO DRAWING 2449285-DRG-33080-AA-0301 FOR MATERIAL AND FINISHES SCHEDULE
3. BACKGROUND EQUIPMENT LAYOUT SHOWN INDICATIVE. EQUIPMENT LAYOUT SUBJECT TO CHANGE DEPENDING ON APPROVED VENDOR LAYOUT.
4. FOR OFFICE AND AMENITIES DETAILS AND NOTES, REFER TO DRAWING 2449285-DRG-33080-AA-7101

ROOF LEGEND

AG:01	APRON FLASHING
BC:01	BARGE CAPPING
GT:01	GUTTER - EAVES
PG:01	PARAPET CAPPING
RF:01	ROOF SHEETING
RF:02	POLYCARBONATE ROOF SHEETING



1 ROOF PLAN
1 : 250

ORIGINAL DRAWING IN COLOUR

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No.	Revision	By	Chk	Appd	Date
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A	UPDATED INFORMATION FOR BUILDING SURVEYOR	UQ	TW	LG	05.12.18

Drawing Originator: Beca

Original Scale (A1): As indicated
Reduced Scale (A3): Half A1

Design	T.W.WANG	05.12.18
Drawn	U.QAISER	05.12.18
Dsg Verifier	M.WARNE	05.12.18
Dwg Check	S.COLES	12.12.18

Client: CSR

Project: MONIER - BADGERYS CREEK DEVELOPMENT
235 Martin Road Badgerys Creek NSW

Title: PROPOSED ROOF PLAN

Discipline: ARCHITECTURAL
Drawing No.: 2449285- DRG-33080-AA-3201
Rev.: B

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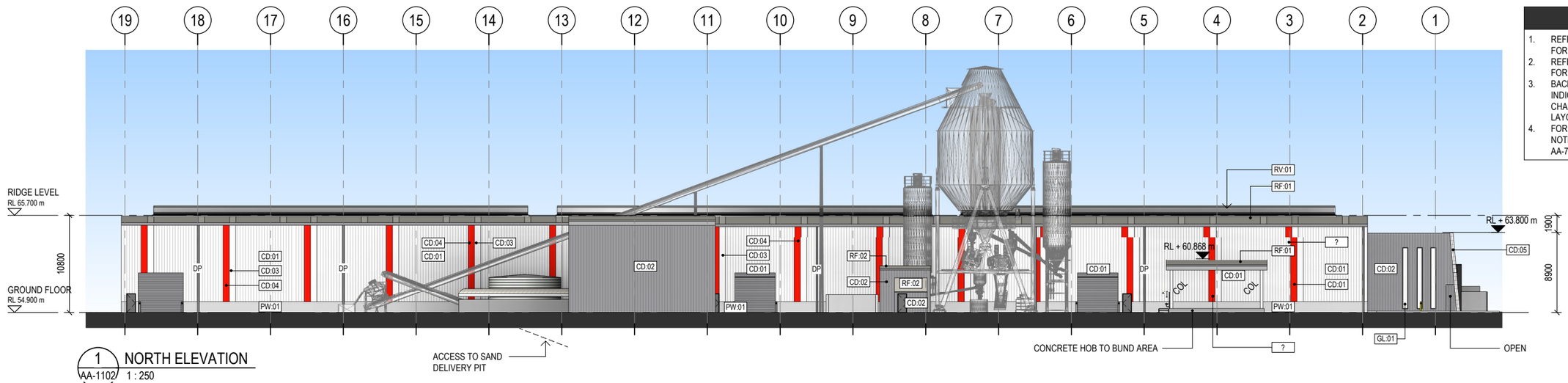
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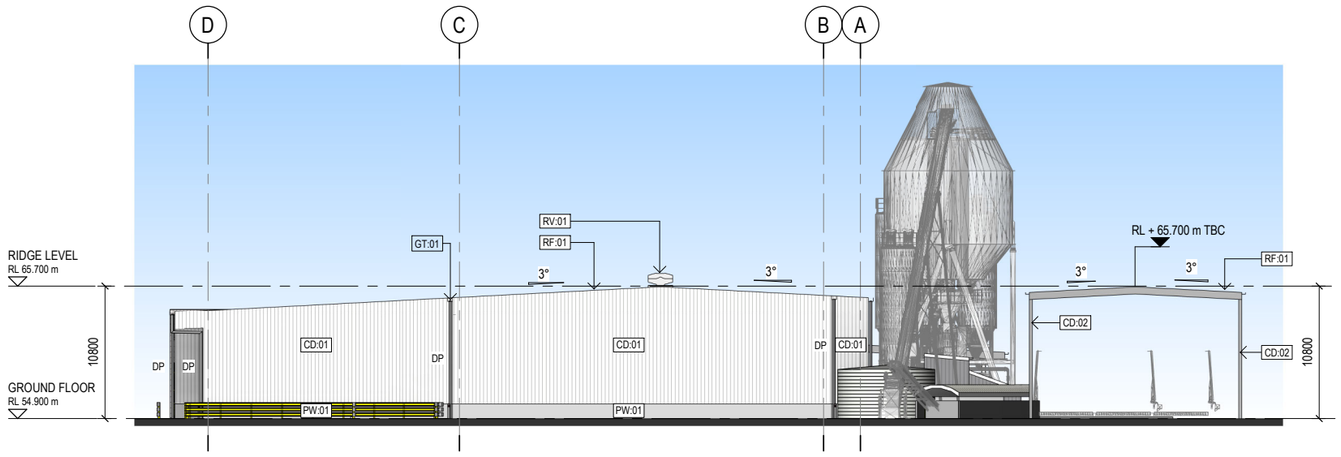
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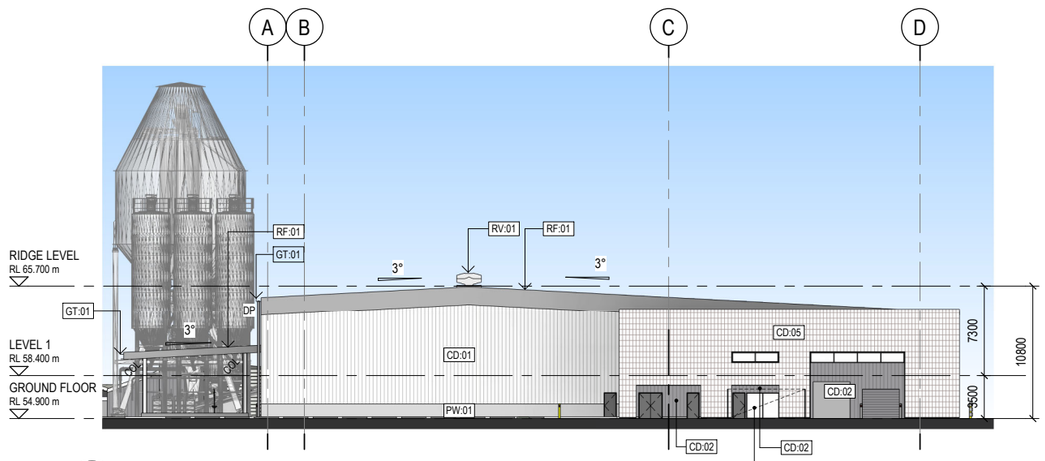
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3. BACKGROUND EQUIPMENT LAYOUT SHOWN INDICATIVE. EQUIPMENT LAYOUT SUBJECT TO CHANGE DEPENDING ON APPROVED VENDOR LAYOUT.
4. FOR OFFICE AND AMENITIES DETAILS AND NOTES, REFER TO DRAWING 2449285-DRG-33080-AA-7101



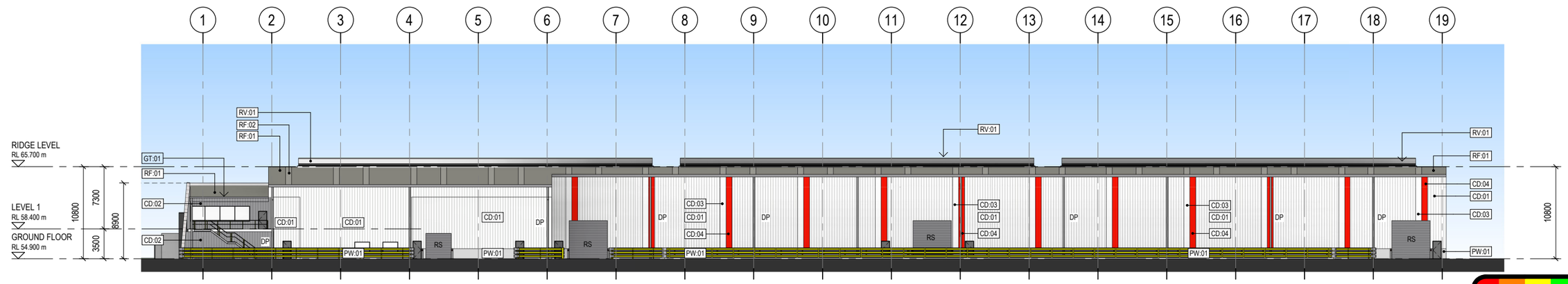
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2 EAST ELEVATION
AA-1102 1 : 250



3 WEST ELEVATION
AA-1102 1 : 250



4 SOUTH ELEVATION
AA-1102 1 : 250

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A	UPDATED INFORMATION FOR BUILDING SURVEYOR	UQ	TW	LG	05.12.18

Drawing Originator: Beca

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Reduced Scale (A3)	Dsg Verifier	M.WARNE	05.12.18
Half A1	Dwg Check	S.COLES	12.12.18

Client: CSR

Project: MONIER - BADGERYS CREEK DEVELOPMENT
235 Martin Road Badgerys Creek NSW

Title: PROPOSED ELEVATION - SHEET 1

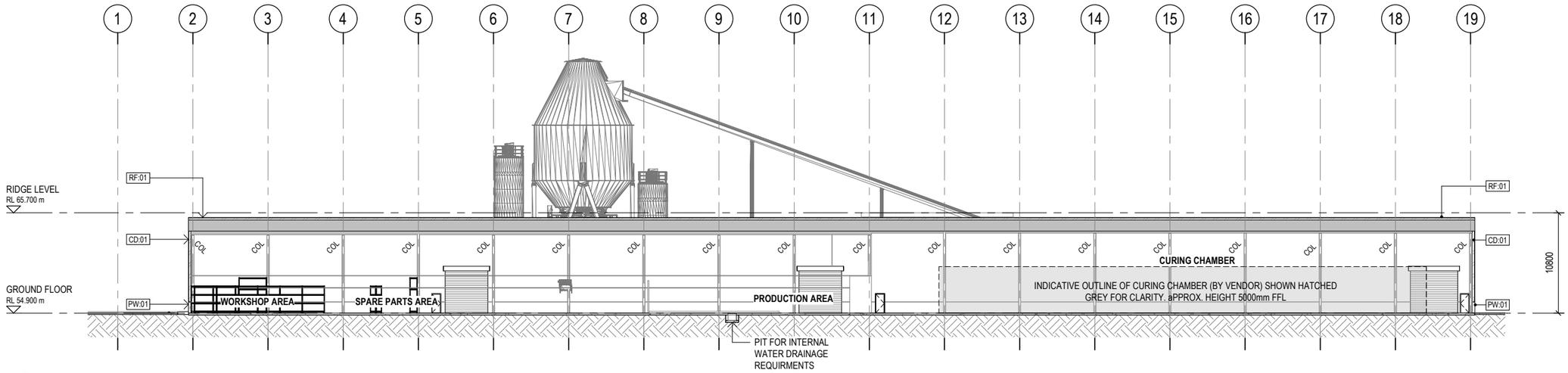
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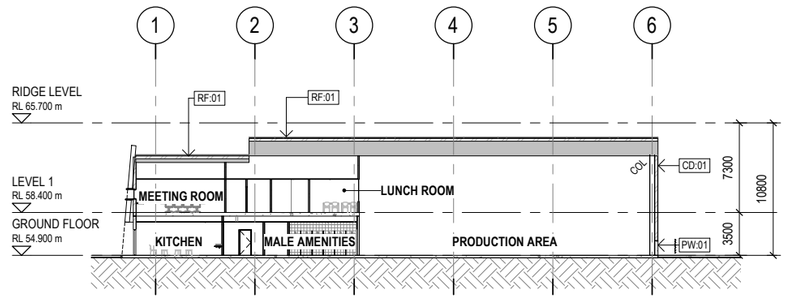
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GENERAL NOTES

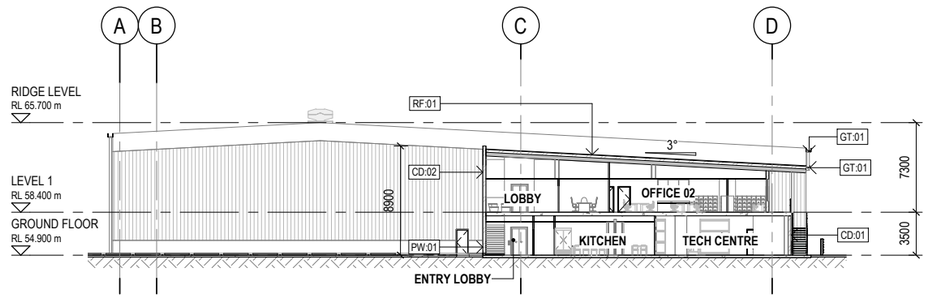
1. IF THE CONTRACTOR FINDS ANY INCONSISTENCY, ERROR OR OMISSION IN THE DOCUMENTS, OR BETWEEN DOCUMENTS, THE ARCHITECT MUST BE NOTIFIED.
2. THE CONTRACTOR IS TO READ ALL DRAWINGS TO COORDINATE FIXTURES, FITTINGS AND DIMENSIONS.
3. ALL DIMENSIONS AND LEVELS ARE TO BE CHECKED ON SITE BEFORE FABRICATION.
4. ALL DIMENSIONS ARE TO FACE POF STRUCTURE OF WALLS UNLESS NOTED OTHERWISE.
5. APPLY PROPRIETARY MATERIALS AND COMPONENTS TO THE MANUFACTURER'S EXPRESS WRITTEN INSTRUCTIONS.
6. DO NOT SCALE DRAWINGS
7. ALL DIMENSIONS ARE IN MILLIMETRES
8. BACKGROUND EQUIPMENT LAYOUT SHOWN INDICATIVE. EQUIPMENT LAYOUT SUBJECT TO CHANGE DEPENDING ON APPROVED VENDOR LAYOUT.
9. LANDSCAPING SHOWN INDICATIVE ONLY

NOTES

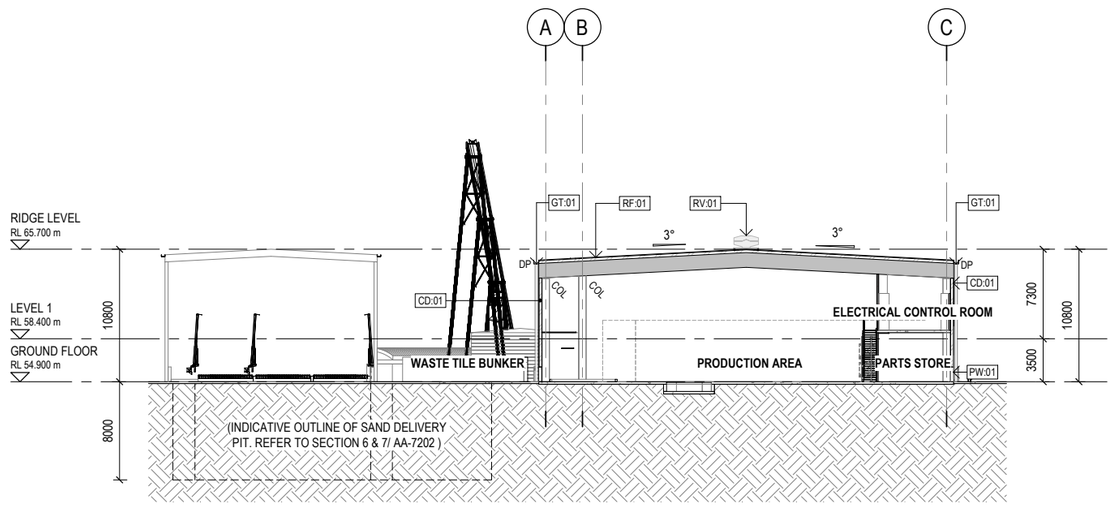
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4. FOR OFFICE AND AMENITIES DETAILS AND NOTES, REFER TO DRAWING 2449285-DRG-33080-AA-7101



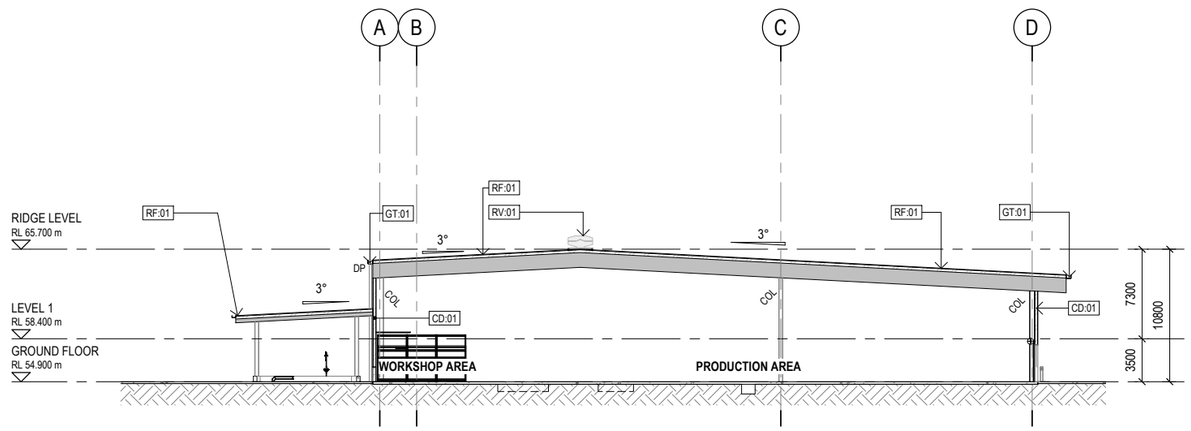
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3 AA-1102 SECTION THROUGH OFFICE 02
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4 AA-1102 SECTION THROUGH PRODUCTION HALL AND SERVICES ROOM
1 : 250



5 AA-1102 SECTION THROUGH PRODUCTION HALL AND WORKSHOP
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A	UPDATED INFORMATION FOR BUILDING SURVEYOR	UQ	TW	LG	05.12.18

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Design	T.W.WANG	07.12.18
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Dsg Verifier	M.WARNE	07.12.18
Dwg Check	S.COLES	12.12.18

Client: CSR

Project: MONIER - BADGERYS CREEK DEVELOPMENT
235 Martin Road Badgerys Creek NSW

Title: PROPOSED SECTION - SHEET 1

Discipline: ARCHITECTURAL
Drawing No.: 2449285- DRG-33080-AA-5101
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APPENDIX H

BADGERIES CREEK DEVELOPMENT PROJECT UTILITIES – SEWAGE MANAGEMENT

Badgerys Creek Development Project
Utilities – Sewage Management

Deliverable Number: 4744-8200-RPT-BE-0001
Prepared for CSR Building Products Limited
Prepared by Beca Pty Ltd
ABN 85 004 974 341

2 August 2019



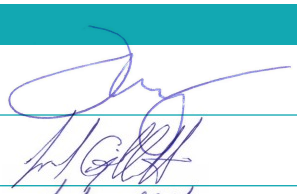
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1 Introduction 1
2 Background 1
3 Purpose 1
4 Waste Water Requirements 2
4.1 Background 2
4.2 Current Infrastructure and Anticipated Demand Requirement 4
4.3 Subsurface Conditions 5
4.4 Recommendations 6

Revision History

Revision Nº	Prepared By	Description	Date
A	Ming Heng	Issued for Development Application submission response	02/08/2019

Document Acceptance

Action	Name	Signed	Date
Prepared by	Ming Heng		02/08/2019
Reviewed by	Tony Carr		02/08/2019
Approved by	Luke Gillett		02/08/2019
on behalf of	Beca Pty Ltd		

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This report has been prepared by Beca on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

1 Introduction

In October 2016, CSR Building Products Limited (CSR) acquired Boral Bricks Pty Limited (Boral) brick business along the eastern seaboard of Australia and with it, the Badgerys Creek Brick Making Facility site ('the site'), which is strategically placed in the Western Sydney Priority Growth Area and borders on the proposed Western Sydney Airport precinct.

To realise the full potential of the Badgerys Creek site and to allow the site to meet the strategic needs of their brick, roof products and other building product manufacturing businesses, CSR is looking to further develop this site to provide an advanced manufacturing facility for the PGH Bricks and Monier Roof tile business units.

2 Background

This report outlines the capacity of the current waste sewage system(s) (domestic only, excluding trade waste requirements (if any)) at the 235 Martin Rd, Badgerys Creek address and determines whether adjustments or additions are required to the existing infrastructure to provide adequate services to service both the new PGH Bricks and Monier Roof sites to meet their proposed per annum capacity.

Existing available utilities have been investigated through site visits, and discussions/requests for information through the respective local authorities and distributors. These values have been compared to the anticipated demand requirements for each service as provided by CSR, with recommendations being made for any service that may not currently have sufficient capacity fulfil anticipated demand.

3 Purpose

The basis for this report is limited to:

- The record of discussion with PGH personnel and information received from CSR, PGH or Monier.
- A visual inspection carried out during an information gathering site visit on the 10th Oct 2018
- Information available in the public domain.

The following limitations have hindered the ability to record or obtain accurate data on the existing and anticipated service capacities:

- Some of the utility information obtained to date has been contradictory in nature. The information should be considered indicative at this stage and could change once dialogue has been established with the respective utility providers.

Beca has not undertaken any intrusive inspections or testing. Our inspection cannot guarantee that all possible defects, conditions, material engineering issues or risks in relation to CSR have been identified within this report.

4 Waste Water Requirements

4.1 Background

The following covers domestic (i.e. human) waste only and does not include trade waste considerations from either the PGH or Monier manufacturing facilities.

The existing site at 235 Martin Rd, Badgerys Creek generates waste water from various amenities across the site as tabulated below with a description of the existing treatment and disposal works.

Table 4.1.1 Current Amenities Producing Waste Water and Associated Treatment & Disposal Systems

Site	Location	Type of Amenities	Treatment System	Disposal System
PGH Bricks	Administration Building	Sinks Toilets	Envirocycle system[1] – Aerated waste water treatment system	Surface irrigation
	Production Facility	Sinks Toilets Showers	Commercial – Septic tank	Pump out septic tank system[2]
	Dispatch Office	Sinks Toilets Showers	Septic tank and transfer to Admin building Envirocycle system	Surface irrigation
Monier	Administration/Production Facility	None currently	No current treatment	No current disposal

The Envirocycle system, located at the existing Administration Building, was altered from a sub-surface soakage field discharge to a spray irrigation discharge in early 2018, with 8 nozzles discharging in a field approximately 1,000m2. The system has a current approval to operate from Liverpool City Council (Approval No-1110).

The Production Facility waste water system has a current approval to operate from Liverpool City Council (Approval No-2137). Detailed information on the existing system has not been located at this stage. The Approval has information attached to it relating to pump-out systems. There is also a sketch and verbal advice indicating that it is a septic tank and soakage field.

The proposed Monier facility location currently has a house located on the site. This will be demolished with the construction of the proposed Monier Roof tile production facility. The current Sydney Water Dial Before You Dig drawing does not show any sewer lines in this area.

[1] No UV disinfection was noted at admin building Envirocycle system during site inspection.

[2] Production facility septic tank did not show evidence of pump out tank local to septic tank during site inspection



Figure 4-1 - Administration building Envirocycle system



Figure 4-2 - Production Facility Septic System



Figure 4-3 – Administration Building Envirocycle Spray Irrigation Area

4.2 Current Infrastructure and Anticipated Demand Requirement

The anticipated staff numbers for the PGH Bricks and Monier Roof sites and their relative waste productions are given in Table 4.2.1 below.

Table 4.2.1 Anticipated Staff Numbers and Waste Volumes

Site	Location	Typical Maximum Staff Numbers	Anticipated Waste Volumes [L/day][3]
PGH Bricks	Administration Building	30[4]	1,800
	Dispatch Office	3	180
	Subtotal	33	1,980
	Production Facility	34[4]	2,040
Monier Roof	Admin Building	5[5]	300
	Production Facility	12[5]	720
	Dispatch Office	3[5]	180

Table 4.2.2 Current Septic Facilities and Anticipated Demand Requirements

Site	Location	Treatment and Disposal Facilities	Current Capacity [L/day]	Anticipated Volumes [L/day]	Upgrade Required
PGH Bricks	North of Administration Building	Treatment system, UV[6] and surface irrigation	3,500[7]	1,980[8]	No
	Dispatch Office	Septic tank pumped to admin Envirocycle			No
	West of Production Facility	Septic tank and soakage field or pump out[9]	Approx. 2,000	2,040	TBC
Monier Roof	Administration Building	N/A	N/A	300	Yes
	Production Facility	N/A	N/A	720	Yes
	Dispatch Office	N/A	N/A	180	Yes

[3] AS1547 – Based on 60L/person/day, does not allow for laundry or canteen

[4] Source: Badgery's Creek Proposed Org Chart Oct18 – Production facility includes day (24) and night shift (10)

[5] Source: Monier Outstanding Information List – Query# 10

[6] UV disinfection to be confirmed operational

[7] WWS600 - http://www.awtssalesandservice.com.au/product/commercial-treatment-plants/

[8] Total amount does not include visitor numbers – it is expected that available capacity in current system will accommodate these volumes

[9] Pump out tank location to be identified, pump out operation to be confirmed

As noted above, the existing Administration Building system is capable to meet the maximum requirements for the expected loads. The existing system capacity for the production facility (Figure 4-4) has been estimated at 2,000L/day. This value, and the disposal capacity of the soakage field or pump out facility will be confirmed through an Environmental Consultant who will perform a site inspection and develop an on-site Wastewater Management Report.



Figure 4-4 – Photograph of existing septic tank west of production facility

The environmental consultant's scope for this system will include investigations into replacing the existing septic system with an aerated waste water treatment system due to the following:

- The risk that the existing facility does not have sufficient capacity for the proposed development
- The unknown extent and state of the soakage field/pump-out facility and,
- The note on the annual approval to operate stating:
  - "Liverpool Development Control Plan Part 1 does not support the installation of new pump-out systems due to the high cost of removing effluent. They are also not considered an environmentally sustainable option."

4.3 Subsurface Conditions

4.3.1 Overview

A high-level review of subsurface conditions has been undertaken, based on the available geotechnical information. A desktop study has been carried out in accordance with Appendix B of *AS/NZS 1547:2012 On-site Domestic Waste Water Management*.

Information has been taken from the following reports:

- 'Draft Preliminary Site Investigations Report' dated May 2018 by Zoic, comprising:
  - Groundwater monitoring record provided
  - Soil logging from groundwater borehole logs
- Cored borehole logs from quarry investigation works by Boral.
- Site observations from a site walkover survey carried out on 10 Oct 2018.
- Geotechnical investigation report reference 2449285-RPT-3109A-GA-0001 dated 20 December 2018 prepared by Beca.

4.3.2 Interpretation of subsurface conditions for disposal system

Reference was specifically made to borehole PBH04, a closest geotechnical test to the location of the proposed disposal facilities. The subsurface information listed in Table 4.3.1 has been inferred using the borehole information.

Table 4.3.1 - Interpretation of Subsurface Conditions for Proposed Disposal System

Depth [mbgl][10]	Expected Subsurface Conditions	Comment
0.0 – 0.5	Fill	Mainly comprises topsoil and clayey fill (estimated in-situ permeability varying from about $1x10^{-6}$ m/s to $1x10^{-8}$ m/s
0.5 to up to 1.95	Silty Clay (Residual Soil derived from Bringelly Shale)	Mainly very stiff to hard (estimated in-situ permeability in the range of $1x10^{-8}$ m/s to $1x10^{-9}$ m/s)

The boreholes in the vicinity such as PBH03, PBH05, PBH06, PBH08 and PBH09 were also considered to infer the groundwater table and bedrock level. The following inferences were made:

- Weathered shale was observed at a depth of about 3m below the existing ground surface at PBH03 location.
- A relatively shallow groundwater table of about 1m below the existing ground surface was measured in PBH09.

4.3.3 Soil evaluation

As the in-situ soils comprise mostly clays, which reflect relatively low permeability values (typically smaller than 0.06 m/day), special design requirements and distribution techniques or soil modification procedures will be necessary in accordance with Table L1 of AS/NZS 1547:2012.

4.4 Recommendations

The recommended treatment and disposal facilities are listed in Table 4.4.1 below:

Table 4.4.1 Recommended Treatment and Disposal Facilities

Site	Location	Treatment and disposal facilities
PGH Bricks	Administration Building	No change – confirm UV operation and rectify as required
	Dispatch Office	No change
	Production Facility	TBC – expected treatment volume to be 2,040L/day Details of disposal system to be confirmed and upgraded if necessary to soakage field or surface irrigation
Monier Roof	Administration Building/Production Facility	TBC – Commercial Septic Treatment System WWS600 or similar with sub-surface or surface irrigation
	Dispatch Office	Pump to admin/production system

4.4.1 Wastewater Management Report

A Wastewater Management Report is to be developed for both sites to inform detailed design regarding treatment requirements and ability to discharge. This will include further testing.

The scope of this investigation and subsequent report includes:

- Local geotechnical testing at PGH production site (Figure 4-5) and Monier sites (Figure 4-6)
- Confirmation of capacity for existing PGH production system
- Recommendation of new system if existing system is not adequate to treat anticipated sewage requirements at the PGH production facility
- Review and confirm operational condition of existing administration system
- Confirm dual check valve existence at PGH dispatch office system potable flush line

[10] mbgl = meters below ground level

- Monier site wastewater management system/s. It is anticipated that a single treatment package as described above will be sufficient to cater for the entire Monier site. Figure 4-6 depicts the proposed location for the treatment facility and possible locations for the disposal facility.



Figure 4-5 – Proposed Locations for PGH Production Treatment and Disposal Facilities



Figure 4-6 - Proposed Locations for Monier Treatment and Disposal Facilities



APPENDIX I

ENDEAVOUR ENERGY SUBMISSION

Melanie Hollis

Subject: Endeavour Energy
Attachments: Endeavour Energy MDI0044 Easements and Property Tenur1.pdf; Endeavour Energy General Restrictions for Overhead Power Lines June 2018....pdf; ENA_emf_what_do_we_know_final 20160902.pdf; Work-near-overhead-power-lines-code-of-practice.pdf; Endeavour Energy Drawing No. 86232 (OH lines minimum clearances near str....pdf;

The Secretary
NSW Planning & Environment

ATTENTION: Director – Resource Assessments

Dear Sir or Madam

I refer to the Department's below email of 11 April 2019 regarding Badgerys Creek Quarry and Brick Making Project Modification 4 (MP 10_0014 MOD 4) and Badgerys Creek Quarry and Brick Making Project Concept Plan Modification 3 (MP 10_0033 MOD 3) at 235 Martin Road, Badgerys Creek (Lots 1 & 2 DP1035249, Lot 1 DP373863, Lot 1 DP 981161, Part Lots 54, 55, 56, 57, 58 & 59 DP 549457). Submissions need to be made to the Department by 9 May 2019.

As shown in the below site plan from Endeavour Energy's G/Net master facility model (and the extract from Google Maps Street View) there are:

- No easements over the site benefitting Endeavour Energy (active easements are indicated by red hatching).
- Low voltage and 11,000 volt / 11 kilovolt (kV) high voltage overhead power lines traversing the site including pole mounted substation no. 1173 and high voltage customer substation no. 7457.
- Whilst the conductor is not shown, there is also an 'Extended Service Line/customer owned' on the site – which may already have been redundant assets and removed from the site.

Please note the location, extent and type of any electricity infrastructure, boundaries etc. shown on the plan is indicative only. Generally (depending on the scale and/or features selected), low voltage (normally not exceeding 1,000 volts) is indicated by blue lines and high voltage (normally exceeding 1,000 volts but for Endeavour Energy's network not exceeding 132,000 volts / 132 kV) by red lines (these lines can appear as solid or dashed and where there are multiple lines / cables only the higher voltage may be shown). This plan only shows the Endeavour Energy network and does not show electricity infrastructure belonging to other authorities or customers owned electrical equipment beyond the customer connection point / point of supply to the property. This plan is not a 'Dial Before You Dig' plan under the provisions of Part 5E 'Protection of underground electricity power lines' of the *Electricity Supply Act 1995* (NSW).

The existing facility is supplied via high voltage customer substation no. 12555. As a high voltage customer the 'High Voltage Operational and Maintenance Protocol' between Endeavour Energy and the customer regarding the

provision of high voltage supply to the site will specify a 'Load of Customers Installation' which is adequate for the then / Customer's current requirements. The Protocol generally also states the following:

> *'Should any further increase in loads be required, contact should be made with Endeavour Energy's Network Connections Branch, who will inform you of the requirements in this regard'.*

The Protocol also identifies where Endeavour Energy's responsibility terminates (normally at the pole or pillar on the road verge from which supply is taken) in respect of:

- ownership of high voltage equipment;
- switching operations; and
- maintenance of equipment.

However, high voltage customer connections must be a single customer site. Multiple occupant developments such as subdivisions, shopping centres, factory units, distribution centres, etc. are not entitled to high voltage connections.

Endeavour Energy has noted the following in the Environmental Assessment:

2.4.8 Utilities

Electricity

The site currently receives a high voltage (HV) supply of 11 kilovolts (kV) from Endeavour Energy. There is an agreed load of 3.15 Mega Volt Amps (MVA) for the site, although the facility has been 'mothballed' since March 2012 with a reduced electricity demand.

In regards to the Endeavour Energy owned low voltage and 11 kV high voltage overhead power lines traversing the site which are not covered by any easements, they are protected assets and deemed to be lawful for all purposes under Section 53 'Protection of certain electricity works' of the *Electricity Supply Act 1995* (NSW). Essentially this means the owner or occupier of the land cannot take any action in relation to the presence in, on or over the land of electricity works ie. the service mains cannot be removed to rectify the encroachment. . These protected assets are managed on the same basis as if an easement was in existence – please refer to the below point 'Easement Management / Network Access'.

As shown in the following extract of the attached copy of Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights', Table 1 'Minimum easement widths', the notional easement width required by for low voltage overhead power lines is 9 metres wide ie. 4.5 to both sides of the centre line of the poles / wires.

Table 1 - Minimum easement widths

	Voltage	Asset Type	Construction	Minimum Easement (m)
Overhead Assets	400V–22kV	Bare Construction	All	9
		ABC		
		CCT		

ABC = Aerial Bundled Cables CTT = Covered Conductor Thick

Whilst a 9 metre wide easement may be excessive in some situations, alternatively, as a minimum the easement width should allow for any buildings, structures, etc. to comply with the minimum safe distances / clearances for voltages up to and including 132,000 volts (132kV) as specified in:

- Australian/New Zealand Standard AS/NZS 7000 – 2016: 'Overhead line design'; and

- ‘Service and Installation Rules of NSW’ which can accessed via the following link to the NSW Planning & Environment website:

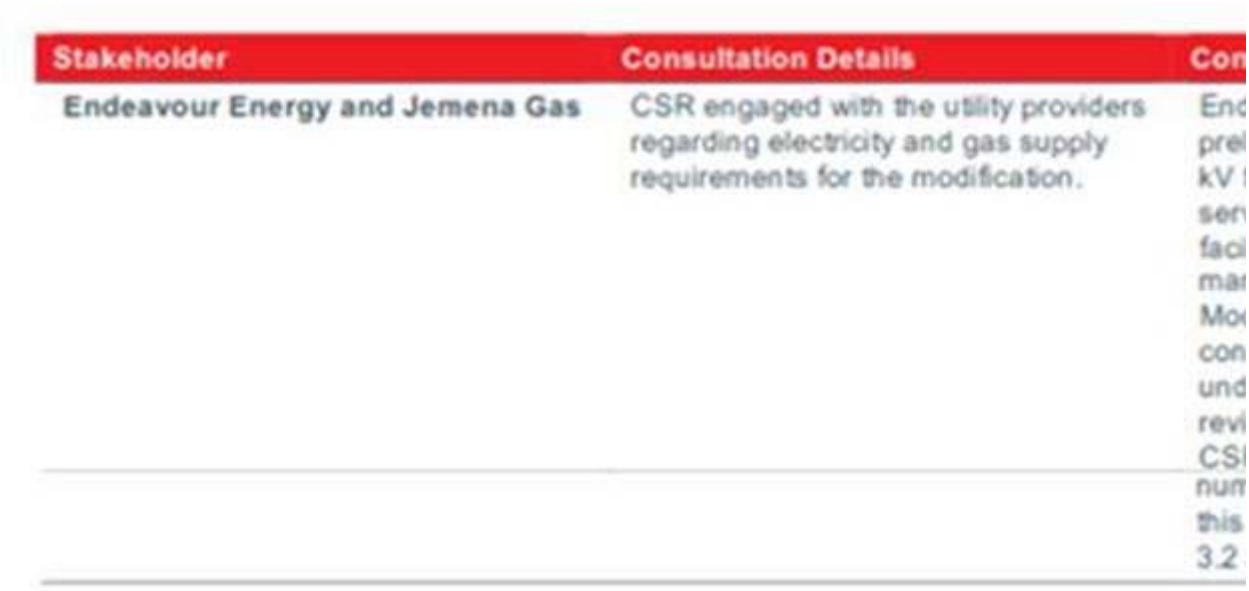
  https://www.energy.nsw.gov.au/energy-supply-industry/pipelines-electricity-gas-networks/network-connections/rules .

These distances must be maintained regardless of the Council’s allowable building setbacks etc. under its development controls and irrespective of the ownership of the overhead power lines or any facilities being ‘mothballed’. As a guide please find attached a copy of Endeavour Energy Drawing ‘Overhead Lines Minimum Clearances Near Structures’.

Subject to the foregoing and the following recommendations and comments Endeavour Energy has no objection to the Development Application / Modifications.

- Network Capacity / Connection

Endeavour Energy has noted the following in the Environmental Assessment:



Stakeholder	Consultation Details	Con
Endeavour Energy and Jemena Gas	CSR engaged with the utility providers regarding electricity and gas supply requirements for the modification.	End pre kV ser fac mai Mo con und revi CS num this 3.2

Endeavour Energy’s Asset Strategy & Planning Branch have reviewed the Solar Report provided with the application and, whilst not having undertaken a detailed evaluation of the proposal, have provided the following advice.

The Department may be concerned that this is large development within the Western Sydney Aerotropolis where Endeavour Energy have advised that existing sub-transmission capacity (n*etwork assets designed to supply zone or customer substations and operate at a primary voltage of 132 kV, 66 kV or 33 kV high voltage) is limited.*

In terms of this development there are two main parts:

1. *Increased load for the expanded* brick making *facilities, previous enquiry of 4.5 megavolt amperes (MVA).*
2. *More recently received solar farm (with tracking system) 5 megawatt (MW) plus a smaller battery component.*

Whilst Endeavour Energy is still in the process of reviewing technical details for the connection, Endeavour Energy’s network should be able to accommodate the connection of both as a combined proposal.

Endeavour Energy needs to consider not just the capacity for load/generation but the impact on reverse power flow at times of high solar/light load on voltage control and protection systems.

As previously advised, the customer may be up for 11 kV works, the extent of which is not currently known.

The solar battery system has reduced the net load required by this customer and has probably reduced the 11 kV upstream works required compared with the load on its own.

Overall the combination of generation plus load is easier to accommodate than if the proponent was only proceeding with one of the proposals.

As the battery is relatively small there will the site will still be reliant on the grid during cloudy days/early morning and night.

Should the Department require any additional advice regarding the foregoing please contact



As the applicant has already submitted a Technical Review Request to Endeavour Energy's Network Connections Branch, they should continue to contact the responsible Contestable Works Project Manager or Endeavour Energy's Network Connections Branch via Head Office enquiries on telephone: 133 718 or (02) 9853 6666 from 8am - 5:30pm. Endeavour Energy's Network Connections Branch are responsible for managing the conditions of supply with the customer / proponent and their Accredited Service Provider (ASP).

- Urban Network Design

Endeavour Energy's Company Policy 9.2.5 'Network Asset Design', includes the following requirements for electricity connections to new urban subdivision / development:

5.11 Reticulation policy

5.11.1 Distribution reticulation

In order to improve the reliability performance of and to reduce the operating expe network over the long term the company has adopted the strategy of requiring nev either underground cables or where overhead is permitted, to be predominantly of insulated construction. Notwithstanding this strategy, bare wire overhead construc appropriate and permitted in some situations as detailed below.

In areas with the potential for significant overhanging foliage, CCT is used to provi reliability as it is less susceptible to outages from wind-blown branches and debris conductors. CCT must only be used in treed[2] areas as the probability of a direct lig low. In open areas where the line is not shielded from a direct lightning strike, bar must generally be used for 11kV and 22kV reticulation.

Non-metallic Screened High Voltage Aerial Bundled Cable (NMSHVABC) must b which are heavily treed and where it is not practicable to maintain a tree clearing the conductors.

[2] A "treed" area is one with a substantial number of trees adjacent to the line, in each span. In these situations CCT is used to provide increased reliability as it is less susceptible to outages from wind-b

5.11.1.1 Urban areas

Reticulation of new residential subdivisions will be underground. In areas of low b consequence, new lines within existing overhead areas can be overhead, unless lines are cost justified or required by either environmental or local council require

Where underground reticulation is required on a feeder that supplies a mixture of commercial and/or residential loads, the standard of underground construction wi types of load within that development.

Where ducting is used, adequate spare ducts and easements must be provided a cover the final load requirements of the entire development plan.

Extensions to the existing overhead 11kV/22kV network must generally be under will be used for conductor replacements and augmentations except in treed areas NMSHVABC must be used.
Extensions to the existing overhead LV network and augmentations must either b ABC. Conductor replacements greater than 100m in route length must utilise aer

- Location of Electricity Easements / Prudent Avoidance

Depending on the outcome of the assessment, any electricity infrastructure required to be located within the property to facilitate the proposed development ie. new feeder routes, padmount substations, will need to be provided in a suitable and accessible location and be protected by an easement and associated restrictions benefiting and gifted to Endeavour Energy. Please refer to Endeavour Energy's Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights'.

Endeavour Energy's preference is to have continuity of its easements over the most direct and practicable route affecting the least number of lots as possible. The incorporation of electricity easements into privately owned lots is generally problematic for both Endeavour Energy and the future landowners and requires additional easement management to ensure no uncontrolled activities / encroachments occur within the easement area. Accordingly Endeavour Energy's recommendation is that whenever reasonably possible, easements be entirely incorporated into public reserves and not burden private lots (except where they are remnant lots or not subject to development).

This is also in keeping with a policy of prudent avoidance by the siting of more sensitive uses away from any electricity infrastructure to minimise exposure to electric and magnetic fields (EMF), noise etc. associated with the 24/7/365 (all day, every day of the year) operation of the electricity network. Please find attached a copy of Energy Networks Association's 'Electric & Magnetic Fields – What We Know, which can also be accessed via the link to their website at https://www.energynetworks.com.au/electric-and-magnetic-fields and provides the following advice:

> *Electric fields are strongest closest to their source, and their strength diminishes rapidly as we move away from the source.*
>
> *The level of a magnetic field depends on the amount of the current (measured in amps), and decreases rapidly once we move away from the source.*

Typical magnetic field measurements associated with Endeavour Energy's activities and assets given the required easement widths, safety clearances etc. and having a maximum voltage of 132,000 volt / 132 kV, will with the observance of these separation distances not exceed the recommended magnetic field public exposure limits.

- Earthing

The construction of any building or structure (including fencing, signage, flag poles, hoardings etc.) whether temporary or permanent that is connected to or in close proximity to Endeavour Energy's electrical network is required to comply with Australian/New Zealand Standard AS/NZS 3000:2018 'Electrical installations' as updated from time to time. This Standard sets out requirements for the design, construction and verification of electrical installations, including ensuring there is adequate connection to the earth. Inadequate connection to the earth to allow a leaking/fault current to flow into the grounding system and be properly dissipated places persons, equipment connected to the network and the electricity network itself at risk from electric shock, fire and physical injury.

- Easement Management / Network Access

The following is a summary of the usual / main terms of Endeavour Energy's electrical easements requiring that the land owner:

- Not install or permit to be installed any services or structures within the easement site.
- Not alter the surface level of the easement site.
- Not do or permit to be done anything that restricts access to the easement site without the prior written permission of Endeavour Energy and in accordance with such conditions as Endeavour Energy may reasonably impose.

Endeavour Energy's preference is for no activities or encroachments to occur within its easement areas. However, if any proposed works (other than those approved / certified by Endeavour Energy's Network Connections Branch as part of an enquiry / application for load) will encroach/affect Endeavour Energy's easements or protected assets, contact must first be made with the Endeavour Energy's Easements Officer, [redacted] on direct telephone [redacted] or alternately by email [redacted] or [redacted].

Please find attached for the applicant's reference copies of Endeavour Energy's:

- General Restrictions for Overhead Power Lines.
- Mains Design Instruction MDI 0044 'Easements and Property Tenure Rights' which in Section 5.14 'Encroachments on overhead line easements' deals with activities / encroachments within easements.

It is imperative that the access to the existing electrical infrastructure on and in proximity of the site be maintained at all times. To ensure that supply electricity is available to the community, access to the electricity infrastructure may be required at any time. Restricted access to electricity infrastructure by maintenance workers causes delays in power restoration and may have severe consequences in the event of an emergency.

- Vegetation Management

The planting of large trees in the vicinity of electricity infrastructure is not supported by Endeavour Energy. Suitable planting needs to be undertaken in proximity of electricity infrastructure. Only low growing shrubs not exceeding 3.0 metres in height, ground covers and smaller shrubs, with non-invasive root systems are the best plants to use. Larger trees should be planted well away from electricity infrastructure (at least the same distance from overhead power lines as their potential full grown height) and even with underground cables, be installed with a root barrier around the root ball of the plant. Landscaping that interferes with electricity infrastructure may become a potential safety risk, cause of bush fire, restrict access, reduce light levels from streetlights or result in the interruption of supply. Such landscaping may be subject to Endeavour Energy's Vegetation Management program and/or the provisions of the *Electricity Supply Act 1995* (NSW) Section 48 'Interference with electricity works by trees' by which under certain circumstances the cost of carrying out such work may be recovered.

- Dial Before You Dig

Before commencing any underground activity the applicant is required to obtain advice from the ***Dial Before You Dig*** **1100** service in accordance with the requirements of the *Electricity Supply Act 1995* (NSW) and associated Regulations. This should be obtained by the applicant not only to identify the location of any underground electrical and other utility infrastructure across the site, but also to identify them as a hazard and to properly assess the risk.

- Demolition

Demolition work is to be carried out in accordance with Australian Standard AS 2601—2001: 'The demolition of structures' as updated from time to time. All electric cables or apparatus which are liable to be a source of danger, other than a cable or apparatus used for the demolition works shall be disconnected ie. the existing customer service lines will need to be isolated and/or removed during demolition. Appropriate care must be taken to not otherwise interfere with any electrical infrastructure on or in the vicinity of the site eg. streetlight columns, power poles, overhead power lines and underground cables etc.

- Public Safety

Workers involved in work near electricity infrastructure run the risk of receiving an electric shock and causing substantial damage to plant and equipment. I have attached Endeavour Energy's public safety training resources, which were developed to help general public / workers to understand why you may be at risk and what you can do to work safely. The public safety training resources are also available via Endeavour Energy's website via the following link:

http://www.endeavourenergy.com.au/wps/wcm/connect/ee/nsw/nsw+homepage/communitynav/safety/safety+brochures .

If the applicant has any concerns over the proposed works in proximity of the Endeavour Energy's electricity infrastructure to the road verge / roadway, as part of a public safety initiative Endeavour Energy has set up an email account that is accessible by a range of multiple stakeholders across the company in order to provide more effective lines of communication with the general public who may be undertaking construction activities in

proximity of electricity infrastructure such as builders, construction industry workers etc. The email address is Construction.Works@endeavourenergy.com.au .

- Emergency Contact

In case of an emergency relating to Endeavour Energy's electrical network, the applicant should note the Emergencies Telephone is 131 003 which can be contacted 24 hours/7 days.

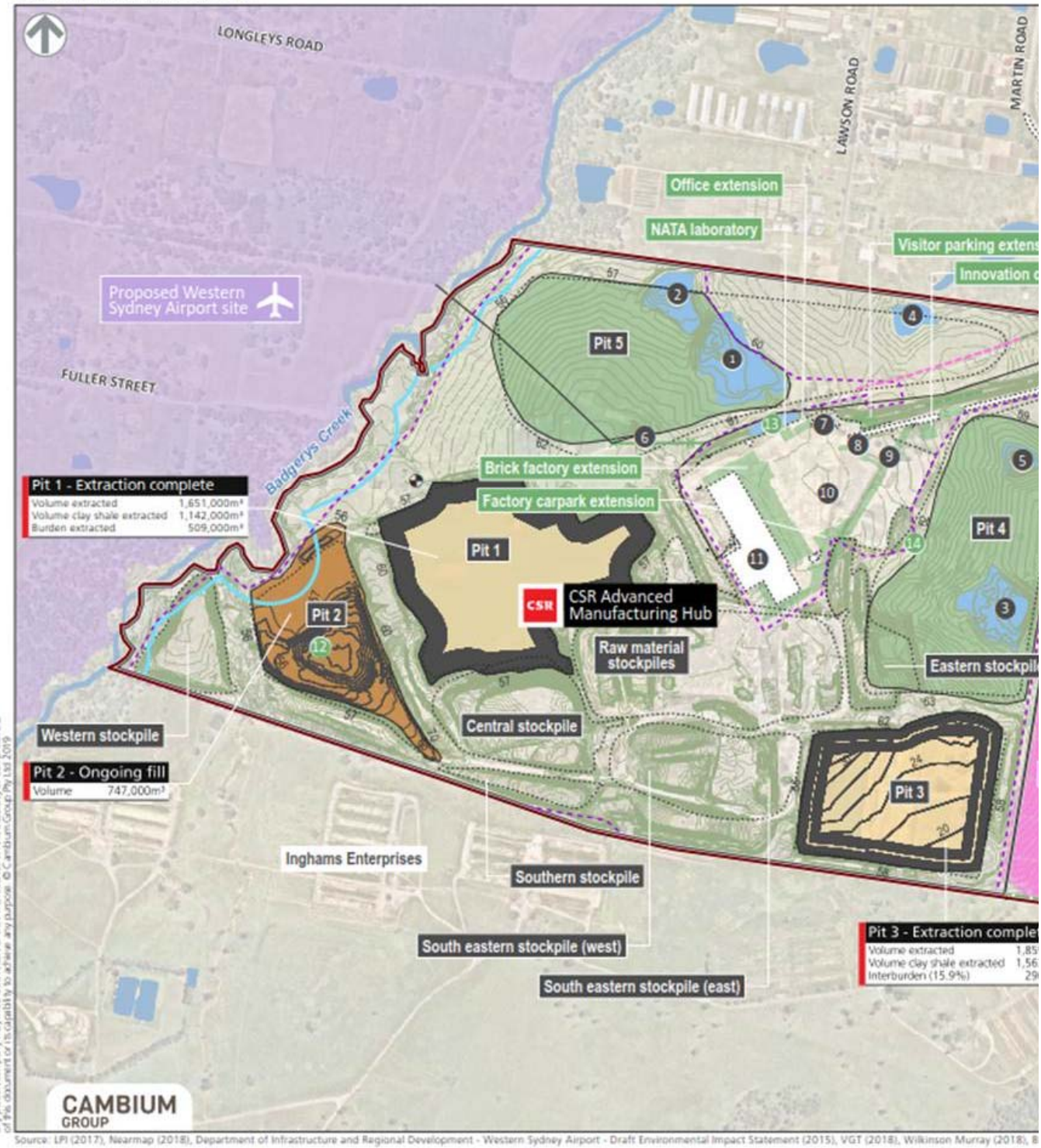
I appreciate that not all the foregoing issues may be directly relevant or significant to the Modifications. However, Endeavour Energy's preference is to alert proponents / applicants of the potential matters that may arise should development within closer proximity of the existing and/or required electricity infrastructure needed to facilitate the proposed development on or in the vicinity of the site occur.

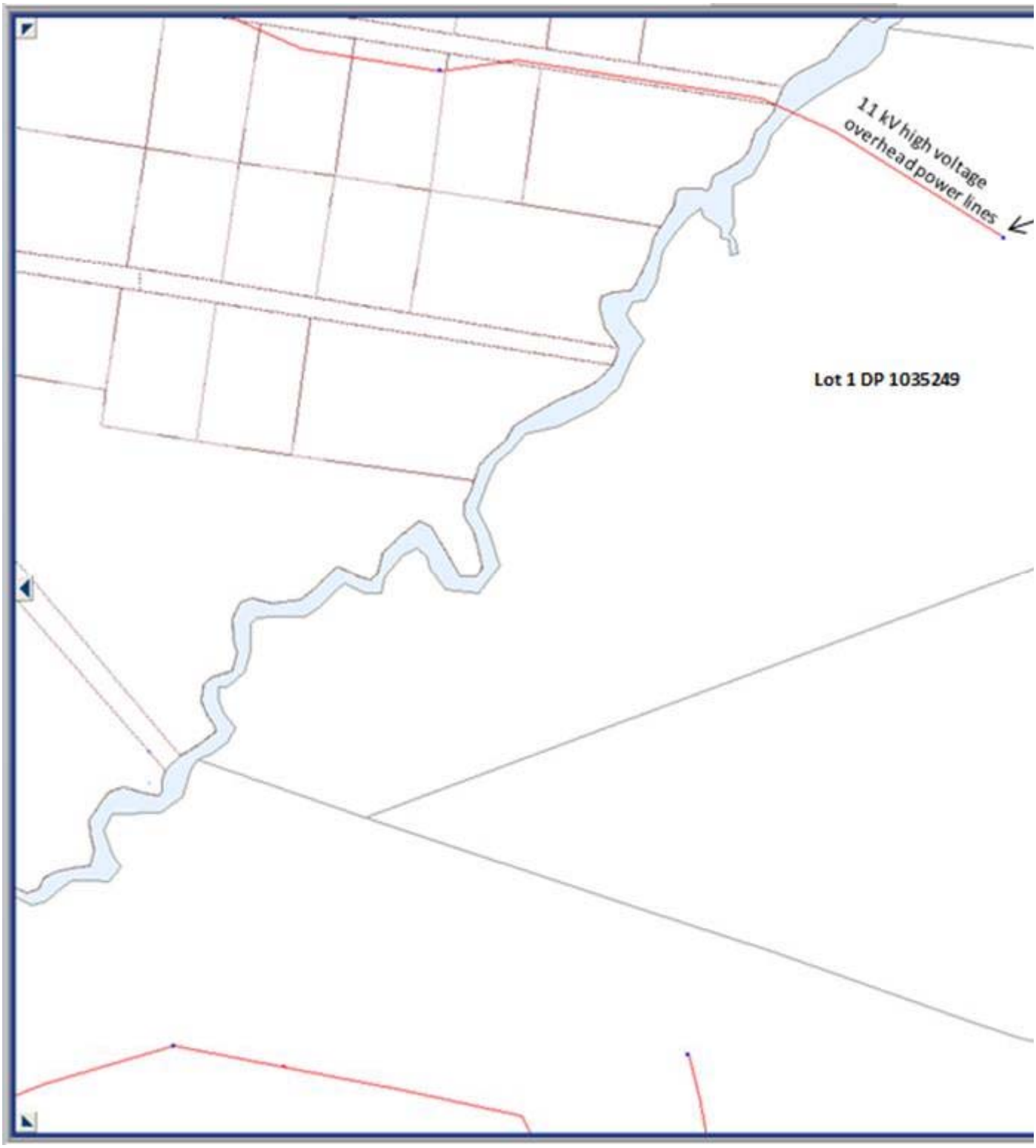
Could you please pass on a copy of this submission and the attached resources to the applicant? Should you wish to discuss this matter, or have any questions, please do not hesitate to contact me or the contacts identified above in relation to the various matters. Due to the high number of development application / planning proposal notifications submitted to Endeavour Energy, to ensure a response contact by email to [redacted] is preferred.

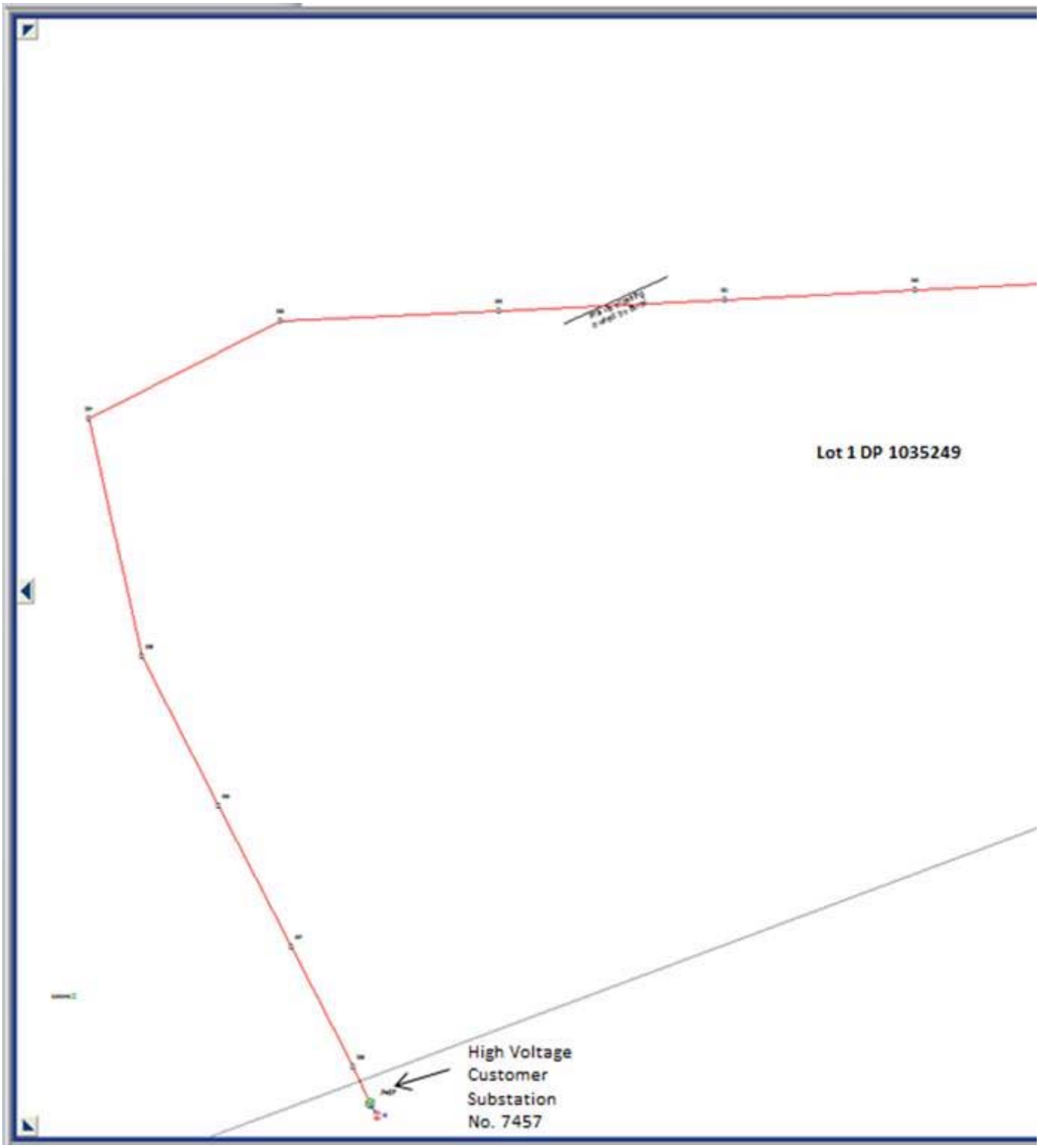
Yours faithfully
Cornelis Duba
Development Application Specialist
Network Environment & Assessment
[redacted]
www.endeavourenergy.com.au

Figure 3.2
30 year quarry staging plan - Stage 2 (years 6-7)

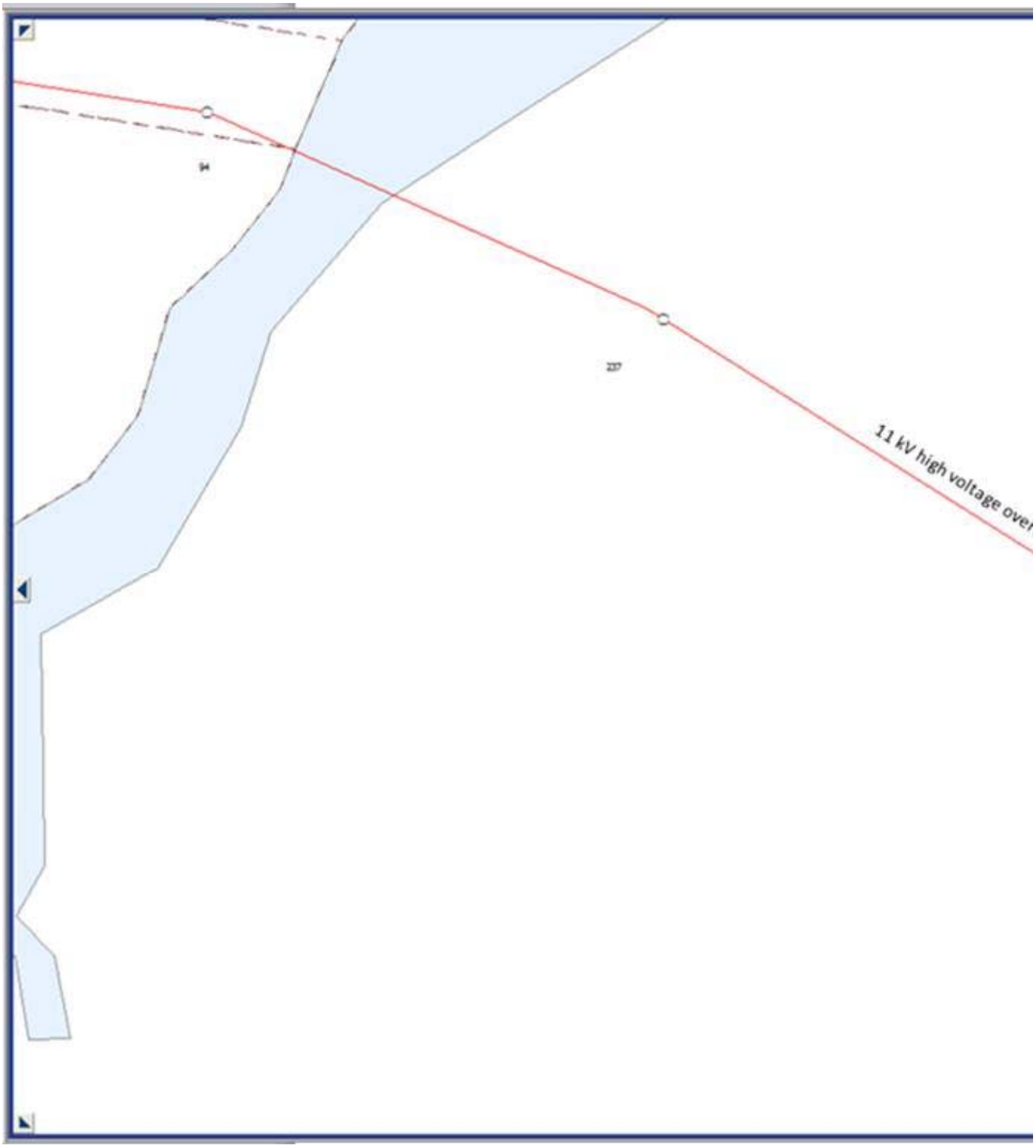
CSR ADVANCED MANUFACTURING HUB - MODIFICATION 4
ENVIRONMENTAL ASSESSMENT




11 kV high voltage
overhead power lines
Lot 1 DP 1035249


Lot 1 DP 1035249
High Voltage
Customer
Substation
No. 7457


Martin Rd
Badgerys Creek, New South Wales
Google
Street View - Oct 2014
Martin Rd


11 kV high voltage

energy networks association

ELECTRIC & MAGNETIC FIELDS – WHAT WE KNOW



ABOUT EMFS

ELECTRIC AND MAGNETIC FIELDS – OR EMFS – ARE FOUND EVERYWHERE THERE IS ELECTRICITY. THEY ARE INVISIBLE.

Electric and magnetic fields - or EMFs - are found everywhere there is electricity. This includes around electrical appliances, equipment and the wiring we use in our homes, workplaces and schools, as well as powerlines and utility facilities. As electricity is so widespread in our society, questions about electricity and health are important to people. Research over more than 40 years has greatly increased our understanding of EMFs. The purpose of this brochure is to inform the public about what we know, and what we are doing about it.



WHAT ARE ELECTRIC FIELDS?

Electric fields are related to the voltage, or the pressure which pushes electricity along wires. The higher the voltage, the higher will be the electric field. Electric fields are present in any appliance plugged into a power point which is switched on. Even if the appliance itself is turned off, if the power point is on, an electric field will be present.

Electric fields are strongest closest to their source, and their strength diminishes rapidly as we move away from the source. The many common materials such as brickwork or metal will block electric fields. Walls, tables and bench tops can act as shields.

WHAT ARE MAGNETIC FIELDS?

Magnetic fields are produced by the flow of electricity, commonly known as current. Unlike electric fields, magnetic fields are only present when electric current is flowing. In other words, if an appliance is operating (even while in 'standby' mode), a magnetic field is produced.

The level of a magnetic field depends on the amount of the current (measured in amps), and decreases rapidly once we move away from the source. While electric fields are shielded by many common materials, this is not the case with magnetic fields. This is one reason why power lines may contribute to magnetic fields in the home and why burying power lines will not eliminate magnetic fields.

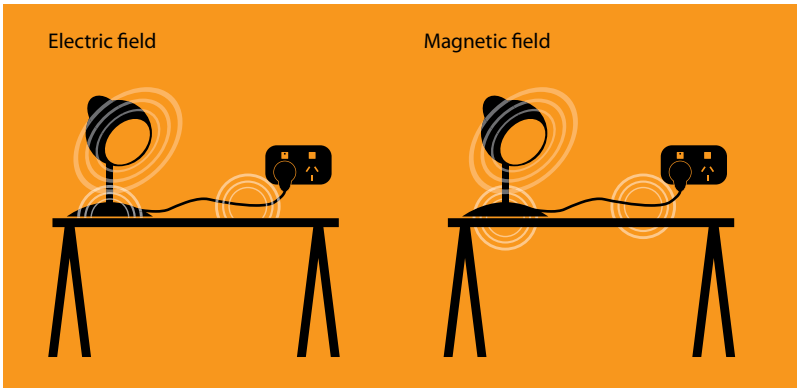
EMFS AND HEALTH

Research on EMFs and health has been conducted for over 40 years. This includes over 2,900 studies at a cost of more than $490 million internationally.

The research has generally focused on the magnetic fields with two main areas of research, *epidemiology* and *laboratory* studies. Both areas would need to provide links between EMFs and adverse health effects for causality to be accepted by health authorities.

Epidemiology (population).

This research looks at statistics to see if there are patterns of disease in large groups of people. The difficult with large statistical studies is that they take several years to produce meaningful results and even then, there are different opinions about how the results should be interpreted.



There may be other factors in the study which could complicate the interpretation of the results. Scientists generally agree that epidemiological studies aren't strong enough by themselves to establish that adverse health effects exist.

Laboratory

In the laboratory researchers have studied animals cells, as well as human volunteers under controlled circumstances to see if EMFs have any effects.

There have been many hundreds of these studies, and scientists look for results which can be successfully repeated in different laboratories. In over 40 years of research there have been no such consistently reproducible results for exposures below the guidelines.

AUTHORITATIVE REVIEWS

It is well accepted by scientists that no one study considered in isolation will provide a meaningful answer to the question of whether or not EMF can contribute to adverse health effects. In order to make an informed conclusion from all of the research, it is necessary to consider the science in its totality.

All of the research is reviewed periodically by expert panels which are established by national or international bodies with the purpose of trying to determine whether or not human exposure to EMF is related to adverse health effects.

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is a Commonwealth Government agency charged with the responsibility for protecting the health and safety of people and the environment from EMF. ARPANSA advises that:

"The scientific evidence does not establish that exposure to ELF EMF found around the home, the office or near powerlines and other electrical sources is a hazard to human health".

"There is no established evidence that ELF EMF is associated with long term health effects. There is some epidemiological research indicating an association between prolonged exposure to higher than normal ELF magnetic fields (which can be associated with residential proximity to transmission lines or other electrical supply infrastructure, or by unusual domestic electrical wiring), and increased rates of childhood leukaemia.

However, the epidemiological evidence is weakened by various methodological problems such as potential selection bias and confounding. Furthermore this association is not supported by laboratory or animal studies and no credible theoretical mechanism has been proposed."

These findings are consistent with the views of other credible public health authorities. For example the World Health Organisation (WHO) advises that:

"Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields."

Similarly, the US National Cancer Institute concludes that:

Currently, researchers conclude that there is little evidence that exposure to ELF-EMFs from power lines causes leukemia, brain tumors, or any other cancers in children."

"No mechanism by which ELF-EMFs could cause cancer has been identified. Unlike high-energy (ionizing) radiation, ELF-EMFs are low energy and non-ionizing and cannot damage DNA or cells directly."

"Studies of animals exposed to ELF-EMFs have not provided any indications that ELF-EMF exposure is associated with cancer, and no mechanism has been identified by which such fields could cause cancer."

EMF GUIDELINES FOR ESTABLISHED HEALTH EFFECTS

The two internationally recognised exposure guidelines are:

- International Commission in Non-Ionizing Radiation Protection (ICNIRP) 2010; and
- International Committee on Electromagnetic Safety, Institute of Electrical and Electronics Engineers (IEEE) 2002.

ARPANSA's advice is:

- *"The ICNIRP ELF guidelines are consistent with ARPANSA's understanding of the scientific basis for the protection of the general public (including the foetus) and workers from exposure to ELF EMF".*
- Under the ICNIRP guidelines of 2010 the recommended magnetic field public exposure limit is 200 microtesla.

Under the IEEE Standard of 2002 the recommended magnetic field public exposure limit is 904 microtesla.

FIGURE 1: TYPICAL MAGNETIC FIELD MEASUREMENT RANGES

Magnetic Field Source	Range of Measurements in μT*
Electric stove	0.2 – 3
Refrigerator	0.2 – 0.5
Electric kettle	0.2 – 1
Toaster	0.2 – 1
Television	0.02 – 0.2
Personal computer	0.2 – 2
Electric blanket	0.5 – 3
Hair dryer	1 – 7
Pedestal fan	0.02 – 0.2
Substation	
» substation fence	0.1 - 0.8
Distribution line	
» under line	0.2 – 3
» 10m away	0.05 – 1
Transmission Line	
» under line	1 – 20
» edge of easement	0.2 - 5

* Note: Levels of magnetic fields may vary from the range of measurements shown. Appliance measurements at normal user distance.

Source: ARPANSA, Measuring magnetic fields

GUIDE TO COMMON EMFS

It is possible to measure magnetic fields using a gaussmeter.

The fields are measured in a unit of microtesla (μT) or milligauss (mG). 1 Microtesa (μT) equals 10 milligauss (mG).

To give you an idea of the relative strengths of EMF, the following guide shows the typical magnetic fields close to appliances and under power lines.

Due to variations in the design of electrical appliances / powerlines and the power consumed or transmitted, the levels of magnetic fields will vary.

ENA'S RESPONSE?

Electricity utilities review scientific developments related to EMFs and are guided by relevant health authorities. In Australia, the Energy Networks Association (ENA) recommends that electricity utilities provide balanced and accurate information to the community and design and operate electrical power systems prudently within relevant health guidelines. This includes such actions as:

- providing training to staff;
- informing the community;
- ensuring that fields are within established guidelines set by health authorities; and
- practising "prudent avoidance" when building new electrical facilities.

Prudent avoidance involves reducing magnetic field exposure where this is practicable and can be done at no cost or very low cost.

The industry has followed this reasonable, common sense approach for many years.

INDIVIDUALS RESPONSE

There are some things you can do very easily to reduce exposure to EMF. Since EMFs drop off rapidly as you move away from their source, you can modify your use of electrical appliances such as clock radios. You can locate beds away from a wall that has a switchboard outside and you can switch off your electric blanket before you get into bed. These actions may reduce exposure to EMFs but it cannot be said that doing any of these things will have any health benefit.

For further information about EMFs:

- your local electricity utility or the Energy Networks Association (ENA) www.ena.asn.au;
- the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) - www.arpansa.gov.au
- the World Health Organisation (WHO) – www.who.int

Energy Networks Association Ltd
P +61 2 6272 1555 **E** info@ena.asn.au
Level 1, 110 Giles St, Kingston ACT 2604
www.ena.asn.au

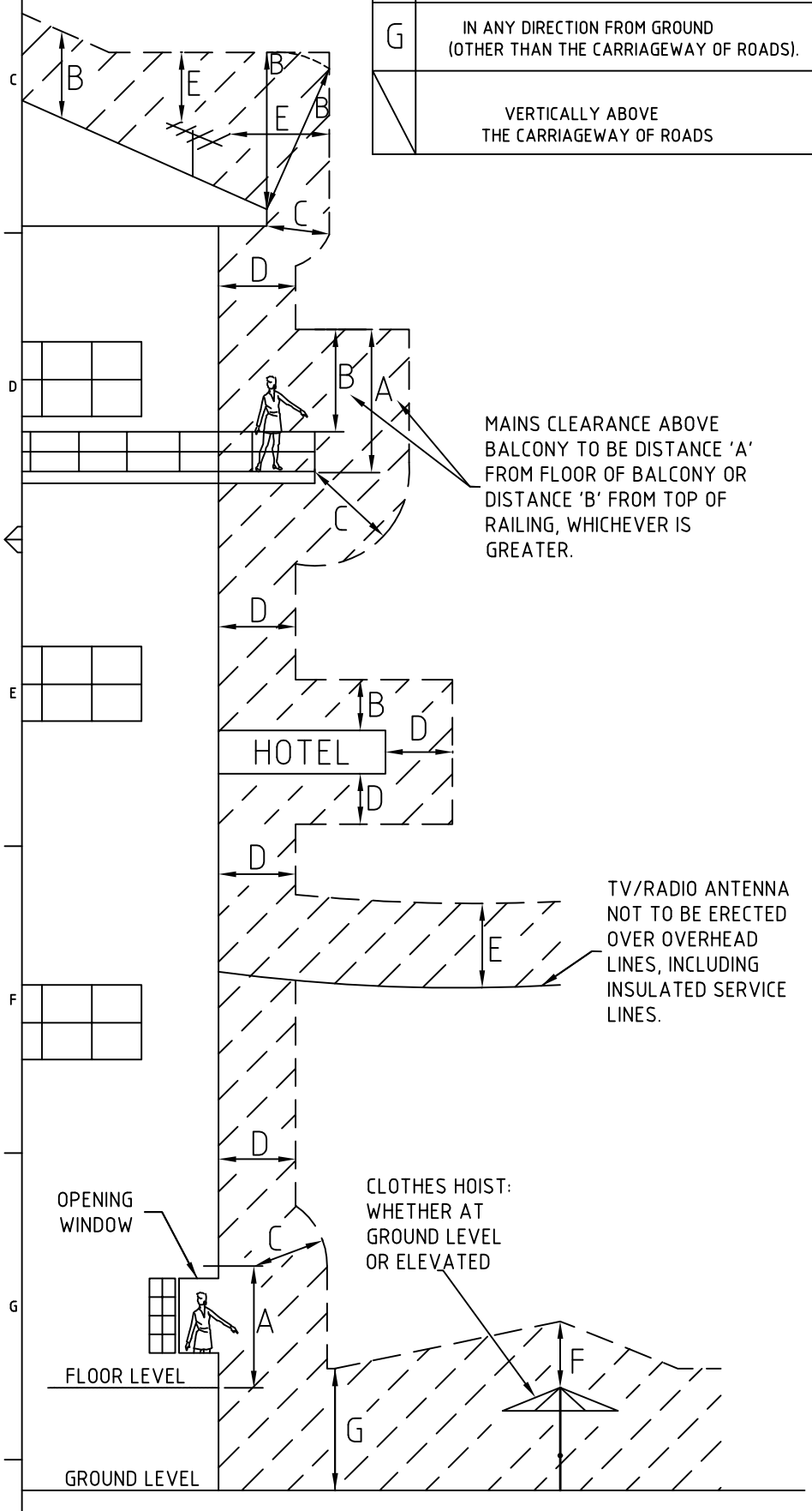
UPDATED DEC 2015 PUBLISHED FEB 2016



AMENDMENTS		
A	ORIGINAL ISSUE	
	J R No.	NA
B	DR'N	C.R.T.
	CH'D	C.R.T.
	DATE	16-2-95
	JR No	930208
REDRAWN: OH SHEET		
SEO		C.H.B.
C	DR'N	C.R.T.
	CH'D	C.R.T.
	DATE	13-7-95
	JR No	950099
TABLE AMENDED.		
SEO		C.H.B.
D	DR'N	C.R.T.
	CH'D	C.R.T.
	DATE	15-8-96
	JR No	950156
INTEGRAL WAS PE, SHEET WAS A2.		
MPDO		CHB
E	DR'N	C.R.T.
	CH'D	C.R.T.
	DATE	03-3-97
	JR No	950156
VOLT BANDS REVISED		
MPDO		CHB
F	DR'N	F.M.
	CH'D	F.M.
	DATE	28/2/03
	JR No	XD3MAINO
FORMAT WAS GDS. DIM 1250 WAS 1800 ROW E. REGULATION TITLE ALTERED. YR 1999 WAS 1991.		
DMC		GB

G	DR'N	KT
	CH'D	MC
	DATE	24.08.06
	JR No	
ROW G ADDED TO TABLE. VOLT BANDS REVISED. ROWS B,C AND LAST ROW AMENDED. NOTES AMENDED. DIAGRAM AMENDED.		
TME		MC
H	DR'N	BF
	CH'D	SD
	DATE	05.09.08
	JR No	XD5STD
CLEARANCES - INSULATED WITHOUT EARTH SC WAS 5500,BARE CONDUCTORS WERE 5500,6700		
DMC		S. DANIEL
J	DR'N	G.S.F.
	CH'D	SD
	DATE	27.03.09
	JR No	--
CLEARANCES - INSULATED ROW E WAS 1250 NOW 1800		
DMC		S. DANIEL
K	DR'N	DC
	CH'D	SD
	DATE	30.07.13
	JR No	--
OH&UG MM		D.MATE
NOTE 5-7500 WAS 7300 AND BRACKETED NUMBERS REVERSED. INSULATED VALUES CHANGED FOR B&C.		

NOMINAL VOLTAGE (U) & CONDUCTOR / APPLICATION		U ≤ 1000V			U > 1000V		1000V < U ≤ 33kV	33kV < U ≤ 132kV
		INSULATED (mm)	BARE NEUTRAL (mm)	BARE ACTIVE (mm)	INSULATED WITHOUT EARTHED SCREEN (mm)	INSULATED WITH EARTHED SCREEN (mm)	BARE CONDUCTORS (mm)	BARE CONDUCTORS (mm)
A	VERTICALLY ABOVE THOSE PARTS OF ANY STRUCTURE NORMALLLY ACCESSIBLE TO PERSONS	2700	2700	3700	3700	2700	4500	5000
B	VERTICALLY ABOVE THOSE PARTS OF ANY STRUCTURE NOT NORMALLY ACCESSIBLE TO PERSONS BUT ON WHICH A PERSON MAY STAND	2000	2700	2700	2700	2700 NOTE 4	3700	4500
C	IN ANY DIRECTION (OTHER THAN VERTICALLY ABOVE) FROM THOSE PARTS OF ANY STRUCTURE NORMALLY ACCESSIBLE TO PERSONS, OR FROM ANY PARTS NOT NORMALLY ACCESSIBLE TO PERSONS BUT ON WHICH A PERSON CAN STAND	1000	900 NOTE 5 (1000)	1500	1500	1500 NOTE 4	2100	3000
D	IN ANY DIRECTION FROM THOSE PARTS OF ANY STRUCTURE NOT NORMALLY ACCESSIBLE TO PERSONS	100 NOTE 2	300 NOTE 2	600 NOTE 2	600	100	1500	2500
E	IN ANY DIRECTION FROM ANY PART OF AN OUTDOOR TELEVISION ANTENNA OR PART OF A STAYWIRE	1800	1800	1800	3000	3000	3000	3000
F	IN ANY DIRECTION FROM CLOTHES LINE	2000	3000	3000	3000	3000	3000	3000
G	IN ANY DIRECTION FROM GROUND (OTHER THAN THE CARRIAGEWAY OF ROADS).	5500 NOTE 6	5500	5500	5500 NOTE 5 (7500)	5500	5500 NOTE 5 (7500)	6700 NOTE 5 (7500)
\	VERTICALLY ABOVE THE CARRIAGEWAY OF ROADS	5500	5500	5500	6000 NOTE 5 (7500)	5500	6700 NOTE 5 (7500)	6700 NOTE 5 (7500)



GENERAL NOTES

1. THE POINT OF ATTACHMENT IS HERE DEFINED AS THE POINT AT WHICH Endeavour Energy'S AERIAL SERVICE MAINS JOIN ONTO THE CONSUMERS BUILDING OR STRUCTURE OR ELSE THE FIRST POLE PAST THE BOUNDARY OF THE CONSUMERS PREMISES.
2. THIS CLEARANCE MAY BE REDUCED TO ALLOW FOR TERMINATION AT POINT OF ATTACHMENT.
3. FOR CLEARANCE REQUIREMENTS OF INSULATED AERIAL SERVICE MAINS, REFER Endeavour Energy'S DRAWING 011985.
4. HIGH VOLTAGE NON-METALIC SCREENED AERIAL BUNDLED CONDUCTOR (NMS-HV ABC) IS CLASSIFIED AS INSULATED WITH EARTHED SCREEN FOR CLEARANCE PURPOSES, EXCEPT FOR DIMENSIONS B & C.
5. TO KEEP LINES BEYOND THE REACH OF PERSONS, THE DESIGN CLEARANCES (SHOWN IN BRACKETS) REQUIRED BY Endeavour Energy IN THESE SITUATIONS ARE GREATER THAN THOSE REQUIRED BY INDUSTRY GUIDELINES.
6. DOES NOT INCLUDE INSULATED SERVICE LINES.

MINIMUM CLEARANCE REQUIREMENTS

MINIMUM SAFE CLEARANCES ARE SPECIFIED IN ELECTRICITY SUPPLY (SAFETY & NETWORK MANAGEMENT) REGULATION 2008, & GUIDELINES FOR DESIGN & MAINTENANCE OF OVERHEAD DISTRIBUTION & TRANSMISSION LINES (ENA C(b)1-2006).
DETAILS SHOWN ON THIS DRAWING COMPLY WITH ENDEAVOUR ENERGY PRACTICE.

THESE CLEARANCES ARE THE MINIMUM NECESSARY WHEN ANY Endeavour Energy OVERHEAD LINE WILL BE IN ITS CLOSEST POSITION TO THE BUILDING OR OTHER STRUCTURE DURING STRONG WINDS OR MAXIMUM OPERATING TEMPERATURE (EXCLUDING FAULT CURRENTS OR EMERGENCY LOAD CURRENTS). UNDER THESE CONDITIONS, CONDUCTOR MAY SWING OR SAG CONSIDERABLY TOWARDS THE BUILDING OR STRUCTURE COMPARED WITH NORMAL CONDITIONS.
ADEQUATE ALLOWANCE SHOULD BE MADE FOR THIS POSSIBLE SWING OR SAG OF CONDUCTORS.

OVERHEAD LINES MUST NOT COME WITHIN HATCHED AREAS.
MINIMUM CLEARANCES SHOWN ARE FOR Endeavour Energy OVERHEAD LINES UP TO THE POINT OF ATTACHMENT (AS DEFINED IN NOTE 1).
MINIMUM CLEARANCES PAST THE POINT OF ATTACHMENT ARE TO BE IN ACCORDANCE WITH SAA WIRING RULES (AS/NZS3000).

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Endeavour Energy

ORIGINAL SCALE NONE
APPROVED C.BROWN
REFERENCE DRAWINGS
DO NOT SCALE DIMENSIONS IN MILLIMETRES
AUTHORISED W.ISLEY

DRAWN	C.R.T.		
DATE	16-2-95		
CH'D			

MGR TRANSMISSION MAINS 16-2-95

Endeavour Energy OVERHEAD LINES MINIMUM CLEARANCES NEAR STRUCTURES

A2P 086232 K

SHEET No 1 OF 1 SHEETS

Last updated 26/6/18

General Restrictions for Overhead Power Lines

Endeavour Energy wishes to provide the following list of 'General Restrictions' applicable to the **'Easement Area'**. It should be noted that these are indicative guidelines only and that this information should be administered in conjunction with the requirements of the Work Health and Safety (WH&S) Act and WorkSafe NSW (formerly WorkCover) legislation.

Endeavour Energy recommends a policy of **'prudent avoidance'** be adopted in relation to the use of the easement area for ongoing staff activities or work areas. Additionally, WH&S and WorkSafe legislation should be consulted in relation to this matter.

As existing ground levels throughout the easement are unknown, it is assumed that minimum design clearances exist within the easement area. As such, references to permissible heights on any activity may alter from that stated within this document. **Written approval** must be sought for any activity within the easement area. For such approval, detailed plans drawn to scale and fully dimensioned showing property boundaries and other relevant information should be forwarded to Endeavour Energy.

Approval to encroach into the easement area will not be granted where an alternate site clear of the easement area exists. All approvals granted are subject to the encroachments being removed or relocated; at the owner's expense should Endeavour Energy require this for cable maintenance, construction or emergency works.

Should any earthing be disturbed whilst work is being carried out, all work should immediately cease and Endeavour Energy notified so that the earthing can be reinstated.

1. Construction of *habitable* buildings (permanent or temporary) e.g. Houses, site-sheds with sleeping quarters, shipping containers, other substantial structures or parts thereof, includes eaves, guttering and footings, *shall not be erected within the easement area.*

1a. *Non-habitable* buildings will be considered. They must be earthed as per Endeavour Energy's 069575.dwg. The building cannot have electrical power connected, or store corrosives, explosives, combustibles or flammables.

2. No encroachment into an overhead Transmission easement will be permitted within 10 metres of the closest steel structure and 5 metres of the closest pole.

2b. No encroachment into an overhead Distribution easement will be permitted within 5 metres of the closest pole.

3. Changes to ground levels within the easement area are not permitted without the prior written approval of Endeavour Energy. Applications are to be supported by a geo-technical report prepared by a civil engineer.

4. **Statutory clearances to the conductors must be kept at all times**.

   It should be noted that power lines are designed to allow for sag and swing sideways, consequently allowance for this needs to be considered at all times. The statutory clearance from 0 kV to 132 kV conductors is minimum 3 metres, in all directions, at all times. This clearance also applies but not limited to; persons, vehicles, hand tools, equipment, cranes, lifting gear, plant and load. Consideration needs to be given and the clearances increased where there is the likelihood of any inadvertent movement or swinging of the plant, crane, load or lifting gear towards the power lines.

5. Construction of roads, car and truck parking areas, and subdivisions will only be considered for approval provided that access to the structures is maintained and the layout is such that; sufficient building area is left clear of the easement, it will not create numerous utility crossings or later requests for encroachments.

6. If required, In order for Endeavour Energy to carry out the necessary calculations, the applicant must submit a Centre Line Profile, a recent survey, showing the following information:

REQUIREMENTS FOR PROFILE CLEARANCE TO TRANSMISSION LINES

Note: Clearances cannot be determined and will not be processed unless all of the required information is submitted i.e. *Current levels **and** Proposed levels.*

THE INFORMATION TO BE SUPPLIED:

- In AutoCAD Format.
- Have a vertical exaggerated scale of 10:1. E.g. Horizontal Scales 1:1000 Vertical Scale 1:100 or Horizontal Scale 1:500 Vertical Scale 1:50.
- Information on the paper size that the drawing needs to be printed at for the scale to be correct e.g. Horizontal Scale 1:1000 Vertical Scale 1:100 when printed on A2.

THE CENTRE LINE PROFILE SURVEY IS TO INCLUDE ALL OF THE FOLLOWING INFORMATION:

- Lot and DP number of property.
- Clearly marked easement width.
- Total length of the conductor span affected.
- Conductor attachment height reading at each structure.
- Existing RL (Natural Ground Surface) and Final readings at the base of each structure.
- Indicate pole or structure identification numbers.
- Date, Time and Temperature at the time of each height reading taken.
- A height reading is required every 10 metres on the conductor closest to the ground of the Existing RL or as the terrain dictates for the entire span.

Note:

- The amount of distance required for each reading may be reduced on poles with smaller spans.

- Other information may be required where the structures are strained or changes of direction occur on pole lines.

7. A second survey may be required upon completion of work.

8. Vehicles with elevating or extending components such as earth moving vehicles, concrete pumping vehicles, loaders, fork lift trucks, tip trucks, cranes, including Derrick style cranes and hoists, Hiabs, Palfingers including others, and are not to proceed under the conductors until such components are returned to the travelling position.
Note: Concrete pumping vehicles are not permitted to operate within an easement for electricity purposes.

9. Vehicles, plant or equipment having a height when fully extended that exceeds 4 metres shall not be brought onto an easement area without the prior written approval of Endeavour Energy.

10. The area within the easement is not to be used for the loading or unloading of trucks.

11. No soil or other material is to be stored, loaded or unloaded within the easement area.

12. The area within the easement is not to be used for storage or stacking of goods or materials, especially flammable or explosive material.

13. Application for approval for the erection of non-climbable flagpoles, CTV cameras, security lighting, weather vanes, signs and the like might be granted, subject to a height limitation of 4 metres and the earthing of all metallic parts.

MINIMUM APPROACH DISTANCES OF PLANT AND LOADS TO LIVE ELECTRICAL APPARATUS (FOR NON-AUTHORISED PERSONS)

NOMINAL VOLTAGE	MINIMUM APPROACH DISTANCE
Not exceeding 132,000V	**3 metres**
Above 132,000V but not exceeding 330,000V	**6 metres**
Above 330,000V	**8 metres**

Caution: *The operator of the plant must be able to identify the voltage level of the apparatus that they are approaching with the plant or assume 8 metres as a minimum.*

14. All personnel are to be advised of the hazards of working in close proximity to high voltage wires. Extreme caution is to be observed when working within the easement area and around any poles and structures.

15. All machinery or plant within an electricity easement is to be operated by adequately trained and accredited persons.

16. Endeavour Energy recommends the use of a suitably trained safety observer when work is being carried out within the easement area.

17. A hazard identification and risk assessment should be carried out within the easement area. A safe work method statement should be provided for any work carried out within the easement area. All staff should be briefed regularly, or when there are any changes, as to the contents of the risk assessment and safe work method statement.

18. For the attention of staff and visitors to the site and to ensure constant vigilance, Endeavour Energy recommends that clearly visible safety signs be erected, in accordance with the relevant safety standards, alerting attention to the transmission lines and associated hazards.

19. Flammable, combustible or explosive materials, including gas bottles, are not permitted within the easement area. Flammable liquid carriers shall not be placed within the easement area.

20. Garbage, refuse or fallen timber is not permitted within the easement area. Burning off is not permitted within the easement area without the prior written approval of Endeavour Energy.

21. Any metallic fencing within the easement shall require earthing and isolating in accordance with the Australian Standards as per AS3000.

22. Structures such as detached garages, sheds, stables, carports, unroofed veranda's, shipping containers, water tanks, fixed plant and equipment, will only be considered for approval if no other practicable alternative site is available clear of the easement area.

    No approvals will be granted for any of the above where they are proposed within the aforementioned minimum clearances.

    No access is to be restricted whilst maintaining safety clearances at all times.

    Furthermore, any proposed structures must not exceed 2.5 metres in height if climbable and 4.3m if not climbable.

***Please Note**: -*

Due to the effects of induction and possible lightning/line fault step and touch potential, requests for pools, spas, open water features and some water tanks inside the easement will not be approved.

23. Installation of utility services, such as power, telephone, gas, water and sewerage (overhead, underground, or on the surface) may be considered for approval by Endeavour Energy's Overhead and Underground Mains Manager. Proposed site dimensions in relation to assets are required.

24. Trees, plants or shrubs with a *mature height* that do not exceed 3 metres may be planted within the easement area provided they are no closer than 3 metres from the nearest structure (i.e. pole or tower). Trees must be a minimum 3 metres from the vertical projection of the nearest conductor (i.e. overhead power line). No plants are permitted in an area where they may obstruct access.

25. Dogs and livestock shall not be kept within the easement area if they are likely to create a dangerous situation for Endeavour Energy staff and thus restrict access.

26. Normal agricultural pursuits are permitted however, care should be taken when ploughing or operating mobile machinery in the vicinity of structures or supporting guys. Earthing systems are particularly prone to damage from such activities. It is imperative that access to the easement area and structures be available at all times. Whilst reasonable care will be taken, Endeavour Energy will not be responsible for any damage to crops caused whilst accessing and working within the easement area. The restrictions applying to the heights of mobile plant and equipment must be observed.

27. 24 hour 7 day a week access is required to the easement for emergency and maintenance purposes. Any locked gates are to have an Endeavour Energy lock incorporated in the locking system. Please contact Integrity Locking 1300 366 488 for details.

In addition to the above, details of some fencing restrictions are provided for your information. Written approval must be sought prior to the commencement of work.

A. Brick, masonry walls or other substantial structures or parts thereof shall not be erected within the easement area.

B. All other types of fencing erected within the easement area are subject to a height limitation of 2.5 metres.

C. The erection of any fencing is not permitted within 10 metres of a structure or guy and is not permitted in a location that could create an unsafe working area for Endeavour Energy staff.

D. All metallic fences are required to be earthed and isolated in accordance with Endeavour Energy's specifications or Australian Standards AS3000.

E. Gates (4.2m) are required in boundary fences to facilitate longitudinal access to the easement area and associated structures by truck. All access gates are to include Endeavour Energy locks in the locking system. Please refer to the above point 27.

Document No: MDI 0044

Amendment No: 1

Mains Design Instruction

Easements and Property Tenure

IMPORTANT DISCLAIMER

As the information contained in this publication is subject to change from time to time, Endeavour Energy gives no warranty that the information is correct or complete or is a definitive statement of procedures. Endeavour Energy reserves the right to vary the content of this publication as and when required. You must make independent inquiries to satisfy yourself as to correctness and currency of the content. Endeavour Energy expressly disclaims all and any liability to any persons whatsoever in respect of anything done or not done by any such person in reliance, whether in whole or in part, on this document.

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MAINS DESIGN INSTRUCTION

ASSET STANDARDS & DESIGN	Document No Amendment No Approved By Approval Date	MDI 0044 1 GMAM 06/03/2017

MDI 0044 – Easements and Property Tenure

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1.0 PURPOSE

To set out Endeavour Energy's design requirements for new easements, other property tenure requirements, and the management of existing easements.

2.0 SCOPE

This instruction covers:

- The rights Endeavour Energy has within its own easements;
- The determination of the minimum easement size for an asset;
- Process for acquiring, modifying and removing easements;
- The definition of controls for the safe operation of activities within easements; and,
- The definition of activities which are prohibited within easements.

The instruction does not cover:

- The release process of easements, which is covered in Company Policy 9.2.4.
- The process for managing existing encroachments, which is defined in Company Procedure GAM 0098.

3.0 REFERENCES

Internal

- Company Policy 9.2.3 – Property Tenure for Network Assets
- Company Policy 9.2.4 – Network Easement Release
- Company Procedure GAM 0098 – Management of Existing Encroachments
- Company Procedure GAM 0114 – Granting Dispensation for Engineering Documents
- Environmental Management Standard EMS 0006 - Maintenance and construction of access tracks
- Mains Construction Instruction MCI 0006 – Underground distribution construction standard
- Mains Design Instruction MDI 0028 – Underground distribution design
- Mains Design Instruction MDI 0031 – Overhead distribution: Design standards manual
- Mains Design Instruction MDI 0047 – Overhead transmission design
- Substation Design Instruction SDI 100 – Distribution Earthing Design, Construct and Test
- Endeavour Energy General Terms & Conditions for Connection of Public Lighting Assets (March 2011)
- Network Management Plan November 2013

External

- *Electricity Supply Act* 1995*
- *Roads Act* 1993*
- *Land Acquisition (Just Terms Compensation) Act* 1991*
- *Conveyancing Act* 1919*
- State Environmental Planning Policy (Infrastructure) 2007
- ISSC 20 - Guidelines for the Management of Activities within Electricity Easements and close to Electricity Infrastructure (April. 2012)
- ENA National Electricity Network Safety Code (Doc 001-2008)

- AS / NZS 7000:2016 Overhead Line Design – Detailed procedures
- AS / NZS 4853:2012 – Electrical hazards on metallic pipelines

** - Act current as of 19/02/2016*

4.0 DEFINITIONS AND ABBREVIATIONS

4.1 Abbreviations

EPR
Earth Potential Rise

HV
High voltage

LV
Low voltage

LPI
Land and Property Information

4.2 Definitions

Easement
An easement is an encumbrance on the title of land (which may be limited in width and height above or below the land) conferring a right to inspect, construct, operate, maintain, repair, renew, replace or upgrade electrical infrastructure.

Positive Covenant
A type of property tenure that requires expenditure by the land owner is required to meet the terms of the covenant.

Property tenure
A broad term covering the rights of the company to carry out network operations within land not owned by the company – exercising statutory rights in accordance with relevant legal requirements and the creation of appropriate recognised property rights. Typical property tenure include easements, Restrictions on Use, Positive Covenant and long term leases.

Public road
Defined under the Roads Act 1993. A road usually includes a vehicle carriageway and associated footpath areas on each side of the carriageway.

Restrictions on use of land
Conditions imposed on the use of the land, to inform the landowner and put limitations on the use of land due to the risk that exists by the electrical asset being located within the burdened lot.

5.0 ACTIONS

5.1 General Requirements

This standard covers two aspects of easement (and other types of property tenure) management:

- The design requirements relating to easements – easement size, creation, modification and release, rights of way and community titles.
- The management of existing easements – encroachments, transfer hazards and rights granted by the Electricity Supply Act 1995.

The general philosophy behind Endeavour Energy's approach to design and management of easements is to secure both the safe operation of the electrical network and, the safety of its employees, contractors and the public. Where a design, activity or proposal could compromise the electrical network or put an employee or the public at risk, the Electricity Supply Act 1995 allows Endeavour Energy to restrict and/or prohibit the activity. Refer to Clause 5.11 for further details.

All Endeavour Energy easements must comply with the requirements of this document, which is based on ISSC 20 "Guidelines for the Management of Activities within Electricity Easements and close to Electricity Infrastructure". However, where this standard and ISSC 20 differ, this standard will take precedence.

All new/proposed transmission and distribution infrastructure, which is not constructed on public roads, an easement in favour of Endeavour Energy must be created in accordance with the requirements of this standard.

5.2 Management process of easements

The following flowchart details the management process for easements.

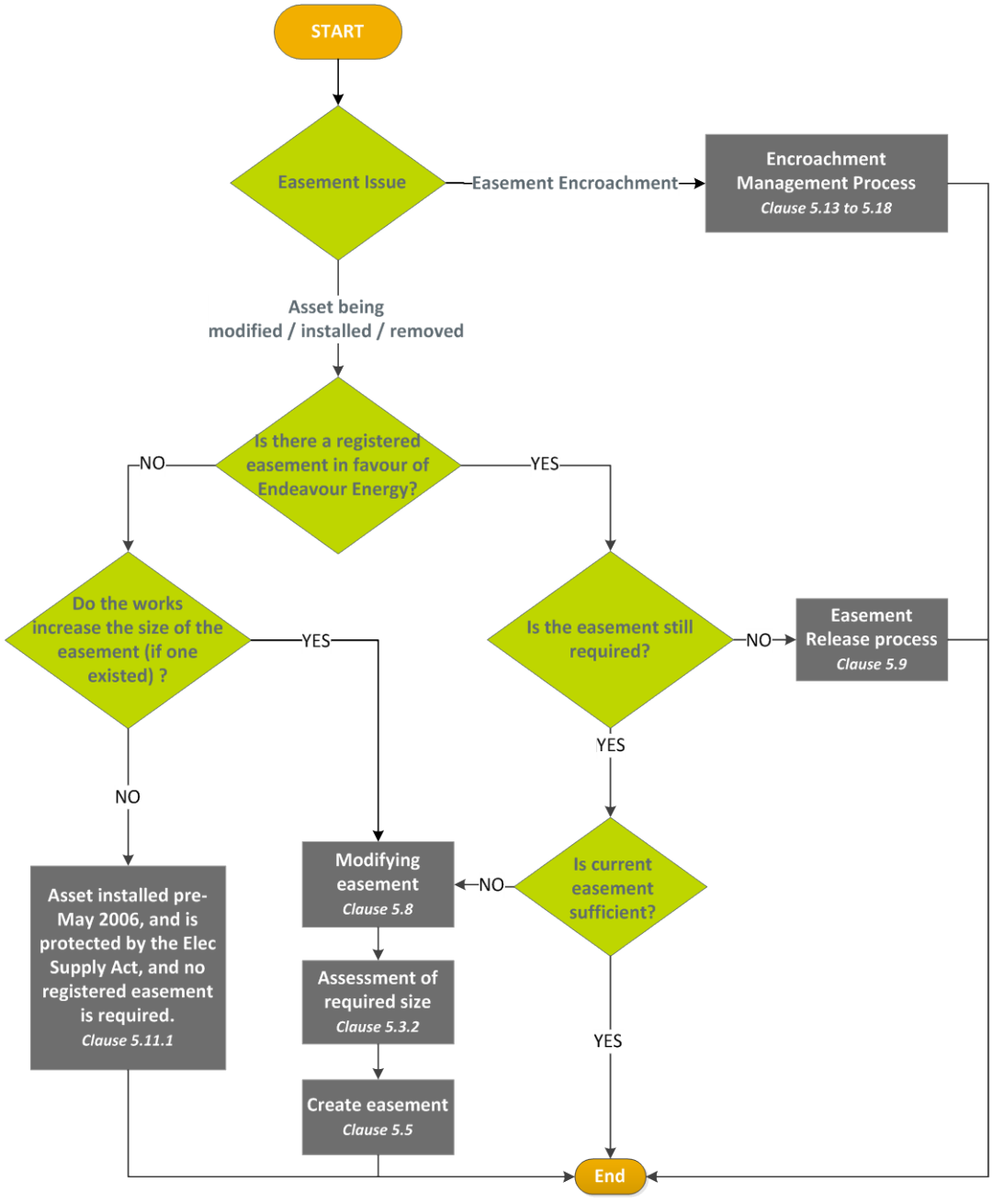


Figure 1 - Easement Management Flowchart

5.3 Minimum easement widths

The minimum easement widths are specified in Table 1. Larger easements may be specified and/or required on a project by project basis. All designs must certify that the easement widths in Table 1 are suitable for the span lengths / conductors used in the design.

5.3.1 Minimum easement required for overhead lines

For overhead lines, the minimum easement width for each span must be the greater width of the following three criteria:

- The width of the structure plus, two (2) times the sum of:
  - Conductor blowout, including insulator swing where applicable, (at 50°C and 500 Pa wind pressure); and,
  - The appropriate clearance from Table 3.7 of AS/NZS 7000 (Refer to Figure 2)
- Minimum maintenance requirements for the type of construction.
- The easement widths specified in Table 1.

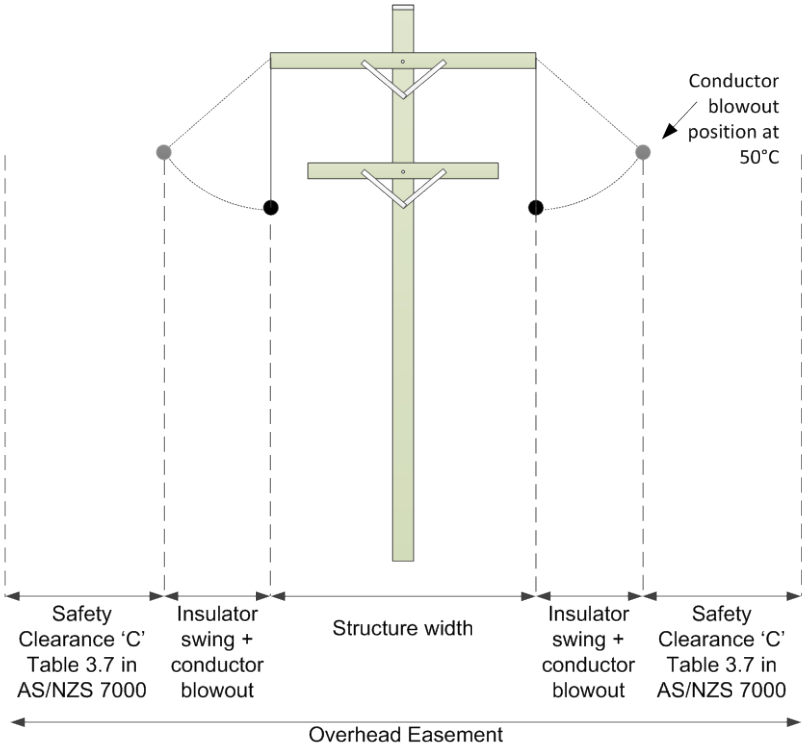


Figure 2 - Minimum overhead easement

New overhead assets must be fully contained within an easement (or other types of property tenure) and not encroach adjoining properties. Existing lines encroaching a property (without a formal easement) are permitted to remain, and may be replaced or uprated, as long as there is no increase in this encroachment. Refer to Figure 5.

5.3.2 Minimum easement required for network assets

The table below details the minimum easement widths for various network assets. Refer to Annexure 4 for graphical representation for a cable joint system; pole stay and padmount clearances.

Table 1 - Minimum easement widths

	Voltage	Asset Type	Construction	Minimum Easement (m)
Overhead Assets	400V–22kV	Bare Construction	All	9
		ABC		
		CCT		
	33kV / 66kV	Bare conductor *(see Note 2)*	Line post insulators	18
			33kV Suspension Insulators	18
			66kV Suspension Insulators	25
			H pole Structures	30
	132kV	Bare conductor *(see Note 2)*	Line post insulators	25
			H pole Structures	30
			Steel tower	30
Underground Assets	400V - 22kV	Cables	Underbore / Ducted / Direct buried	3
			Ducted < 100m and with concrete protection *(min 50 mm concrete cover at standard burial depth)*	1
	33kV - 132kV	Cables *(single feeder only)*	Ducted / Direct buried	5
			Cable Pits / Joint Bays	6
	-	Communications cables	Ducted / Direct Buried	1
		Earthing conductors		1
		Bonding leads		1
		Link Box / Comms Pit		2.0 x 2.0
Other	-	Streetlight Column / Service Pillar	-	1.0 x 1.0
		Switching Station		2.75 x 2.75 *(see clause 5.3.6)*
		Padmount Substation		2.75 x 5.5 *(see clause 5.3.6)*
		Auto Transformer		
		Indoor Substation		See clause 5.3.5
		Pole stays / Ground stays		See Note 2
	Rights of Access	Vehicle access tracks easement in rural areas *(see Note 3)*		5
		Vehicle access in urban areas		5 *(see Note 5)*
		Pedestrian access only		1.2

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Notes:

1. All Network assets, except for padmounts / switching stations, must be positioned in the centre of the easement. Refer to Drawings 016665 and 282551 for easement details of padmounts and switching stations. For non-symmetrical assets, such as post insulators, the centre must be measured from the position of the conductors at rest.
2. The easement for a termination pole/structure or for an aerial / ground stay must extend at least half the easement width beyond the last network pole or stay.
3. For further details regarding the construction and maintenance requirements of access tracks, refer to EMS 0006.
4. For an overhead line which its operating voltage differs from its constructed voltage, the easement must be for the constructed voltage.
5. Applies to straight line of access only. If angles or bends are required in the access path, then width to be determined by assessing a truck turning diagram, and gaining approval from the relevant Endeavour Energy Operations Manager. .

5.3.3 Parallel overhead feeders

When considering overhead lines installed in parallel, an optimised easement width may be determined in accordance with the following principles:

- It is not necessary to consider the lines blowing toward each other with the maximum wind load. Instead consider the line with the larger sag blowing under maximum wind load toward the other line in its vertical position.
- Allowance must be given for physical movement of the line (conductors and insulators swinging), as well as electrical clearances and climbing corridors.
- Minimum horizontal separation between the two centrelines of the two feeders must be no less than 10m.

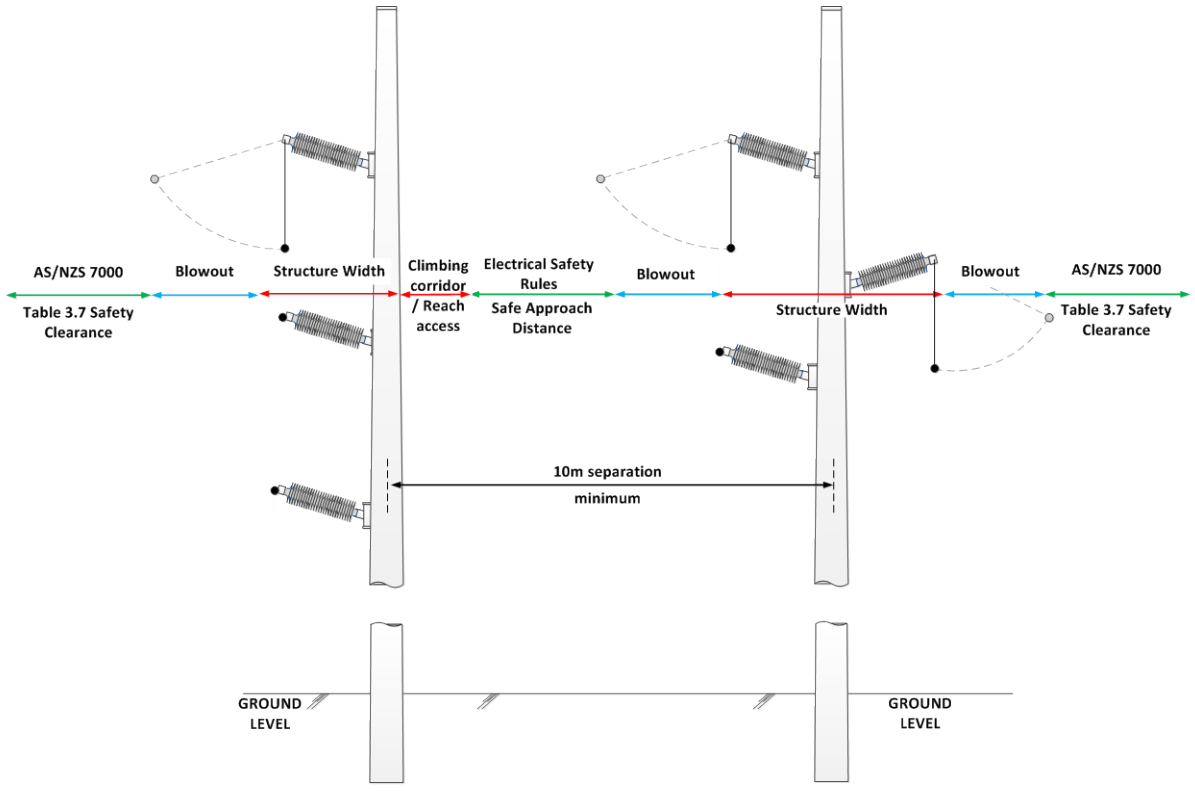


Figure 3 – Easement requirements for parallel feeders
(Structure on the right assumed to have the greatest conductor blowout)

5.3.4 Request for dispensation to the minimum easement width

A request for dispensation must be made to Endeavour Energy's Mains Assets Manager for any proposed easement that is smaller than the stated minimum width listed in Table 1. The submission must show there is no reduction in access for maintenance purposes and that the easement provides adequate electrical clearance to any existing and/or planned structures that may be built adjacent to the easement.

All designs must consider the following factors when determining an easement width:

- Electrical safety clearance
- Insulator and conductor blowout
- Access for maintenance, repair and upgrading
- Future requirement for additional feeder(s)
- Public safety based on potential earth potential rise (EPR) and electromagnetic field (EMF) issues
- Radio and television interference
- Audible noise
- Cable duct / jointing bay requirements

5.3.5 Indoor substations

The boundaries of an easement for indoor substation must be defined by the internal face of the walls, ceiling, floor, and cable trenches of the substation room.

An easement for the cables that enter and exit the substation room will also be required if they are not installed within public roads and/or existing Endeavour Energy easements.

A right of access may also be required to give Endeavour Energy employees, vehicles, and equipment unrestricted access to the indoor substation at all times.

5.3.6 Padmount substations and switching stations

The easement size for a padmount substation must be increased when a retaining wall or safety bollard has been installed/built to protect a padmount substation from vehicle impact, as indicated in Figure 4.

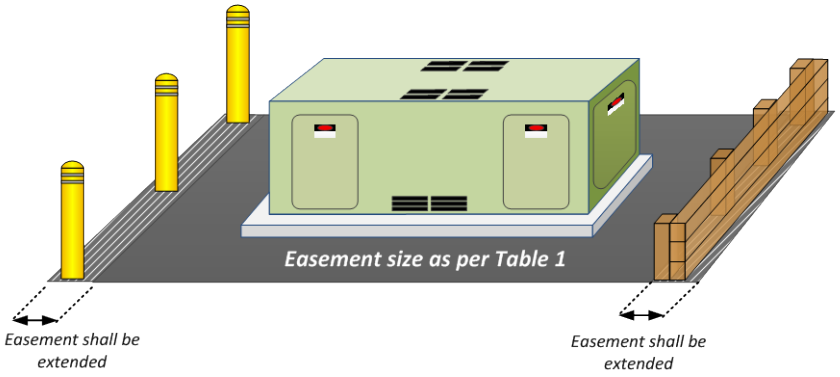


Figure 4 - Easements to include retaining wall or safety bollard

5.4 Assets within special areas

5.4.1 Assets within the road verge

Assets installed within a road carriageway cannot be provided with an easement. However, overhead assets proposed to be installed within the road verge still require the clearances specified in Table 1 and Clause 5.3.1.

As a minimum, the separation between the power line and the property line, must be the conductor blowout (at 50°C and 500 Pa wind pressure) and Safety Clearance 'C' from Table 3.7 of AS/NZS 7000.

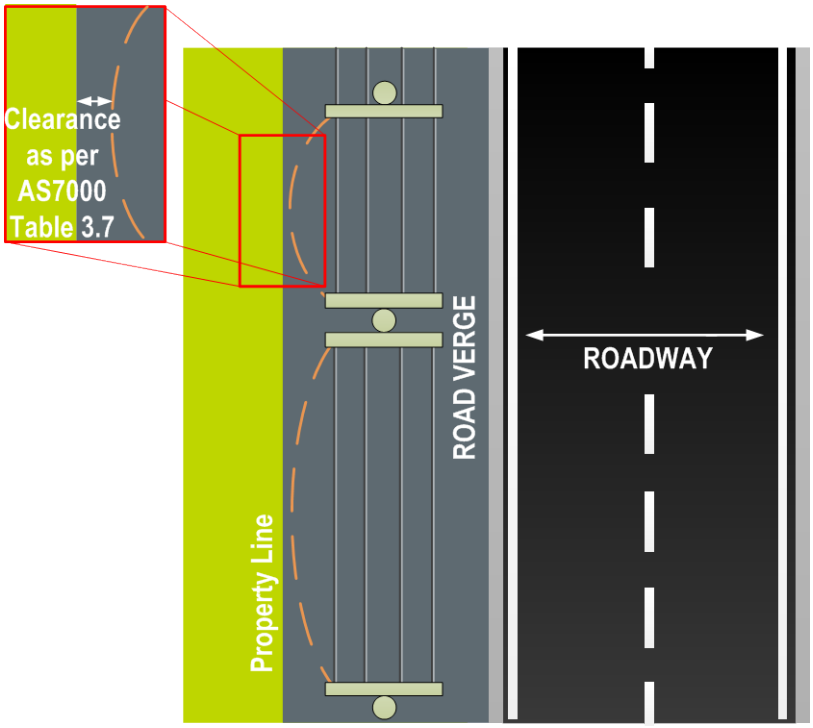


Figure 5 - Roadway requirements

5.4.2 Assets within roadways

Assets installed within a public road (as defined in the *Roads Act 1993*) requires the consent of the appropriate road authority to be obtained prior to the construction of any electrical works. Neither the *Roads Act 1993* or the *Electricity Supply Act 1995* requires an easement within public roads.

5.4.3 Overhead lines crossing private property

Where Endeavour Energy overhead lines cross private property, the line must be protected by a registered easement. The minimum width of this easement must be in accordance with the requirements in Clause 5.3.1 and 5.3.2.

5.4.4 Easement over Railway Corridor land

In 2002, Endeavour Energy entered into a *Master Access Deed* with Transport for NSW (then Railcorp), covering all new and existing Endeavour Energy network assets located within any rail corridor. This deed defines a rail corridor as any land owned by Transport for NSW. Network assets located within a rail corridor under the provisions of the *Master Access Deed* do not require easements.

Transport for NSW may also permit developers to install network assets in a rail corridor under an *Individual Access Deed* or *Deed of Release and Indemnity*. Any deed between the developer and Transport for NSW, will need to provide the same minimum requirements as those under the Master Access Deed and be transferable to Endeavour Energy for any new network assets installed by the developer.

Transport for NSW's process for third party works within the rail corridor is documented on its website, which includes the application form. Applications for rail corridor access must be submitted to the Rail Corridor Management Group in Sydney.

The ARTC website must be consulted for contact information regarding proposed rail corridor access.

5.4.5 Easements over National Park Land

Land dedicated as a wilderness area, national park, state recreation area, regional park, or nature reserve is managed by the NSW Office of Environment & Heritage.

Endeavour Energy is usually required to enter into a Formal Deed of Easement under Section 153 of the National Parks & Wildlife Act 1974 whereby compensation or an annual rent may be payable. The minimum easement dimensions given in Table 1 still apply, however, specific requirements will need to be negotiated with NSW Office of Environment & Heritage.

5.4.6 Easements over Forestry Land

Land dedicated as state forest is managed by Forests NSW/Department of Primary Industries and may be subject to native title.

Forests NSW will grant a limited form of property tenure under an Occupation Permit and an annual rent may be payable. The minimum easement dimensions given in Table 1 still apply, however, specific requirements will need to be negotiated with Forests NSW.

5.4.7 Easements in water catchment areas

Land that is classed as a water catchment area by the Sydney Catchment Authority, the standard easement terms do not always apply fully. The minimum easement dimensions given in Table 1 still apply, however, specific requirements will need to be negotiated with Sydney Catchment Authority.

5.4.8 Community Title developments

5.4.8.1 Asset ownership

The ownership of electrical assets (both HV and LV) within a community title development will only be accepted (owned and maintained) by Endeavour Energy if they are installed in accordance with Endeavour Energy's standard requirements and installation practices.

Endeavour Energy will generally own and maintain all high voltage electrical equipment within the development.

Endeavour Energy or the Community Title Association may own and maintain the low voltage electrical equipment and/or street lighting network.

Annexure 3 outlines the relevant by-laws that must be incorporated into the Community Title Management Plans to define the ownership and access requirements for the electricity assets within the development.

Community title developments and their management associations or developers are not considered to be public lighting customers under the NSW Public Lighting Code and therefore must meet the requirements stated in Endeavour Energy's *"General Terms and Conditions for Connection of Public Lighting Assets".*

5.4.8.2 Asset construction

For all assets the installation must provide the same level of security and access as normally would be found in standard urban residential development, this includes:

- All cables / spare conduits being located in the standard allocation within the road verge

- All pillars, padmount substations and switching stations are located in acceptable areas as stated in MDI 0028.
- No other assets and/or utilities being installed directly above the electrical assets
- Minimum distances between electrical assets and other utility services being maintained
- Sufficient access for Endeavour Energy vehicles (including trucks and EWP's) to access and maintain the assets without the need to close and/or block private roads.

5.4.8.3 Easements within Community Title developments

All assets owned by Endeavour Energy within a Community Title development and not installed within a public road, are to be provided with an easement to allow for future maintenance and repair.

For assets other than underground cables, the minimum easement widths defined in Table 1 must be achieved. However, the minimum easement widths for underground cables defined in Table 1, do not apply to Community Title developments. An easement the size of the trench width plus 500mm either side must be achieved as a minimum,

All easements must be created under a Section 88B of the Conveyancing Act 1919.

5.5 Easement creation

Easements must be created in favour of Endeavour Energy and can be created by one of the following three methods:

- Creation by Section 88B of the Conveyancing Act;
- Creation by Deed or transfer granting easement; and,
- Creation by compulsory process.

The easement must be defined on a plan, and registered at LPI.

A restrictive or positive covenant cannot be compulsory acquired.

5.6 Easement terms

The easement terms defines the rights and restrictions for an easement for Endeavour Energy and the landowner. The terms of an easement must be defined to the landowner in writing. Annexure 1 contains the standard easement terms for Endeavour Energy's:

- Overhead Lines, Underground Cables, Padmounts, Switching Stations and streetlighting;
- Indoor Substations; and,
- Rights of Access.

There may be additional rights and restrictions required for certain easements so that Endeavour Energy interests are protected.

An owner may have specific site requirements that require amendment to the standard terms. The details of any proposed amendment are to be submitted to Endeavour Energy's Mains Assets Manager for review prior to certification of the design for approval.

5.7 Other types of Property Tenure

Restrictions on the use of land are sought by Endeavour Energy on land on which its infrastructure exists to protect the integrity and security of its network, whilst still allowing the landowner to own and make use of their land.

A positive covenant is sought when Endeavour Energy will allow activities on the site but only with additional controls. An example of a positive covenant is requiring the installation of fire proof screen walls near Endeavour Energy's electrical assets.

In situations where Endeavour Energy requires covenants to be provided around electrical equipment / assets, the following standards terms defined in Annexure 3 must be used.

5.8 Modifying assets with an easement

Where an existing asset (post May 2006) is to be replaced/upgraded/modified, and there will be an increase to the existing easement size, then the designer must go through the process of applying for a new easement.

An easement may be reduced in size if:

- The easement meets the minimum size requirements as detailed in Table 1;
- If approval is sought and granted from Capacity Planning Manager, and the corresponding Regional Transmission/Distribution Manager.
- A design for the existing line demonstrating the asset will have sufficient access and clearance.

5.9 Easement release

Easements may be released if the need arises and the easement has no / limited benefit to Endeavour Energy. Easements releases must be managed in accordance with Company Policy 9.2.4.

5.10 Easement height

Easements do not have a specified height to which they apply. Endeavour Energy does not allow assets to be installed above its assets, as this presents access, safety and reliability risks. Where all other options have been exhausted, a dispensation must be submitted as described in Company Procedure GAM 0114.

5.11 Rights granted by the Electricity Supply Act

5.11.1 Protection of assets installed before May 2006

Section 53 of the Electricity Supply Act 1995, protects Endeavour Energy infrastructure that was constructed prior to the commencement of the *Electricity Supply Amendment (Protection of Electricity Works) Act* 2006 (26th May 2006), from action from the owner of the land in which Endeavour Energy infrastructure exists.

Endeavour Energy may maintain, operate, repair, replace or upgrade the infrastructure despite whether a registered easement exists. However, this protection does not exist for new assets which are constructed on private land after the 26th of May 2006, and as such, easements must be acquired for new assets.

5.11.2 General protection of network assets

The following summarises the powers Section 49 and 49A of the Electricity Supply Act 1995, grants Endeavour Energy:

Section 49 – Endeavour Energy may serve a written notice to a person who has control of a structure, which may interfere, destroy or damage Endeavour Energy's network to remove the imposing structure. This is regardless if the person owns the land on which Endeavour Energy's asset exists.

Section 49A - Endeavour Energy may serve a written notice to a person who is carrying out excavation work in, on or near its network which may destroy or damage Endeavour Energy's network to cease work immediately.

5.12 Works on assets without a registered easement

Endeavour Energy is legally required to provide a safe and reliable network. As such, where the need arises where a network asset is required to be modified or replaced, and does not have the benefit of an easement (installed before May 2006), Endeavour Energy will evaluate all possible options in the refurbishment/replacement of the asset.

In assessing the upgrade of the asset the following factors will be considered:

- If there will be an increase in the required size of the easement;
- Is it a like-for-like replacement.
- The impact on the customer and the aesthetic nature of the new asset;
- The risk to the customer, to the public or to Endeavour Energy employees of the current installation;
- The preference of the customer;
- The required access to maintain and install the new asset.

Where the evaluation has concluded that the asset needs to be replaced/modified, Endeavour Energy reserves the right to do so. However, where the rectification works will increase the size of the required easement width, an easement must be created for the rebuilt asset.

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5.13 General requirements on encroachment management

For easements managed by Endeavour Energy, encroachments fall into three (3) categories – *permitted*, *prohibited* or *controlled*.

- Permitted activity – An activity which is allowed within an easement, but must still adhere to the minimum safety requirements within the easement.
- Prohibited activity – An activity that must not be performed under any circumstance within the easement.
- Controlled activity – An activity which is allowed only if it meets both the minimum safety requirements for that type of easement with additional controls which are specified in the appropriate clause detailed below. Approval from Endeavour Energy is required for any controlled activity.

The main principle behind these categories is to maintain a high level of safety of the public and Endeavour Energy employees, whilst also allowing Endeavour Energy to inspect, operate, maintain, access and upgrade its network.

The activities listed below are not exhaustive, and where an activity/encroachment is not covered, a request to Mains Assets Manager must be submitted, which is to include:

- a full risk assessment detailing the risk to the network and safety and suitable controls.
- an overview of the easement, all current and proposed Endeavour Energy assets as well as all current and proposed encroachments

Refer to Annexure 5 for the current list of identified encroachments, how Endeavour Energy manages these, and the applicable clauses.

Encroachments on assets which do not have a formal easement, must be treated as though an easement does exist as per clause 5.11, and how the applicable encroachment is handled in the following sections. Table 1 may be used as an indication as to the applicable easement width, however, an assessment of the minimum easement size required to maintain access and safe operation of the asset is required.

5.14 Encroachments on overhead line easements

5.14.1 Minimum safety requirements for overhead line easements

For an overhead line easement, the following criteria must always be met, to maintain the safe operation of the network and employees:

- Minimum ground clearances, as defined in MDI 0031 and MDI 0047 are maintained, when the conductor is operating at maximum design temperature;
- Sufficient clearance is maintained to accommodation for overhead line blowout (500Pa, with the conductor operating at 50ºC);
- Minimum separation clearances between the network and objects/structures are maintained to this standard and AS/NZS 7000.
- Does not allow a person to breach the safety clearances to the network, namely, allow any part of a person to be greater than 4.3m above the ground (See Figure 6) ;
- Access to Endeavour Energy assets are not reduced and the minimum requirements of Figure 6 and clause 5.19 are adhered to.

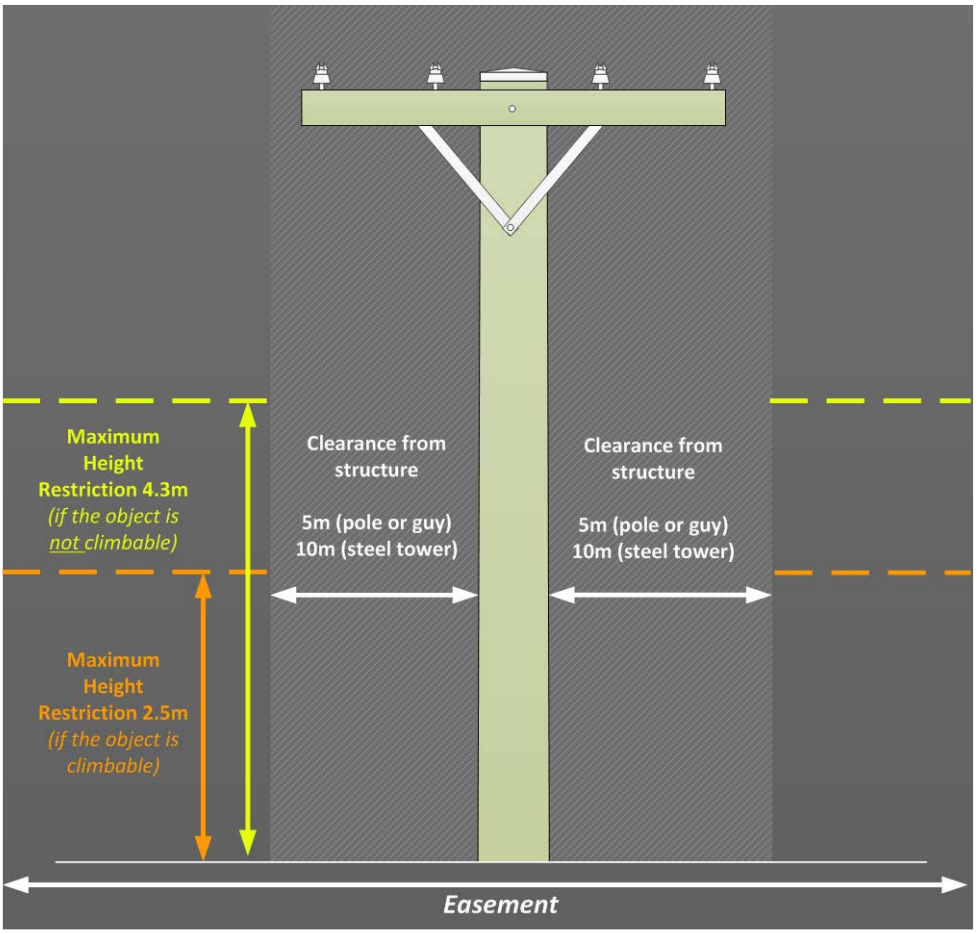


Figure 6 - Overhead line restriction within easement

5.14.2 Prohibited activities / encroachments

The following activities / encroachments listed below are prohibited within all Endeavour Energy easements and will not be approved:

- Construction of habitable buildings (permanent or temporary);
- Construction of garages or large sheds, whether permanent or temporary, or any other structure which may allow safety clearances to be breached;
- The installation of fixed plant (such as conveyor belts) or equipment, or its footings;
- The planting of trees that exceed a height of three (3) metres ;
- The placement of obstructions which may hinder access requirements;
- In-ground or above-ground swimming pools (permanent and / or temporary constructions);
- The storage and / or use of flammable, combustible, corrosive or explosive material;
- The storage and / or handling of conductive material of lengths in excess of three (3) metres;
- Lighting of any fires (this does not include back burning, refer to section 5.14.4.8);
- Parking of large vehicles (such as tankers and semi-trailers with large loads);
- The setting up of campervans or tents, which would allow persons to reside in the easement;
- The construction of flag poles and/or weather vanes which are taller than 4.3m;
- Electric fencing;
- Ploughing near electricity structures or stay poles/wires, that may impact the assets structural integrity;
- Use of any types of explosives;
- Flying of kites, model aircraft or drones;
- BMX bike riding (with jumps);
- Installation of flood lighting;
- Any activity which involves firearms.

Where an activity or encroachment is found to be being undertaken/installed and is on the above list, arrangement of its removal must be made. Any cost incurred will be at the expense of the owner of the land.

5.14.3 Permitted activities / encroachments

The following activities/encroachments are allowed within Endeavour Energy easements if it meets the minimum safety requirements detailed in clause 5.14.1:

- Low growing vegetation;
- Ground cover/surfaces such as wood chips and bluemetal stones;
- Storage of non-combustible, non-explosive, non-conductive, non-corrosive materials.

5.14.4 Controlled activities / encroachments

All controlled activities require approval to be sought from the applicable Regional Easement Officer of Endeavour Energy, in writing as set out in Clause 5.18.2. The Easement Officer will assess the activity/encroachment as defined Clause 5.18. The proposed activity must not commence unless approval is received in writing from Endeavour Energy Regional Easement Officer.

All these controlled activities must meet the required minimum safety requirements detailed in clause 5.14.1, as well as any additional controls listed below.

5.14.4.1 Minor structures

The following minor structures are permitted:

- clothes hoists;
- playground equipment;

- shade cloths / umbrellas;
- non-metallic fences (Endeavour Energy may require gates);
- small brick barbecues.

All metallic parts must be effectively earthed and no electrical supply must be brought within the easement.

If Endeavour finds that a structure impedes access or presents an unacceptable level of risk, Endeavour Energy reserves the right to have the structure removed, or to remove it at the owner's expense.

5.14.4.2 Non-habitable buildings (carports and metallic garden sheds)

Carports or metallic garden sheds can be installed within an overhead line easement provided they are effectively earthed, and no power is connected to the structure. Only metallic sheds which will not be inhabited must be approved.

5.14.4.3 Erection of conductive fencing / sound walls

All conductive fencing and/or sound walls crossing or running parallel to an easement are to be effectively earthed and / or have interval breaks in electrical continuity to prevent electromagnetic induction and transferred voltage hazards. Refer to drawing 242450, 242451 and 069575 for requirements for fencing.

A minimum 4.2 metre wide opening or gate (with provision to accept Endeavour Energy locks) for vehicle access will be a condition of approval.

5.14.4.4 Metal safety barriers and guardrails

Where a metal barrier (Armco guardrail or similar) crosses and continues beyond an easement, the following is required:

- The section of barrier within the easement must be earthed.
- A minimum 300 mm clear air gap must be left between the end of the barrier within the easement boundary and the starting point of the barrier beyond the easement boundary.

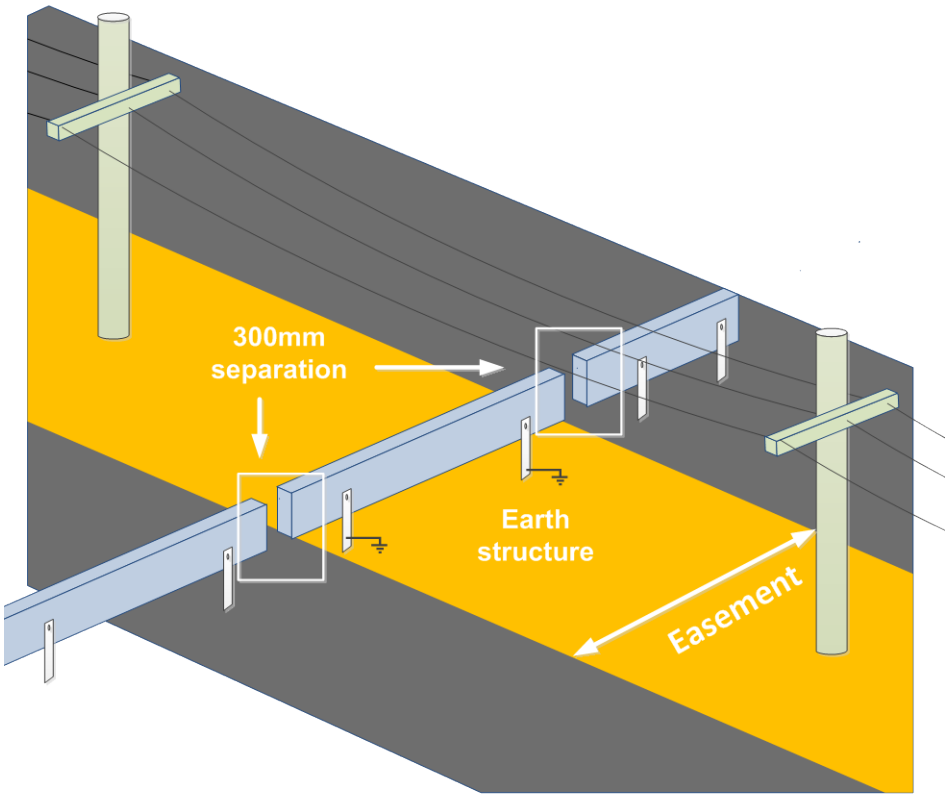


Figure 7 - Safety Barrier Requirement

5.14.4.5 Retaining walls

All proposed retaining walls must be made as to provide sufficient strength for any future work to be performed by Endeavour Energy, and must not impact the maintenance activities required on any assets within the easement.

5.14.4.6 Parking of vehicles or mobile plant

Parking within an overhead easement is subject to the vehicle:

- having a height limitation of 4.3 metres;
- is not occupied;
- is not connected to power; and,
- must be able to be readily removed if Endeavour Energy requires access to its assets.

5.14.4.7 Operation of mobile plant and equipment

No mobile plant and equipment must exceed a maximum height of 4.3 metres.

Within an overhead easement area, approval for the operation of mobile plant and equipment is dependent upon available clearances to the conductors under maximum operating conditions, power line voltages, vehicle operating heights and the level of accreditation of the vehicle operator.

Consequently, each application for the operation of mobile plant and equipment will be processed by the Regional Easement Officer and assessed for compliance with relevant Safework NSW legislation. A dedicated observer must also be present so that clearances are maintained.

Precautions must be taken to prevent collision or interference with overhead structures or stay poles.

5.14.4.8 Back burning

Back-burning operations carried out by fire authorities or bushfire brigades must be referred to Endeavour Energy's Control Room Manager and must include a map of the area showing the time, date and the area of the burn. An Endeavour Energy representative may attend back-burning procedures to maintain the safety of structures and conductors.

5.14.4.9 Agricultural pursuits

Agricultural pursuits, such as dusting, harvesting, netting and irrigation must have the following controls:

- Clear, defined vehicle access to structures is required to prevent damage to crops.
- Irrigation systems must not be placed within five (5) metres of the overhead conductors at any time.
- The location of any irrigation equipment must be such that it is not capable of projecting a solid jet of water to within three (3) metres of any overhead conductor.
- Gun type irrigators must have the water jet directed away from the conductors.
- Care must be taken when moving equipment around such as irrigation pipes or equipment, grain augers and the like.
- The equipment must not interfere with maintenance or safe operation of the power line, nor must it interfere with access to electricity assets.
- No electrical supply brought within the easement without prior approval of Endeavour Energy..

5.14.4.10 Rainwater tanks

Rainwater tanks must have the following controls:

- Above ground rainwater tanks, either for fire-fighting purposes or rainwater harvesting, erected within an easement, must be fully enclosed and of non-conducting material. (Concrete is considered to be a conductive material)
- All pipework is to be non-conductive and no electrical supply must be supplied to the tank for any purpose (including pumps and/or lighting).
- Any pumps and/or lights must be installed outside the easement.
- Ladders must not be installed on the rainwater tank.
- Rainwater tanks must not be installed within five (5) metres of a pole or stay pole, 10 metres from a steel structure or within five (5) metres of the vertical projection of the conductor.
- The tank and associated pipe work must not interfere with maintenance or access to electricity assets.

5.14.4.11 Detention basins

Applications for detention basins will be considered, subject to:

- The location has local council approval;
- The location is not within five (5) metres of a pole or stay pole or 10 metres from a steel structure;

- Sufficient clearance is maintained to all structures along the easement to allow unrestricted access.

5.14.4.12 Quarrying, filling, earthworks, or change of ground contours

Approval by the Easement Officer may be given, subject to:

- The maintenance of standard ground clearances (if conductor heights need adjustment, this will be at the proponents expense);
- Equipment/machinery performing earth works maintains standard clearances to the overhead lines;
- access maintained to all line structures;
- the subsoil stability and surface drainage in the vicinity of structures is not adversely affected; and,
- excessive quantities of dust are not generated.

5.14.4.13 Roads (other than access tracks)

For roads proposed within an existing easement, the minimum ground clearances as specified in MDI 0047 and MDI 0031 must be achieved.

Where alterations to conductor height and/or relocation of poles are required for the development of the road, this will be at the cost of the developer. This will include any work required to maintain safety clearances arising from activities in the easement after the road works are completed.

Where a road is proposed to run parallel to a feeder, a risk assessment evaluating the risk of impact with each structure as outlined in MDI 0031 must be submitted.

Earthing conductors may have been laid near, around and between the structures and must not have their electrical integrity compromised. Where a developer plans to construct a road which crosses the easement, the onus is on the developer to locate and avoid all earthing cables. If earthing cables are damaged, Endeavour Energy must be notified immediately.

Roads and driveways that are required for access to electrical infrastructure must be capable of carrying a 30 tonne truck.

5.14.4.14 Installation of utility services

Applications for the installation of telephone, water and sewerage services (overhead, underground, or on the surface) may be considered for approval by Endeavour Energy's Mains Assets Manager. The approval of the installation of these services will be based on:

- There is no practical alternative available;
- Any services within 15 metres of a structure must be constructed of non-conducting materials;
- The integrity of all line structures and stay pole/wires are to be maintained at all times;
- Designers and installers of utility services must consider any hazards associated with induced voltages and transferred earth potentials, in accordance with AS 4853, which must be controlled. Applications will require a risk assessment and proposed controls for each of the identified hazard.

Establishment of an easement for other utilities assets within Endeavour Energy's easement may be required.

5.14.4.15 Residential/Commercial subdivisions

Where subdivisions of property are proposed for land in which Endeavour Energy has an easement, the following requirements must be met:

- Unrestricted access to Endeavour Energy's structures are retained;
- No structures are to be erected within the easement;
- Structures suitably protected against motor vehicle impact;
- The number of crossings of Endeavour Energy's overhead line by utilities must be minimised, and complies with 5.14.4.14.

5.14.4.16 Domestic recreational activities and recreational facilities

Approval will be given for domestic recreation activities, but will not include activities that may interfere with clearances to the conductors, such as those listed in 5.14.2.

Approval will be given for recreational facilities, such as tennis courts, subject to:

- fencing is to be non-conductive material or must be effectively earthed (refer to section 5.14.4.3);
- Height of any fence is 4.3 metres or less;
- facilities surface construction will be required to withstand the movement of large heavy plant up to a 30 tonne truck; and,
- not located within five (5) metres from a power pole or ten (10) metres from a steel structure.

5.14.4.17 Storage of organic materials

Small amounts of organic materials, such as leaves and compost, may be stored underneath overhead powerlines, provided they do not impede access to structures and do not create a fire hazard.

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5.15 Encroachments on underground easements

5.15.1 General information for underground asset easements

Where relocation of existing assets are proposed, the costs to enable the activity to proceed, will be borne by the applicant.

Safework NSW (previously Workcover Authority of NSW) Publications provides guidance on risk control measures when working close to electricity infrastructures both below and above ground. Refer to *Code of Practice – Work near Overhead Power Lines* or *Work Near Underground Assets Guide*.

5.15.2 Minimum safety requirements for underground asset easements

For an underground asset easement, the following criteria must **always** be met, to maintain the safe operation of the network and employees:

- Before commencing any underground activity, all applicants are required to obtain advice from the ***Dial before You Dig*** **1100** service in accordance with the requirements of the Electricity Supply Act and associated Regulations.
- Ground contour does not substantially change, which would impact the rating of the conductors;
- Any storage of an asset is temporary in nature and can be moved at a given notice or the cost of removal of the encroachment will be at the expense of the owner, if Endeavour Energy requires access to its asset;
- No mechanical compacting is to occur within an easement.
- Access to Endeavour Energy joints/joint bays are not impeded.
- No excavation which is greater than 300mm deep must occur.

5.15.3 Prohibited activities / encroachments

The following activities / encroachments listed below are prohibited within all Endeavour Energy easements and will not be approved:

- Construction of habitable buildings (permanent or temporary)
- Installation of minor structures (such as shade cloths, clothes lines, flood lights, playground equipment, fences and BBQs.)
- Installation of all types of garages, sheds, shipping containers, or carports.
- Installation of sound walls or safety barriers.
- Installation of conductive fencing which runs through an easement.
- Installation of rainwater tanks;
- Electric fencing;
- Retaining walls running longitudinally above underground assets;
- The installation of footings for fixed plant or equipment;
- Plants with significant root systems that grow greater than 400 mm below ground level;
- In-ground or above-ground swimming pools and spas (permanent and / or temporary constructions)
- Ploughing that is greater than 300mm deep, or at a depth greater than 400mm above underground assets
- The storage and / or use of flammable, combustible, corrosive or explosive material
- Changing of the ground level such that relative depth of underground cables increases or decreases
- Permanent surfaces, such as asphalt or concrete;
- The placement of obstructions which may hinder access requirements
- Concrete driveways located above and/or that restrict access to existing cable joints/pits.
- Use of explosives;
- Installation of tennis courts;

Where an activity or encroachment violates the above requirements, arrangement of its removal must be made. Any cost incurred will be at the expense of the owner of the land.

5.15.4 Permitted activities / encroachments

The following activities/encroachments are allowed within Endeavour Energy easements if it meets the minimum safety requirements detailed in clause 5.15.2:

- Tents;
- Flag poles and/or weather vanes;
- Sound walls;
- Metal safety barriers;
- Parking of small vehicles;
- Shrubs with root systems that are less than 400mm;
- Alternative ground surfaces (such as Bluemetal stones and woodchips);
- Storage of non-combustible, non-flammable, non-explosive material;
- Rainwater tanks;
- Detention basins;
- General recreational activities, the flying of kites and model aircraft, and the use of firearms;

5.15.5 Controlled activities / encroachments

All controlled activities require approval to be sought, from Endeavour Energy's Regional Easement Officer, in writing as set out in Clause 5.18.2. The Easement Officer will assess the activity/encroachment as defined Clause 5.18. The proposed activity must not commence unless approval is received in writing from Endeavour Energy Regional Easement Officer.

Controlled activities must meet the minimum safety requirements detailed in clause 5.15.2, as well as any additional controls listed below.

5.15.5.1 Fencing

A minimum 4.2 metre wide opening or gate (with provision to install Endeavour Energy locks) for vehicle access will be a condition of approval of fencing on the boundary of the easement.

Where fencing runs through an easement, the posts must be located outside the easement.

5.15.5.2 Metallic pipes (greater than 3 metres)

The storage of metallic pipes greater than three (3) metres is acceptable provided the metallic pipes can be moved upon request.

5.15.5.3 Fixed plant and/or equipment

Fixed plant is generally not allowed within Endeavour Energy's underground easement areas. This is due to potential access issues as well as risk of damage to Endeavour Energy's assets for the installation fixed plant footings. A proposal where fixed plant crosses an underground easement perpendicularly, will be considered upon application.

5.15.5.4 Parking of Mobile plant, equipment or vehicles

Within an underground easement area, approval is dependent upon an adequate surface to support the mobile plant/vehicle (up to 30 tonne) or equipment likely to be parked to prevent the crushing of the cables/ducts or erosion of the ground. In some instances, the activity may require supervision by an Endeavour Energy representative at the operator's expense.

5.15.5.5 Agricultural pursuits

Agricultural pursuits, such as dusting, irrigation and grazing are permitted within an underground easement. However, any activity which is likely to affect the ground level (such as ploughing and the planting of crops) is not allowed within the easement.

Equipment and/or crops must not interfere with access to electricity assets.

5.15.5.6 Roads and concrete driveways

Roads and concrete driveways are permitted within Endeavour Energy underground easements where:

- Cables are in existing continuous ducts;
- The roadway/driveway is capable of supporting the heaviest vehicle likely to traverse the driveway;
- The thermal rating of the cable is not compromised by the installation;
- The concrete driveway is not proposed to be installed within a distance that would restrict access / maintenance of a joint / pit.
- The concrete driveway is not proposed to be installed over a joint / pit.

The need for (including size and quantity) spare conduits must be confirmed with Network Capacity Planning prior to construction within Endeavour Energy's easements. All required conduits must be funded by the applicant.

If a roadway/driveway is found to be installed without the installation of spare ducts, the owner of the driveway must bear the cost of installing additional ducts, which will be done either by digging up the driveway or under-boring if required by Endeavour Energy at a future stage.

5.15.5.7 Installation of utility services

The installation of underground services must comply with MCI 0006 and Drawing 403230 Sheets 1 – 12.

5.15.5.8 Residential/Commercial subdivisions

Where subdivisions of property are proposed for land in which Endeavour Energy has an easement, the following requirements must be met:

- Unrestricted access to Endeavour Energy's structures are retained;
- No structures are to be erected within the easement;

5.15.5.9 Retaining walls

Retaining walls must not be approved where they run longitudinally over an underground easement.

Retaining walls which encroach on an underground easement, must be:

- Built using concrete material (for example, *Besser* blocks, concrete / clay bricks);
- Have mustow foundations;
- Must be a maximum of one (1) metre in height

Where foundations require digging post holes, these must be located outside the easement.

5.16 Encroachments on Padmount Substation or Switching Station easements

5.16.1 General information for padmount substation easements

For the purpose of this section, wherever a padmount substation is referenced, this also applies a ground substation, padmount substation and switching station.

Where the relocation of existing assets is proposed, the costs to enable the activity to proceed will be borne by the applicant.

Workcover Authority of NSW Publications provides guidance on risk control measures when working close to electricity infrastructures both below and above ground. Refer to *Code of Practice – Work near Overhead Power Lines* or *Work Near Underground Assets Guide*.

5.16.2 Minimum safety requirements for padmount substation easements

The minimum safety requirements padmount substations easements are outlined below and must **always** be met to maintain the safe operation of the network and employees:

- Screening vegetation for padmount substations must be planted outside the easement. Any vegetation adjacent to the easement must not obstruct access to the padmount substation and must be maintained in such a manner as to allow easy access to Endeavour's assets.
- The ground contour surrounding the padmount substation does not substantially change;
- Storage of an object/machinery is temporary in nature and can be moved at a given notice and if Endeavour Energy requires access to its asset the cost of removal of the encroachment will be at the expense of the owner;
- No building overhangs within the six (6) metre airspace above a padmount substation site;
- No construction must occur within the padmount substation / switching station easement;
- No mechanical compacting is to occur within an easement.
- Access to Endeavour Energy joints/joint bays and the padmount substation must not be impeded and must comply with clause 5.19.

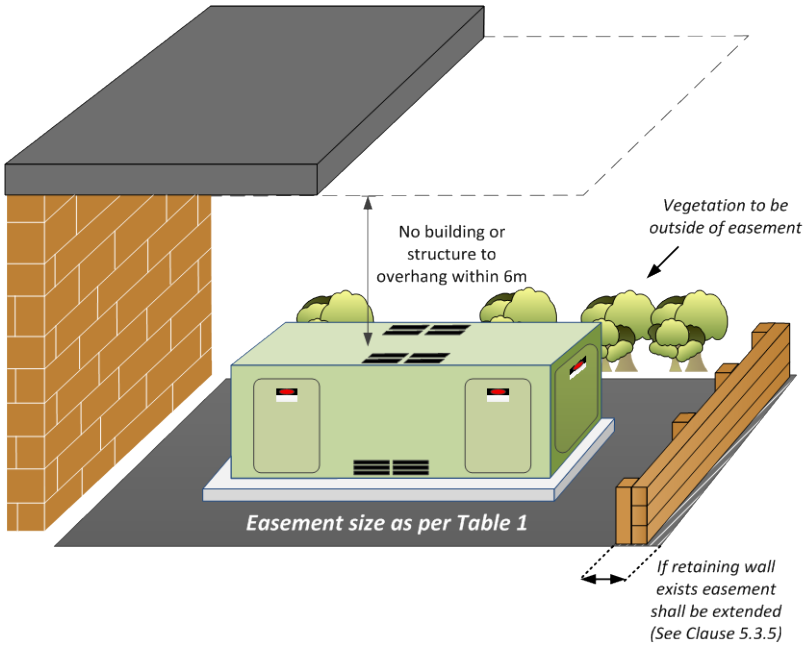


Figure 8 - Padmount Substation Easement Requirements

5.16.3 Prohibited activities / encroachments

Most activities are prohibited within the padmount substation easement. For a full list refer to Annexure 5 – Encroachment reference guide.

5.16.4 Permitted activities / encroachments

The following activities/encroachments are allowed within Endeavour Energy easements if it meets the general requirements in Clause 5.16.2.

- The use of mobile plant and/or equipment;
- Planting of vegetation with a root system not greater than 400mm;
- The installation of easily removable surfaces other than grass (bluemetal or woodchips);

5.16.5 Controlled activities / encroachments

All controlled activities require approval to be sought, from Endeavour Energy's Regional Easement Officer, in writing as set out in Clause 5.18.2. The Easement Officer will assess the activity/encroachment as defined Clause 5.18. The proposed activity must not commence unless approval is received in writing from Endeavour Energy Regional Easement Officer.

All controlled activities must meet the minimum safety requirements detailed in Clause 5.16.2, as well as any additional controls listed below.

5.16.5.1 Mobile plant/equipment and Parking of vehicles

Where a padmount substation is in the vicinity of a parking facility, suitable crash and impact protection from vehicles must be installed. These must be positioned in such a way to allow access to the substation to be maintained. Any proposals for the installation of suitable vehicle impact protection measures are subject to approval from the Regional Easement Officer.

5.16.5.2 Agricultural pursuits

Agricultural pursuits are prohibited within a padmount substation easement. Grazing would be the only activity that would be permitted.

5.16.5.3 Roads and concrete driveways

Roads and concrete driveways are permitted within the padmount easements where:

- Cables are in existing continuous ducts;
- The roadway/driveway is capable of supporting the heaviest vehicle likely to traverse the driveway;
- The thermal rating of the cable is not compromised by the installation;
- Suitable crash and impact protection must be installed, positioned in such a way to allow access to the substation to be maintained.

5.16.5.4 Retaining walls

Retaining walls built around distribution substations or switching stations, as part of reticulation requirements, must be outside the standard easement Refer to 5.3.6.

Proposed retaining walls must not impact the maintenance activities performed by Endeavour Energy on any assets within the easement.

5.16.5.5 Fencing

For fencing requirements around a padmount substation refer to MCI 0006 – Section 7.

Fencing surrounding an easement must comply with Table 2.

Table 2: Fencing near a Padmount Substation

Padmount Earthing	Fence Allowed	
	On easement boundary	Through easement
Common Earthed	YES	NO
Separately earthed	If within 4m of padmount, fence posts must be insulated and a touch-voltage assessment required.	NO

5.17 Transfer earth hazards

In addition to all requirements stipulated in this standard the risk of transfer earth hazards associated with Endeavour Energy's assets and/or equipment, structures or objects must be managed in accordance with SDI 100 "Distribution earthing design, construct and test".

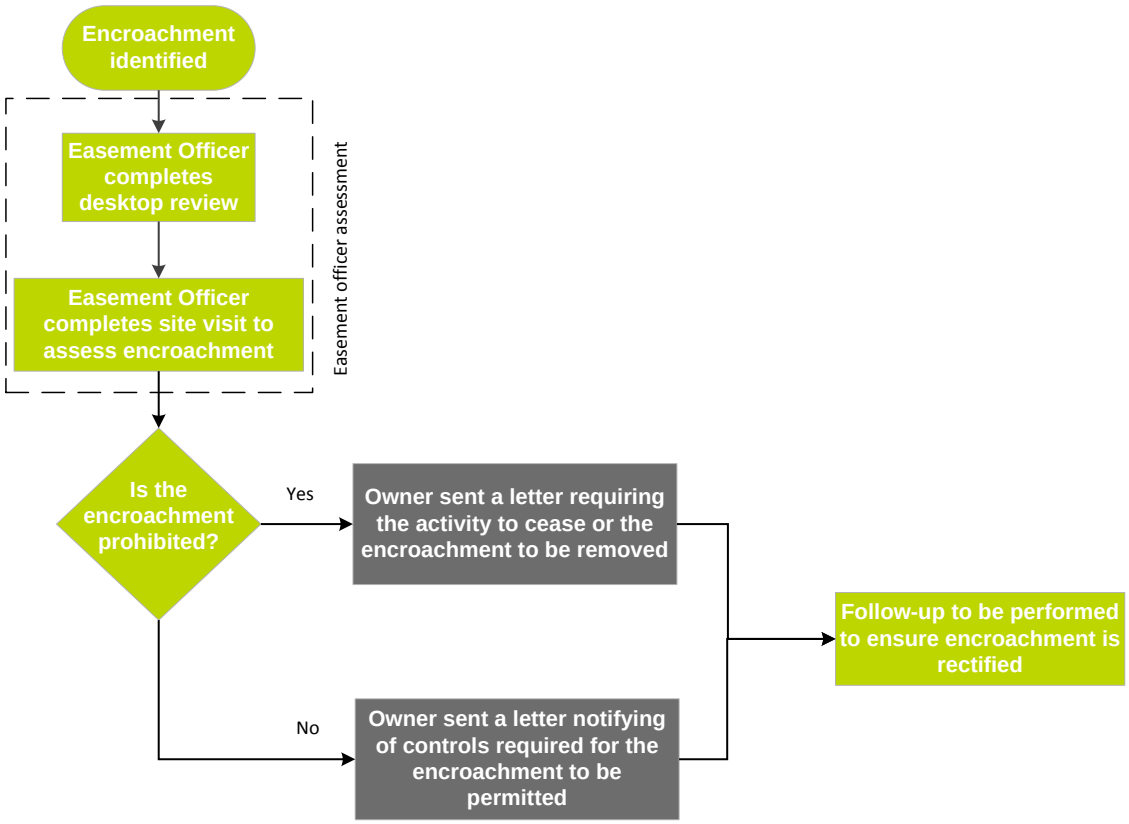
This requirement may impose restriction zones around Endeavour Energy's assets limiting the use of land within the defined area(s).

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5.18 Encroachment management process

5.18.1 Existing encroachment management process

Endeavour Energy will manage existing encroachments that have not been previously approved, according to the flowchart below:



5.18.1.1 Easement Officer Review

Once identified, the Easement Officer will perform both a desktop assessment and a site visit to determine whether the encroachment is permitted, controlled or prohibited, as defined in Clause 5.11, or whether with possible controls can overcome / lessen the encroachment.

On completion of the assessment, a letter will be sent to the owner, identifying:

- Explanation of the terms of the easement;
- Identifying the hazards to themselves, members of the public and Endeavour Energy's employees;
- Providing advice on possible solutions to overcome / lessen the encroachment.
- The outcome of the assessment:
    - Where the encroachment is determined to be a "controlled activity", conditional approval for it to continue must be given only if the applicable controls (as defined in Clause 5.11) are used.
    - Where the encroachment is determined to be a prohibited activity/structure, the owner will be required to remove the encroachment or cease the activity.

A follow-up site visit will be completed within 30 days to check whether the encroachment has been adequately managed.

Legal action will be considered when all other avenues are exhausted.

The local council must be included in correspondence to highlight the need for their approval process to include a corresponding approval from Endeavour Energy where easements are involved.

5.18.2 Applications for controlled encroachments

All applications for an activity or encroachment, or requests for advice, must be referred to Endeavour Energy's Regional Easement Officers. Applications must be addressed to:

Regional Easement Officer – North / Central / South *(see table below)*
Endeavour Energy
PO Box 811
Seven Hills NSW 1730

Endeavour Energy's network franchise area has three (3) regions, responsible for the local government areas set out in the following table:

Region	Local government areas
North	Bathurst, Baulkham Hills, Blacktown, Blue Mountains, Hawkesbury, Lithgow, Parramatta, Penrith, plus parts of Hornsby, Mid-Western and Ryde.
Central	Camden, Campbelltown, Fairfield, Cumberland (Holroyd), Liverpool, Wingecarribee, Wollondilly, plus parts of Bankstown.
South	Kiama, Shellharbour, Shoalhaven, Wollongong.

5.18.2.1 Application requirements

Due to the varied circumstances that apply to easements, all applications will be assessed individually, and will be site specific.

All applications require the following:

- The application is to be made in writing.
- The application is to include detailed plans, drawn to scale and with full dimensions, showing property boundaries, lot number, Deposited Plan (DP) number, any electricity structures, and other relevant information.
- A survey plan of an easement for padmount substation must show the substation number and at least two (2) offsets from adjacent sides of the concrete plinth to the easement boundary.
- Each application will require an impact and risk assessment and must be assessed on the site-specific circumstances and Endeavour Energy's risks assessment company procedure of the proposal.

5.18.2.2 Easement Officer Review

After the application has been received, the easement officer will perform a desktop review of the application and if required, a site visit.

Where Endeavour Energy is uncertain about the impact of the controlled activity or encroachment, the applicant/s will be asked to arrange an independent study of the risk at their own expense. Endeavour Energy will consider the outcome of the study when deciding on the application.

Where additional testing is required, the applicant will be responsible for:

- Arranging the test with an organisation acceptable to Endeavour Energy;
- Paying for the test;
- Supplying the test results to Endeavour Energy.

5.19 Access and Rights of Way

Where possible, access to Endeavour Energy assets must be made possible by access tracks located within Endeavour Energy easements.

Consideration must be given to securing access by the way of a land tenure agreement and/or other legal instruments such as 'Right of Ways', where:

- access tracks must traverse outside of easements;
- access options to assets is limited;
- significant investment has been outlaid to upgrade and/or construct an access; or,
- there is future development planned for an area that may affect or obstruct access routes.

The appropriate land tenure agreement and or legal instrument must be discussed with the Property, People and Services Branch.

5.19.1 Locking arrangements for shared access gates

In some cases, access to land with electricity easements is shared by Endeavour Energy with others – utilities, customers, and organisations such as the NSW National Parks and Wildlife Service or the Rural Fire Service.

Where access is through a gate protected by dedicated locks, an EL specification lock must be installed. The preferred arrangements for single or multiple locks are shown in Figure 9. Where there is more than one lock, the locks must be spaced as evenly as possible by joining with equal lengths of chain.

The entire chain must be of exact length to allow the gate to be fully secured, while allowing for the chain to be rotated so that access to the locks is possible from either side of the gate.

When replacing locks after entering or leaving, the correct ends of the chain must be connected with the lock, so that it remains a continuous loop.

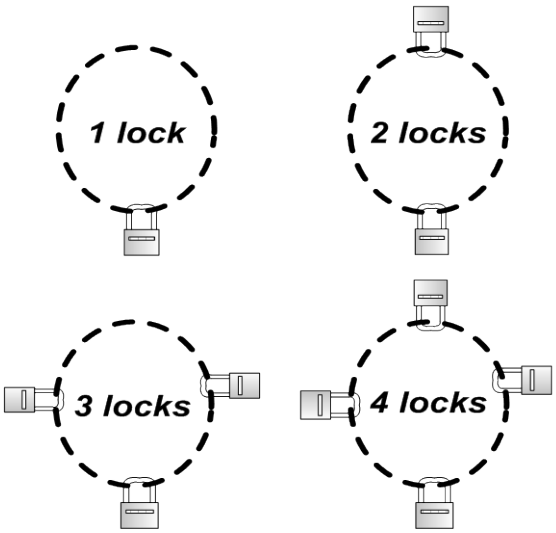


Figure 9 – Locking arrangements for shared access gates

5.20 Recording of easements in GIS

When an easement is created, the easements must be reflected in the Endeavour Energy's GIS system.

5.21 Drawings

Drawing No	Amendment	Title
016665	S	11kV and 22kV Padmount substation easement layout
086232	K	Minimum clearances near structures
282551	A	Size 16 Switching Station easement layout
289702 (Sheets 1 – 7)	A	Fencing arrangement for padmount substation easement details
403230 (Sheets 1 – 12)	A	Shared trenching arrangements
242451	B	Chain wire fence – isolation panel and earthing installation detail
069575	G	Solid Metallic Fence – Isolated panel and earthing installation detail
242450	A	Transmission Line Structure – Metallic fence clearance and isolation panel requirements.

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6.0 AUTHORITIES AND RESPONSIBILITIES

General Manager Asset Management has the authority and responsibility for approving this instruction.

General Manager, Network Services has the authority and responsibility for all new distribution and transmission projects complying with the contents of this instruction.

Manager Asset Standards & Design has the delegated authority and responsibility for approving this instruction and the endorsing of non-standard/reductions in easement widths.

Manager Network Connections has the authority and responsibility for new contestable works electrical designs complying with this instruction.

Mains Assets Manager has the authority and responsibility for:

- Endorsing the content of this instruction;
- Keeping the content of this instruction is kept up to date;
- Approval for encroachments within easements.

Substation Assets Manager has the authority and responsibility for providing input into the content of this instruction.

Earthing and Power Quality Manager is responsible for the assessment and approval of earthing issues within easements.

Easements Officers are responsible for:

- Reviewing easement encroachment applications;
- Performing investigations into possible encroachments;
- Providing advice and consultation to stakeholders.

7.0 DOCUMENT CONTROL

Documentation content coordinator: Mains Assets Manager

Documentation process coordinator: Branch Process Coordinator

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Annexure 1 STANDARD EASEMENT TERMS

A1.1 - Overhead Lines, Underground Cables, Padmounts, Switching Stations, Street Lighting, Pole/Ground Stays

1.0 Definitions:

1.1 **easement site** means that part of the lot burdened that is affected by this easement.

1.2 **electrical equipment** must be defined as stated below for each of the easement terms associated with the following asset classes:

1.2.1 *Overhead Power Lines* - includes pole, tower, overhead electrical conductors, underground earthing system, and ancillary equipment.

1.2.2 *Underground Cables* - includes underground electrical cable, duct, service pillar, underground earthing system, and ancillary equipment.

1.2.3 *Padmount Substation / Switching Station* - includes electrical transformer (padmount only), switchgear, protective housing, concrete plinth, underground electrical cable, duct, underground earthing system, and ancillary equipment.

1.2.4 *Pole Stays / Ground Stays* – includes stay pole, concrete strainer block, stay cable, stay wire, and ancillary equipment.

1.2.5 *Street Lighting* – includes the column, lantern and foundations of the street light.

1.3 **Endeavour Energy** means Endeavour Energy and its successors (who may exercise its rights by any persons authorised by it).

1.4 **install** includes construct, repair, replace, maintain, modify, use, and remove.

1.5 **owner** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

1.6 **services** includes Network gas, telephone, communications, water, sewage, and drainage services.

1.7 **structure** includes building, wall, retaining wall, carport, and swimming pool; but excludes garden furniture and garden ornaments.

2.0 Endeavour Energy may:

2.1 install electrical equipment within the easement site,

2.2 excavate the easement site to install the electrical equipment.

2.3 use the electrical equipment for the transmission of electricity,

2.4 enter the lot burdened using the most practical route (with or without vehicles, machinery or materials) at all reasonable times (and at any time in the event of an emergency) and remain there for any reasonable time. This may include the installation of gates in existing fencing if access is not readily available,

2.5 install its own access gates and locks,

2.6 trim or remove any vegetation from the lot burdened that interferes with or prevents reasonable access to the easement site or the electrical equipment, and

2.7 remove any encroachments from the easement site and recover the costs of carrying out the removal work and repairing any damage done to the electrical equipment by the encroachment.

3.0 In exercising its rights under this easement Endeavour Energy will take reasonable precautions to minimise disturbance to the lot burdened and will restore the lot burdened as nearly as practicable to its original condition.

4.0 The owner agrees that, without the written permission of Endeavour Energy and in accordance with such conditions as Endeavour Energy may reasonably impose, it will not:

4.1 install or permit to be installed, any services or structure within the easement site, or

4.2 alter the surface level of the easement site, or

4.3 do or permit to be done anything that restricts access to the easement site by Endeavour Energy

5.0 Lessee of Endeavour Energy's Distribution System

5.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

5.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

A1.2 - Indoor Substation

1.0 Definitions:

1.1 **building** means the building within which the electrical equipment is located.

1.2 **easement site** means that part of the lot burdened that is affected by this easement.

1.3 **electrical equipment** includes electrical transformer, electrical switchgear, electrical cable, duct, services, ventilation, and ancillary equipment.

1.4 **Endeavour Energy** means Endeavour Energy and its successors (who may exercise its rights by any persons authorised by it).

1.5 **install** includes construct, repair, replace, maintain, modify, use, and remove.

1.6 **owner** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

1.7 **services** includes Network gas, telephone, communications, water, sewage, and drainage services.

2.0 Endeavour Energy may:

2.1 install electrical equipment within the easement site,

2.2 use the electrical equipment for the transmission of electricity,

2.3 enter the lot burdened using the most practical route (with or without vehicles, machinery or materials) at all reasonable times (and at any time in the event of an emergency) and remain there for any reasonable time. This may include the installation of gates in existing fencing if access is not readably available,

2.4 install its own security doors to gain access to the electrical equipment and to prevent access by others, and

2.5 install conduits, cables, and pipes on, under or through the building for the purpose of connecting the electrical equipment with any services and to operate those services.

3.0 Endeavour Energy agrees that it will not cut, drill, alter or demolish any part of the building necessary to install or operate the electrical equipment without the written permission of the owner and in accordance with such conditions as the owner may reasonably impose.

4.0 In exercising its rights under this easement Endeavour Energy will take reasonable precautions to minimise disturbance to the lot burdened and will restore the lot burdened as nearly as practicable to its original condition.

5.0 The owner agrees that, without the written permission of Endeavour Energy and in accordance with such conditions as Endeavour Energy may reasonably impose, it will not:

5.1 install or permit to be installed any thing within the easement site, or

5.2 interfere with, allow to be interfered with, or prevent the ventilation of the easement site, or

5.3 direct or allow to be directed drainage into the easement site, or

5.4 do or permit to be done anything that restricts access to the easement site by the Endeavour Energy

6.0 Lessee of Endeavour Energy's Distribution System

6.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

6.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

A1.3 – Rights of Access

1.0 Definitions:

1.1 **access site** means that part of the lot burdened that is affected by this right of access.

1.2 **Endeavour Energy** means Endeavour Energy and its successors (who may exercise its rights by any persons authorised by it).

1.3 **owner** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

2.0 Endeavour Energy may:

2.1 by any reasonable means pass across the access site for the purpose of exercising or performing any of its powers, authorities, duties or functions, and

2.2 do anything reasonably necessary for passing across the access site, including:

2.2.1 Entering the lot burdened;

2.2.2 taking anything on to the lot burdened; and,

2.2.3 carrying out work within the site of the easement, such as constructing, placing, repairing or maintaining trafficable surfaces, driveways or structures.

3.0 In exercising its rights set out in Clause 2.0, Endeavour Energy must:

3.1 complete all work properly;

3.2 take reasonable precautions to minimise disturbance to the lot burdened and owner of the lot;

3.3 cause as little damage as is practicable to the lot burdened;

3.4 restore the lot burdened as nearly as practicable to its former condition; and,

3.5 make good on any collateral damage;

4.0 Lessee of Endeavour Energy's Distribution System

4.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

4.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

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Annexure 2 Terms of Restrictions on the Use of Land

A3.1 Safety Clearance between Padmount Substations and Adjacent Buildings

Terms of Restrictive Covenant numbered [xx] in the plan

1.0 Definitions:

1.1 **"120/120/120 fire rating"** and **"60/60/60 fire rating"** means the fire resistance level of a building expressed as a grading period in minutes for structural adequacy / integrity failure / insulation failure calculated in accordance with Australian Standard 1530.

1.2 **"building"** means a substantial structure with a roof and walls and includes any projections from the external walls.

1.3 **"erect"** includes construct, install, build and maintain.

1.4 **"restriction site"** means that part of the lot burdened affected by the restriction on the use of land as shown on the plan.

2.0 No building must be erected or permitted to remain within the restriction site unless:

2.1 the external surface of the building erected within 1.5 metres from the substation footing has a 120/120/120 fire rating and

2.2 the external surface of the building erected between 1.5 metres and 3.0 metres from the substation footing has a 60/60/60 fire rating

2.3 and the owner provides the authority benefited with an engineer's certificate to this effect.

3.0 The fire ratings mentioned in Clause 2.0 must be achieved without the use of fire fighting systems such as automatic sprinklers.

4.0 Lessee of Endeavour Energy's Distribution System

4.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

4.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

A3.2 Fire Proof Screen Walls

Terms of Positive Covenant numbered [xx] in the plan:

1.0 Definitions

1.1 **"fire proof screen wall"** means a wall of brick or concrete necessary to achieve a 120/120/120 fire rating up to a minimum height of **[***xx***]** metres from the level of the substation footing.

1.2 **"owner"** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

1.3 **"prescribed authority"** means Endeavour Energy (and its successors).

1.4 **"120/120/120 fire rating"** means the fire resistance level of a building structure expressed as a grading period in minutes for structural adequacy/integrity failure/insulation failure calculated in accordance with Australian Standard 1530.

2.0 The owner covenants with the prescribed authority that the owner:

2.1 Will construct fire proof screen **[***wall/s***]** adjacent to the **[***northern, southern, eastern, western***] [***boundary/ies***]** of the easement for padmount substation.

2.2 Will maintain the fire proof screen **[***wall/s***]** in a satisfactory state of repair and in accordance with any reasonable conditions that the prescribed authority may impose.

3.0 Lessee of Endeavour Energy's Distribution System

3.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

3.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

A3.3 Fire Proof Walls and Roof

Terms of Positive Covenant numbered [xx] in the plan:

1.0 Definitions

1.1 **"fire proof wall"** means a wall of brick, concrete or other material necessary to achieve a [60/60/60 or 120/120/120] fire rating up to a minimum height of 6 metres from the level of the substation footing. It also includes any structures attached to the wall such as eaves and gutters.

1.1 **"fire proof roof"** means a roof constructed of concrete or other material necessary to achieve a [60/60/60 or 120/120/120] fire rating.

1.2 **"owner"** means the registered proprietor of the lot burdened and its successors (including those claiming under or through the registered proprietor).

1.2 **"padmount substation"** means padmount substation No. [xxxx]

1.3 **"prescribed authority"** means Endeavour Energy (and its successors).

1.4 **"60/60/60 or 120/120/120 fire rating"** means the fire resistance level of a building structure expressed as a grading period in minutes for structural adequacy/integrity failure/insulation failure calculated in accordance with Australian Standard 1530.

2.0 The owner covenants with the prescribed authority that the owner:

2.1 Will construct fire proof **[***wall/s***]** adjacent to the **[***northern, southern, eastern, western***] [***boundary/ies***]** of the easement for padmount substation.

2.2 Will maintain the fire proof **[***wall/s***]** in a satisfactory state of repair and in accordance with any reasonable conditions that the prescribed authority may impose.

2.3 Will construct fire proof roof above the padmount substation.

2.4 Will maintain the fire proof roof in a satisfactory state of repair and in accordance with any reasonable conditions that the prescribed authority may impose.

3.0 Lessee of Endeavour Energy's Distribution System

3.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

3.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

A3.4 Separation of Metal Structures to an Earth Grid

Terms of Restrictive Covenant numbered [xx] in the plan

1.0 Definitions:

1.1 **"erect"** includes construct, install, build and maintain.

1.2 **"restriction site"** means that part of the lot burdened affected by the restriction on the use of land as shown on the plan.

2.0 Except as provided in Clause 3.0, no metal structure must be erected or permitted to remain within the restriction site.

3.0 Metallic fencing may be erected within the restriction site if the fence panels are insulated from the fence posts and from the ground.

4.0 Lessee of Endeavour Energy's Distribution System

4.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

4.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

A3.5 Separation of Swimming Pools to an Earth Grid

Terms of Restrictive Covenant numbered [xx] in the plan

1.0 Definitions:

1.1 **"erect"** includes construct, install, build and maintain.

1.2 **"restriction site"** means that part of the lot burdened affected by the restriction on the use of land as shown on the plan.

2.0 No swimming pool or spa must be erected or permitted to remain within the restriction site.

3.0 Lessee of Endeavour Energy's Distribution System

3.1 Notwithstanding any other provision in this easement, the owner grants to Endeavour Energy the easement and acknowledges and agrees that any lessee of Endeavour Energy's distribution system, and any nominee of such lessee (which may include a sublessee of Endeavour Energy's distribution system from that lessee), may, without the need for any further approvals or agreements, exercise the rights and perform the obligations of Endeavour Energy as if that lessee or nominee were Endeavour Energy, but only for so long as the lessee leases Endeavour Energy's distribution system from Endeavour Energy.

3.2 The owner must do all things reasonably necessary to ensure any such lessee, and any such nominee, is able to exercise the rights and perform the obligations of Endeavour Energy.

Annexure 3 COMMUNITY TITLE BY-LAWS

To maintain access to assets the following by-law must be incorporated into all community title management statements where HV or LV (including street lighting) assets are owned and maintained by Endeavour Energy:

> **BY-LAW [X] ENDEAVOUR ENERGY – Access Ways**
>
> *The Association agrees that if the surface of the access ways does not support the heavy vehicles, machinery and materials necessary to maintain Endeavour Energy's electrical equipment, the Association will be responsible for repairing any damage caused to the surface of the access ways during such maintenance.*
>
> *This provision applies despite any other easement term to the contrary.*

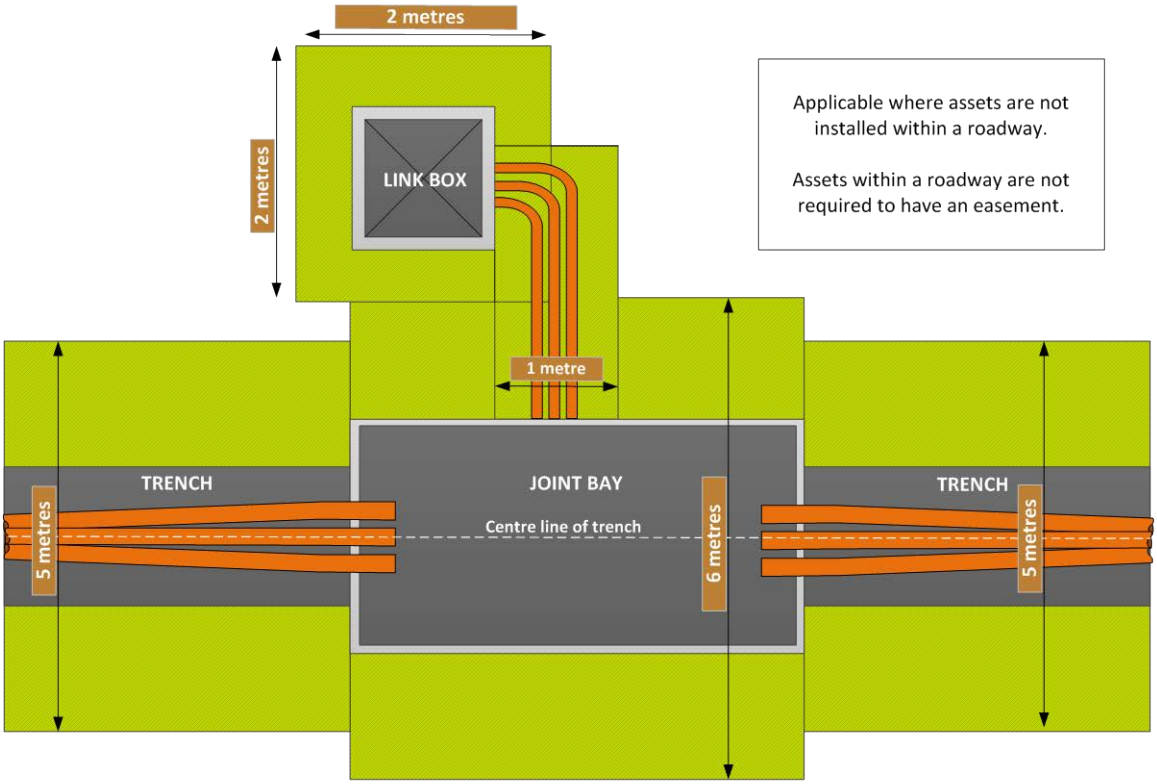
Where the ownership of any part of the electricity network (HV, LV or street lighting) within the community title development is to be the responsibility of the community association, the following by-law must be incorporated into the community title management statement:

> **BY-LAW [X] ENDEAVOUR ENERGY – Ownership of Assets by the Association**
>
> *The low voltage electricity system is defined on the prescribed diagram as [eg "electricity"].*
>
> *This electricity system is Association property.*
>
> *The Association is responsible for the maintenance, repair, refurbishment, and augmentation of this electricity system.*
>
> *The design of this electricity system has been based on a maximum demand of [as advised by the designer] Amps per dwelling.*

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Annexure 4 Typical easement layouts

A4.1 - Underground assets



A4.2 – UGOH and Stay pole easements

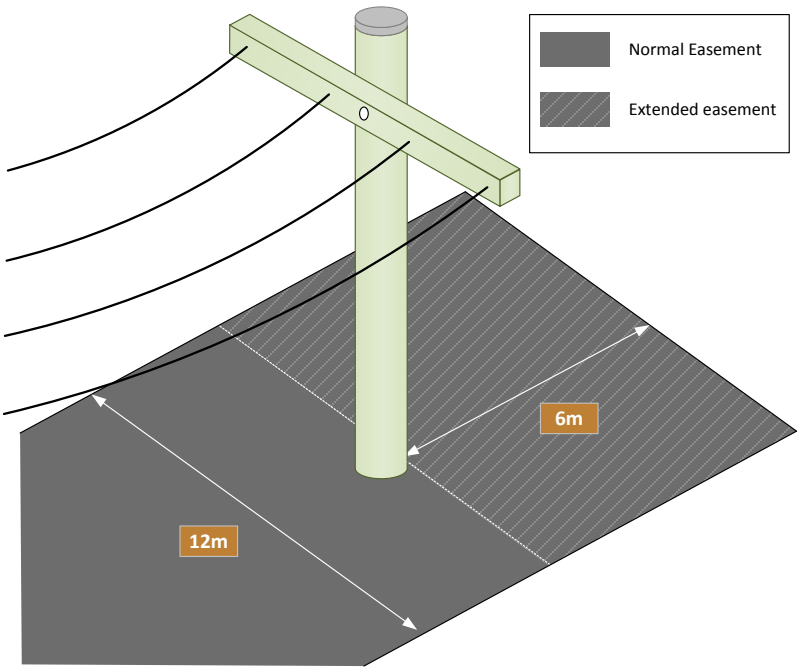


Figure 10 –UGOH pole easement

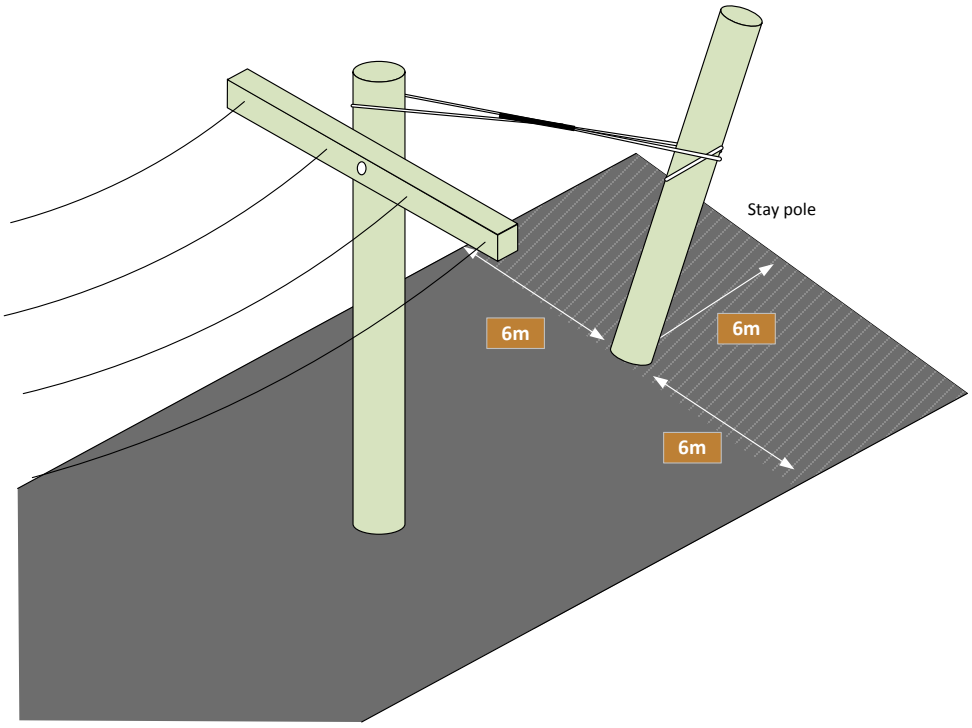


Figure 11 – Stay / Ground pole easement

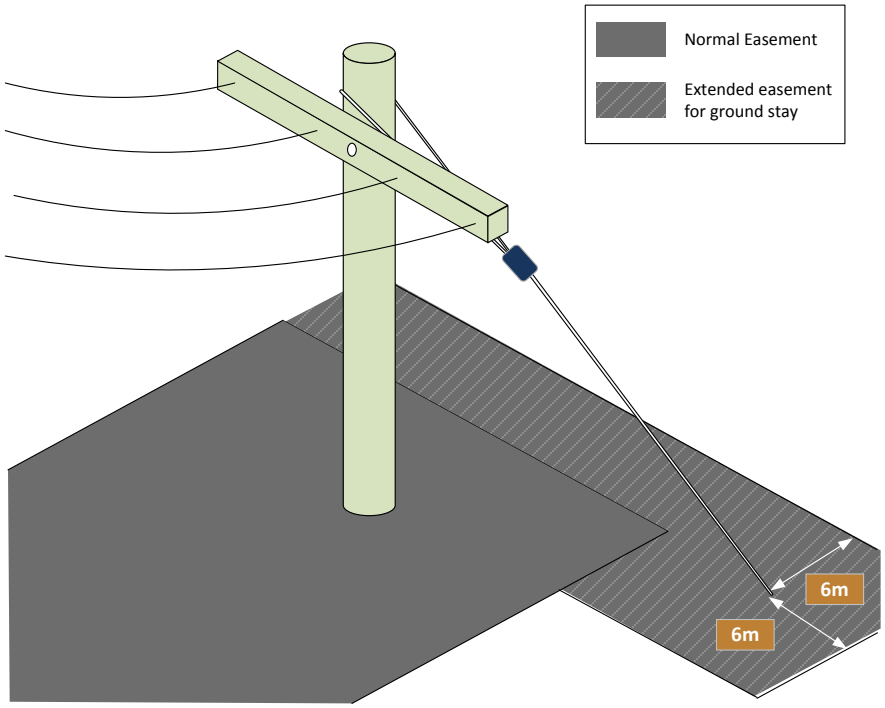
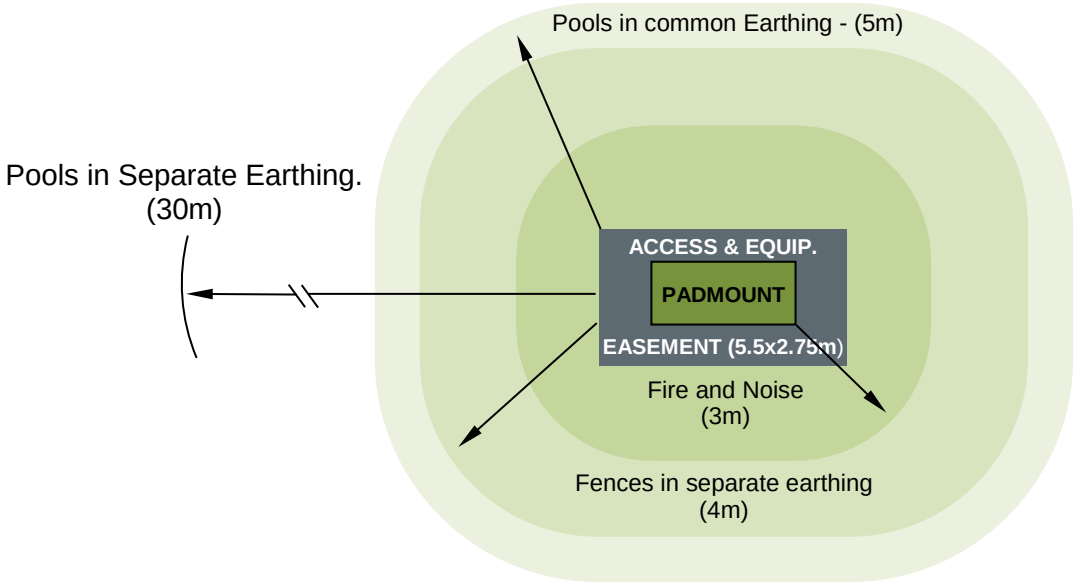


Figure 12 – Ground stay easement

A4.3 - Padmount easements and clearances



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Annexure 5 – Encroachment reference guide

Allowed - An activity which is allowed within an easement, but must still adhere to the minimum safety requirements within the easement stated in this document.
Prohibited - An activity that must not be performed under any circumstance within the easement.
Controlled - An activity which is allowed only if it meets both the minimum safety requirements for that type of easement with additional controls which are specified in the corresponding clause. Approval from Endeavour Energy is required for any controlled activity.

Category	Encroachment	Overhead				Underground				Padmount Substations			
		Allowed	Prohibited	Controlled	Clause	Allowed	Prohibited	Controlled	Clause	Allowed	Prohibited	Controlled	Clause
Buildings/ Structures	Buildings (habitable)		✓				✓				✓		
	Tents – Commercial or Recreational		✓			✓					✓		
	Shade Cloths / Umbrellas			✓	5.14.4.1		✓				✓		
	Minor structures (clothesline, playground equipment, non metallic fences and bbqs)			✓			✓				✓		
	Garages, large sheds and shipping containers (habitable)		✓				✓				✓		
	Non-habitable buildings (Carports and metallic sheds), and shipping containers (uninhabited)			✓	5.14.4.2		✓				✓		
	Flag pole / weather vane		✓				✓				✓		
Barriers/Walls	Sound walls			✓			✓				✓		
	Conductive fencing through an easement			✓	5.14.4.3			✓	5.15.5.1		✓		5.16.5.5
	Conductive on boundary of an easement			✓				✓			✓		
	Metal safety barriers			✓	5.14.4.4		✓				✓		
	Electric fencing		✓				✓				✓		
	Retaining walls			✓	5.14.4.5			✓	5.15.5.9			✓	5.16.5.4
	Metallic pipes in lengths greater than 3m		✓					✓	5.15.5.2		✓		
Fixed/ Mobile plant	Footings of Fixed plant		✓				✓				✓		
	Fixed Plant or equipment		✓				✓		5.15.5.3		✓		
	Mobile plant or equipment			✓	5.14.4.7			✓	5.15.5.4	✓			5.16.5.1
	Parking of tall vehicles, trucks, caravans, campervans		✓					✓			✓		
	Parking of other vehicles			✓	5.14.4.6	✓					✓		5.16.5.1
Vegetation	Shrubs with roots < 400mm	✓				✓				✓			
	Planting of trees which grow less than 3m	✓					✓				✓		
	Planting of trees which exceed 3m		✓				✓				✓		
	Storage of organic matter (leaves, compost)			✓	5.14.4.17			✓	5.14.4.17		✓		
Swimming Pools	Spas and Swimming pools – above ground		✓				✓				✓		
	Swimming pools – in ground		✓				✓				✓		

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Category	Encroachment	Overhead				Underground				Padmount Substations			
		Allowed	Prohibited	Controlled	Clause	Allowed	Prohibited	Controlled	Clause	Allowed	Prohibited	Controlled	Clause
Fires	Lighting of fires		✓				✓				✓		
	Back burning			✓	5.14.4.8		✓				✓		
Agricultural use of the land	Agricultural pursuits such as dusting, harvesting, netting, irrigation			✓	5.14.4.9			✓	5.15.5.5			✓	5.16.5.2
	Ploughing near structures		✓			N/A					✓		
	Ploughing not near structures	✓					✓				✓		
Other	Objects which may hinder access		✓				✓				✓		
	Storage of combustible/flammable/corrosive material		✓				✓				✓		
	Storage of non-combustible, non-flammable, or non-corrosive material	✓				✓					✓		
	Rainwater tanks			✓	5.14.4.10		✓				✓		
	Detention basins			✓	5.14.4.11		✓				✓		
	Earth works – reducing cover or filling			✓	5.14.4.12		✓				✓		
	Permanent surfaces (asphalt, concrete etc)	✓					✓				✓		
	Different surfaces (bluemetal, woodchips)	✓				✓				✓			
	New Roads			✓	5.14.4.13			✓	5.15.5.6			✓	5.16.5.3
	Concrete driveways			✓				✓					
	Installation of Utility services – telecoms, water, LV elec, sewerage			✓	5.14.4.14			✓	5.15.5.7		✓		
	Residential/ Commercial subdivision lots			✓	5.14.4.15			✓	5.15.5.8	N/A			
	Use of explosives		✓				✓				✓		
Recreational Activities	Recreational activities – general (not including activities listed below)	✓				✓					✓		
	Recreational activities – flying kites, model aircraft, balloons		✓			✓					✓		
	Recreational activities – Flood lighting, grandstands		✓				✓				✓		
	Recreational activities – firearms		✓			✓					✓		
	Recreational activities – tennis courts			✓	5.14.4.16		✓				✓		

Note: Highlighting within the Encroachment column indicates a category which has been added since the last amendment. However, highlighting within the Overhead, Underground or Padmount columns represents a change in approach to the management of the encroachment since the last amendment.

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ELECTRICAL SAFETY

FOR BUILDING AND CONSTRUCTION WORKERS



WORKPLACE FACT SHEET

KNOW THE DANGERS

Employees and contractors in the building and construction industry may run the risk of receiving an electric shock and causing substantial damage to plant and equipment when operating plant near overhead power lines or when excavating. This fact sheet has been developed to help you understand why you may be at risk and what you can do to work safely.

THINGS YOU SHOULD DO BEFORE STARTING WORK

- Complete a risk assessment. This should identify hazards (including work practices and procedures) and help you implement appropriate control measures.
- Find out the location of underground and overhead power lines and their proximity to your work activities and transit routes before commencing digging or other activities by phoning **131 081**.
- Know the location of underground and overhead power lines and their proximity to your work activities and transit routes before commencing digging or other activities.
- Dial **1100** or visit **www.1100.com.au** when planning underground work.
- Visually inspect points of attachment, at both ends, before commencing work as gutters and metal roofs may become "alive" due to deteriorating insulation on electrical wiring.
- Use a safety switch to reduce the risk of shock from portable tools.
- Before commencing work, install eye level visual markers in any area where overhead power lines are identified.
- Carefully monitor weather conditions – power lines can sway in the wind, sag as temperatures increase and are difficult to see at dawn and dusk.
- Ensure operators are aware of the height and reach of their machinery in their travel, stowed and working positions to ensure that minimum approach distances to power lines are maintained. For more information refer to *Work Near Overhead Power Lines Code of Practice 2006*, WorkCover NSW.
- Determine electricity asset safety clearances and whether an isolation needs to occur by referring to *Where to draw the line on safety clearances from electricity assets*, available at www.endeavourenergy.com.au
- Ask the occupant if they have experienced any minor electrical shocks from plumbing or appliances.

Call 131 081 and put safety first.
www.endeavourenergy.com.au

Endeavour Energy

BEFORE YOU DIG

- Apply for Dial Before You Dig plans for each location where you intend to dig.
- Use cable location services and technologies such as Global Positioning Systems (GPS) and Ground Penetrating Radar (GPR) to accurately identify the location of underground utilities.
- Pothole once you reach the applicable approach distance – for more information on approach distances for underground assets refer to *Work Near Underground Assets Guide 2007*, WorkCover NSW.

SAFE WORK HABITS

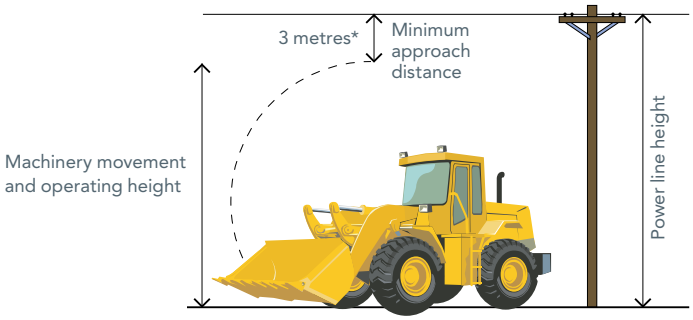
- Look up and locate overhead power lines and maintain at least the minimum approach distance from them.

Minimum safe approach distances when working near power lines

Workers and their equipment should not approach overhead power lines any closer than the following, when machinery is being operated:

Power lines with voltages up to 132,000 volts	e.g. low voltage distribution and subtransmission lines, usually on poles	3 metres
Between 132,000 and 330,000 volts	e.g. subtransmission and transmission lines, usually on either poles or towers	6 metres
More than 330,000 volts	e.g. transmission lines usually on towers	8 metres

The distance that must be assessed prior to work



*Voltages up to 132,000 volts.

- Remember that WorkCover requires a minimum approach distance of at least three metres from overhead power lines (up to 132,000 volts).
- Exercise extreme caution when working near the point of attachment of the electrical service line to the house/building.
- Look for cables and the signs of underground assets whenever digging, such as changes in grass, depressions or mounds and pipe work.
- Look out for electrical arcs. If identified, do not commence work and contact Endeavour Energy immediately on **131 003**.
- To eliminate the possibility of making contact with power lines on a job site, plan and communicate safe traffic paths by providing diagrams of plant and vehicle travel paths away from overhead power lines.
- Assign a spotter to each operator of high machinery and excavators to guide movements near overhead power lines and underground cables and ensure that minimum approach distances are maintained.
- Before every relocation, lower all machinery into the transport position.
- Use proximity sensor technologies on plant while you dig.

PERMIT TO WORK SYSTEMS

Using a permit to work (PTW) system can be an effective way to be sure preventative measures have been taken before any digging commences. It acts as a checklist that can only enable digging work to commence (usually with supervisor sign off) once all preventative actions have been taken *first*.

A typical permit to work checklist should ask/specify the following:

01 Has Dial Before You Dig been undertaken?

02 Have cable location services/technologies been used and their results compared with the DBYD plans?

03 Have the plans been marked up to reflect any new information/changes?

04 Has the safest plant suitable for the job been selected and ordered?

05 Has a spotter been allocated to this job to observe hand, mechanical or powered digging?

06 Is potholing included in the safe work procedure?

07 Has the job been assessed to use non-destructive digging?

08 Have overhead power lines been identified as a risk? If so, has this risk been managed as low as reasonably practicable?

09 Have all persons who may face/are affected by the risk of hitting underground utilities been consulted/made aware of the safe work procedures?

SAFETY EXCELLENCE

IN EMERGENCIES CALL 131 003

24 hours a day, 7 days a week

If you have any questions about what you should do to stay safe please call 131 081 or visit us at www.endeavourenergy.com.au

0611-ENE2352_BC

LIVING SAFELY WITH ELECTRICITY

When working outside, whether it's a small job or large job or even something you do every day, you need to be aware of the electrical dangers of working near overhead power lines or underground cables.

Endeavour Energy wants to help protect you from potential electrical dangers on your work site. In turn, this will ensure families, households and businesses can continue to enjoy a safe and reliable electricity supply.

This brochure highlights some of the things you can do to avoid electrical dangers on the job.

Did you know?

Australian households receive communication, gas, water and electrical services via a labyrinth of cables stretching millions of kilometres underground. If just one of these cables is damaged, you could potentially be seriously injured and/or isolate thousands of households from essential services. Such incidents can result in hefty fines.

01 Call Emergency Services on **000**.

02 Request an ambulance if anyone is injured.

03 Report the incident to Endeavour Energy on **131 003** as soon as possible.

SAFETY EXCELLENCE

IN EMERGENCIES CALL 131 003

24 hours a day, 7 days a week

If you have any questions about what you should do to stay safe around damaged power lines and other electrical infrastructure please call 131 081 or visit us at www.endeavourenergy.com.au

0611-ENE2351-CONT

SAFETY ON THE JOB



51 Huntingwood Drive
Huntingwood NSW 2148
PO Box 6366 Blacktown NSW 2148
T: 131 081 • F: 61 2 9853 6000

Endeavour Energy

Call 131 003 and put safety first.
www.endeavourenergy.com.au

Endeavour Energy

BE ALERT AT WORK

Do you know where the underground cables are?

Unfortunately, serious incidents occur when excavators hit underground cables because cables aren't identified before work has commenced. Obtaining information about underground cable locations once involved making numerous calls to many utility providers.

Now there's really no excuse. Information and site maps showing the general location of underground services can be obtained by calling **1100** or visit **www.1100.com.au**. Remember it's the law.

Check, double check, triple check and reassess

Always check, double check, triple check and reassess for electrical dangers on the job. Remember, earthmoving operations often require material to be relocated to mounds or piles. When this happens under and around power lines it reduces the clearance distances between plant and the electrical infrastructure.

Completed your job?

Stay alert when packing up or removing scaffolding or equipment or when returning plant to its transit position.

Transporting trees?

Remember tall trees and shrubs such as palms can come into contact with power lines. Water is a good conductor of electricity and can therefore conduct through vegetation due to its water content.

Excavating?

Always check the voltage of cables listed on plans so that you can then apply this to *Work Near Underground Assets Guide 2007*, WorkCover NSW, to determine what the clearance and other requirements are to commence excavation. Select the safest plant for the job, e.g. toothless buckets and blunt hand tools. Before using mechanical plant to dig, use a cable location service to check the accuracy of plans. Always pothole by hand with non-conductive, blunt hand tools.



Look up and live

If a tip-truck, scaffolding, pump, ladder, crane or metal platform approaches or comes in contact with overhead power lines, the operator and even people nearby, could be electrocuted. Before starting work always look up and identify the location of any overhead power lines. Plan the job to minimise work near and around power lines.

Compare the height of power lines to the maximum height of your equipment, and ensure the full reach of your equipment will not breach the approach distances outlined in the *Work Near Overhead Power Lines Code of Practice 2006*, WorkCover NSW. For "ordinary persons" WorkCover requires an approach distance of at least three metres from overhead power lines (up to 132,000 volts).

Additional clearances are required when working near power lines carrying higher voltages. It's also a good idea to nominate a co-worker to observe and check that you and your equipment do not go into the approach distance zone.

HOW CAN YOU HELP?

Electricity can jump

You don't have to be touching power lines to get an electric shock because electricity can 'jump' – also known as arcing. A safe 'clearance' distance needs to be maintained to prevent electricity from arcing across to you and your equipment.

Five things to remember

01 Check, double check, triple check and reassess – always assess your work site for electrical dangers before you start and stay alert until you've left the site.

02 Look up and live – identify the location of overhead power lines and plan your job away from them.

03 Dial **1100** or visit **www.1100.com.au** before you dig – confirm the location of all underground cables before you begin any excavation work.

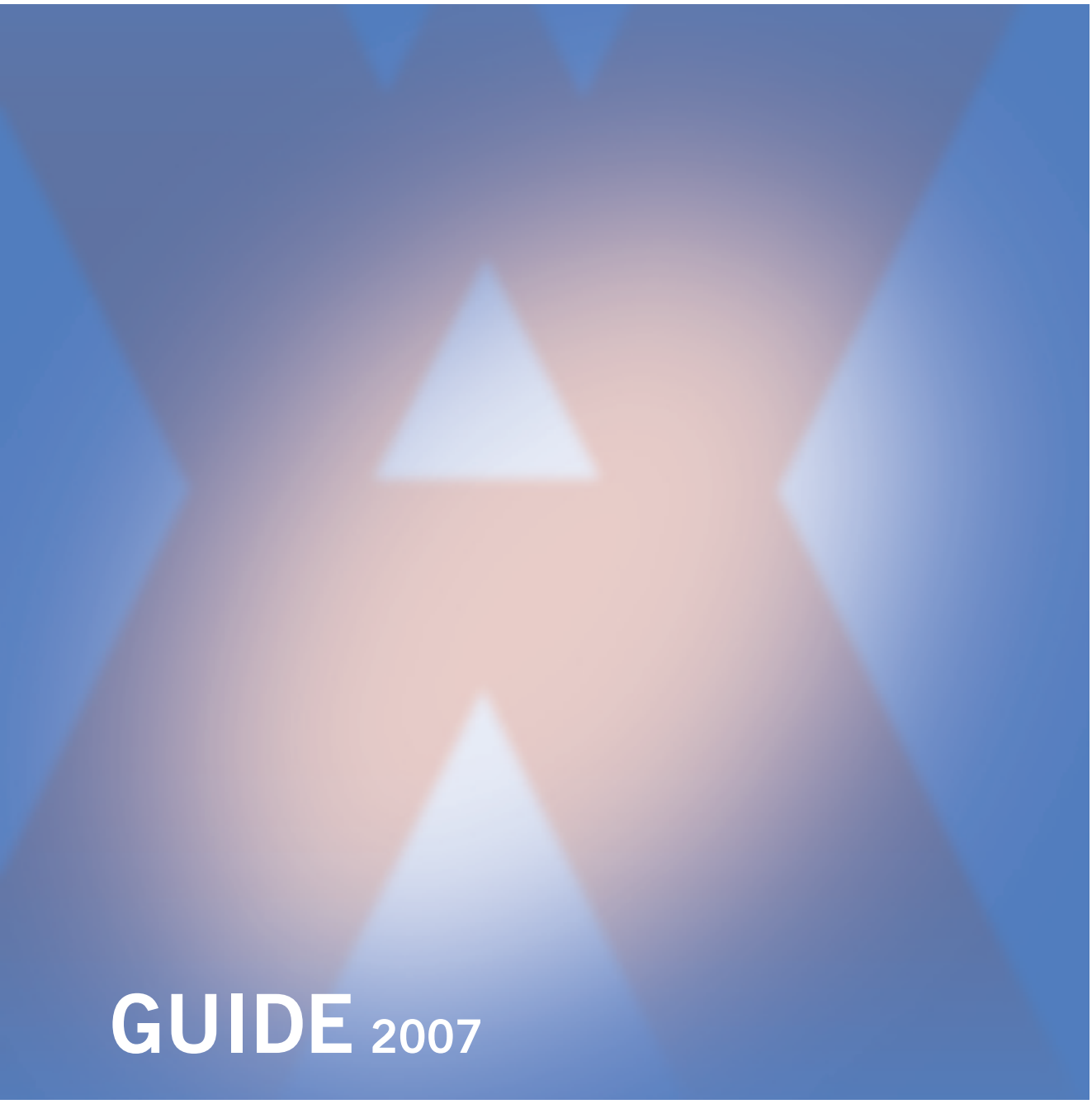
04 Before using mechanical plant to dig, check the accuracy of your plans using a cable location service. Pothole by hand using blunt plant items.

05 Always maintain a minimum approach distance from power lines and assign a co-worker as an observer while you operate and move machinery around power lines.

DIAL BEFORE YOU DIG®
www.1100.com.au

WorkCover
NEW SOUTH WALES

WORK NEAR
UNDERGROUND ASSETS



GUIDE 2007

making a difference

New South Wales Government

INDUSTRY REFERENCE GROUP
UTILITIES

This is a Utilities Industry Reference Group (IRG) project in partnership with WorkCover and Industry.

The Utilities IRG working party consisted of representatives from the following organisations:

- Alinta
- Australian Workers Union – Technical Administrative Professional Staff Branch
- Civil Contractors Federation
- Department Energy, Utilities and Sustainability
- EnergyAustralia
- Integral Energy
- Local Government Engineer's Association
- Local Government and Shires Association
- Roads and Traffic Authority
- Sydney Water
- Telstra
- WorkCover.

ACKNOWLEDGEMENT

The Working Party wishes to acknowledge that some references in this document are sourced from the WorkSafe Victoria *Guide for Undertaking Work Near Underground Assets,* the Utility Providers *Code of Practice for Western Australia* and the NSW Streets Opening Conference *Guide to Codes and Practices for Streets Opening.*

Disclaimer
This publication may contain occupational health and safety and workers compensation information. It may include some of your obligations under the various legislations that WorkCover NSW administers. To ensure you comply with your legal obligations you must refer to the appropriate legislation.

Information on the latest laws can be checked by visiting the NSW legislation website (www.legislation.nsw.gov.au) or by contacting the free hotline service on 02 9321 3333.

This publication does not represent a comprehensive statement of the law as it applies to particular problems or to individuals or as a substitute for legal advice. You should seek independent legal advice if you need assistance on the application of the law to your situation.

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PREFACE

This Guideline is for employers, employees, contractors, subcontractors and other parties involved in construction work near underground assets. Note: This Guideline is not designed to impact on mining legislation.

The aim of this Guideline is to assist employers in deciding appropriate measures to eliminate or control risks to workers and other people on construction sites. It provides practical advice on implementing the requirements of the *Occupational Health and Safety Act 2000* (OHS Act) and the *Occupational Health and Safety Regulation 2001* (OHS Regulation).

At times, construction work may be carried out near underground assets on greenfield construction sites as well as on or near public roads and pedestrians. Where construction and maintenance work is carried out on or near public roads, work should be carried out in accordance with the AS 1742 set of Standards – *Manual of uniform traffic control devices.* These Standards are supported by a set of field guides (HB 81) *Field guide for traffic control at works on roads.*

Use this Guideline to assess the effectiveness of your present arrangements for dealing with safety issues associated with working near underground assets, and to check that sources of risk have been identified and dealt with. If you are setting up a new business, this Guideline can serve as your step-by-step guide to establishing a program to manage the hazards arising from work near underground assets.

Work on, near or adjacent to gas and electricity services are deemed to be high risk construction work. Also water and sewerage assets may be deemed to be high risk construction work.

What do the symbols in the Guideline mean?

To help you work out what you require, a number of symbols are used to highlight things you need to take into account and tools to help you undertake the activity.



Assess the risks in your workplace



Processes of finding things that cause harm, work out how serious the problems are and then to fix them



Legal obligations that must be followed



The process of finding things that cause harm, working out how big a problem they are and fixing them

1. ESTABLISHMENT

1.1 TITLE

This is the Work Near Underground Assets Guideline.

1.2 PURPOSE

This Guideline provides practical guidance to prevent injury to people and damage to underground assets.

1.3 SCOPE

This Guideline informs asset owners, contractors, employers, workers and industry as to their obligations to:

- accurately install and record the location of the asset
- operate and maintain utility assets
- foster co-operation between underground utility owners and industry so as to eliminate or control the risk to individuals and the community, as well as damage to underground assets
- manage the risks involving underground assets at a workplace
- provide safe systems of work for individuals dealing with works near underground assets
- encourage the use of agreed practices for such work
- carry out JSA/Risk assessment and develop safe work method statements prior to commencing high risk construction work.

Note: This Guideline relates to underground utility assets on public land, within easements and on private property. While the principles may be similar, this Guideline does not specifically relate to underground assets on private property.

1.3.1 Encouraging compliance

All worksite controllers within NSW have a duty of care to persons within their worksite or those who may be affected by actions or omissions arising from their work activities.

The adoption of this Guideline when dealing with underground assets should help ensure that this duty of care is met.

All persons working near underground assets are encouraged to adopt this Guideline.

All asset owners must promote and encourage the adoption of this Guideline, not only within their own workplaces but to sub-contractors and all persons performing work near underground assets.

1.4 COMMENCEMENT

This Guideline takes effect on 05/07.

1.5 INTERPRETATION

1.5.1 Recommended practices

Words such as 'should' indicate recommended courses of action. 'Consider' indicates a possible course of action that the Guideline is indicating the duty holder should think about. However, you may choose an alternative method of achieving a safe system of work.

1.5.2 Legal requirements

Words such as 'must', 'requires' or 'mandatory' indicate that legal requirements exist which must be complied with.

1.6 DEFINITIONS

access authority — a written authorisation, issued by an asset owner, which allows persons to work within a specified proximity of the asset.

accredited person — a person who has successfully completed a recognised training course relating to the specific job, the training having been conducted by a registered or accredited training organisation.

approach distance — the minimum separation in air from an exposed conductor that shall be maintained by a person, or any object held by or in contact with that person.

approved — having appropriate endorsement in writing for a specific activity.

asset owner — the owner, controller or operator of an underground asset. For the purpose of this Guideline an underground asset includes electrical, water, sewage and drainage, gas, telecommunications, petrochemicals and hazardous substances.

authorised person — a person with technical knowledge or sufficient experience who has been approved, or has the delegated authority to act on behalf of the organisation, to perform the duty concerned.

cable — an insulated conductor or two or more such conductors laid together, whether with or without fillings, reinforcements or protective coverings.

competent person — a person who has acquired through training, qualification or experience, or a combination of them, the knowledge and skills to carry out the task.

confined space — confined space as defined in Australian Standard AS 2865 *Safe working in a confined space.*

construction work — means any of the following:

- excavation, including the excavation or filling of trenches, ditches, shafts, wells, tunnels and pier holes, and the use of caissons and cofferdams
- building, construction (including the manufacturing of prefabricated elements of a building at the place of work concerned), alteration, renovation, repair, maintenance and demolition of all types of buildings
- civil engineering, including the construction, structural alteration, repair, maintenance and demolition of – for example, airports, docks, harbours, inland waterways, dams, rivers, avalanche and sea defence works, roads and highways, railways, bridges and tunnels, viaducts – and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies.

consumer services	the supply to individual houses or premises, as opposed to "mains" which form part of the utility's distribution system.
– water	the cold water supply pipework from the water main up to and including the outlet valves at fixtures and appliances. The water service is owned by the consumer.
– electricity	consumer services means the conductors from the supply authorities' distribution mains (overhead or underground) to the customers' premises.
– gas	the pipe used to supply gas to the property, which runs from the distribution main to the meter position.
	the Network Operator, also known as the Asset Owner, owns the section of the pipe between the distribution main and the property. The property owner owns the section of pipe between the property line and the meter.
– telecommunications	the conduit and cabling controlled by the Carrier from the Network Point of Presence to the Network Boundary Point (NBP). Cabling beyond the NBP is customer owned cabling.
contaminated ground	a contaminated site that poses a significant risk of harm to human health or the environment and is regulated by the EPA (NSW) under *Contaminated Land Management Act 1997.* Refer to http://www.epa.nsw.gov.au/clm/searchregister.aspx
control measures	measures taken to minimise a risk to the lowest level reasonably practicable.
crane	an appliance intended for raising or lowering a load and moving it horizontally. Includes the supporting structure of the crane and its foundations, but does not include industrial lift trucks, earth moving machinery, amusement devices, tractors, industrial robots, conveyors, building maintenance equipment, suspended scaffolds or lifts.
earthed	direct electrical connection to the general mass of earth so as to ensure and maintain the effective dissipation of electrical energy.
earth moving machinery	an operator controlled item of plant used to excavate, load or transport, compact or spread earth, overburden, rubble, spoil, aggregate or similar material, but does not include a tractor or industrial lift truck.
electrical apparatus	any electrical equipment, including overhead power lines and underground cables, the conductors of which are live or can be made live.
electricity network	transmission and distribution systems consisting of electrical apparatus which are used to convey or control the conveyance of electricity between generators' points of connection and customers' points of connection.
emergency work	work to rectify or prevent imminent danger to human life or physical injury.
	work to rectify or prevent imminent or continuing damage to, or destruction of, property or the environment.
	work to rectify or prevent an unscheduled outage which has or is likely to have a significant impact on the Distribution Network or the Carrier's network.
employee	an individual who works under a contract of employment or apprenticeship.
employer	a person who employs persons under contracts of employment or apprenticeship.
energised	connected to any source of energy.

excavating	the movement or placement of soil or other surface materials by removing, boring or forcing objects into the ground or surface of the earth.
exposed conductor	an electrical conductor, approach to which is not prevented by a barrier of rigid material or by insulation that is adequate under a relevant Australian Standard specification for the voltage concerned.
extra high voltage (EHV)	in NSW, means a transmission system cable with a nominal voltage of 132,000V a.c. (132kV) or above.
hazard	anything (including work practices and procedures) that has the potential to harm the health and safety of a person.
high pressure gas (HP)	210kPa – 1050kPa. **Note:** Transmission Pressure gas is equal to or greater than 1050kPa.
high-risk construction work	means any of the following construction work: • involving structural alterations that require temporary support • at a height above 3 metres • involving excavation to a depth greater than 1.5 metres • demolition work for which a licence is not required • in tunnels • involving the use of explosives • near traffic or mobile plant • in or around gas or electrical installations • over or adjacent to water where there is a risk of drowning.
high voltage (HV)	a nominal voltage exceeding 1000V a.c. or exceeding 1500V d.c.
insulated	separated from adjoining conducting material by a non-conducting substance which provides resistance to the passage of current, or to disruptive discharges through or over the surface of the substance at the operating voltage, and to mitigate the danger of shock or injurious leakage of current.
instructed person	a person adequately advised or supervised by an Authorised Person to enable them to avoid the dangers which electricity may create.
isolated	disconnected from all possible sources of energy by means that prevent unintentional energisation of the apparatus.
lancing	using water or air aided by vacuum extraction to achieve non-destructive excavation.
live	energised.
low pressure gas (LP)	pressure less than or equal to 7kPa.
low voltage (LV)	a nominal voltage exceeding 50V a.c. or 120V d.c. but not exceeding 1000V a.c. or 1500V d.c.
mains	part of the utility's distribution system as opposed to "services" which are the take-offs for individual properties.
– water/sewerage	a conduit or pipeline controlled and maintained by a network utility operator or water authority.
– electricity	aerial or underground wires or cables from 400/230V to 330kV a.c
– gas	a pipe installed in a street to convey gas to individual services.
– telecommunications	any facility owned by the carrier – typical underground plant consists of conduits, cables, pits and manholes linking exchanges, or exchanges to distribution points.

medium pressure gas (MP)	pressures greater than 7kPa and up to 210kPa.
mobile plant	includes plant that: • moves either under its own power or is pulled or pushed by other mobile plant • moves on or around the worksite, enters or leaves the site, or moves past the site • includes road vehicles operating at a worksite. **Note:** This definition has been adopted for the purposes of this Guideline. This includes items such as earthmoving machinery, concrete boom pumps and tipper trucks operating at a worksite.
network operator	also known as the asset owner.
nominal voltage (U)	the a.c. or d.c. voltage by which a system of supply is designated.
OHS act	the Occupational Health and Safety Act 2000.
OHS regulation	the Occupational Health and Safety Regulation 2001.
overhead power line	any bare or covered aerial conductors and other associated electrical parts that make up an aerial line for the distribution and transmission of electrical energy.
other cable systems	telecommunications cables, optic fibre cables, control cables, earth cables or electrolysis drainage cables.
personal protective equipment (PPE)	items that workers can use to protect themselves against hazards. PPE includes insulating gloves, mats or sheeting, glasses and face protection. **Note:** A number of items of PPE are made and tested to Australian Standards. PPE that is not designated as meeting a recognised Standard may be unreliable in service, as its performance is unknown.
place of work	premises where people work.
plant	any machinery, equipment or appliance. **Note:** For the purposes of this Guideline the definition includes a broad range of machinery and equipment, but not limited to, cranes, mobile plant, scaffolding, load shifting equipment, industrial lift trucks, earth moving machinery, amusement devices, tractors, rural machinery, vehicles, conveyors, building maintenance equipment, suspended scaffolds or lifts, implements or tools and any component or fitting of those things.
polymeric	made from polymers otherwise known as plastics.
pot-holing	excavating with hand tools to a pre-determined depth to establish if assets exist in the immediate location.
premises	includes any place, and particularly includes: • any land, building or part of a building • any vehicle, vessel or aircraft • any installation on land, on the bed of any waters or floating on any waters • any tent or movable structure.
permit conditions	permission conditions stipulated by asset owner.
pressurised	a constrained flow of a substance in a pipeline which may be of varying diameters and thicknesses, the flow of which may or may not be directly controlled by an asset owner.
procedure	the documentation of a systematic series of actions (or activities) directed to achieve a desired result.

property line	the boundary line between the road reserve and the adjacent property.
railway assets	electrical, signalling and communications infrastructure owned and maintained by the rail entity. Assets also included but are not limited to, drainage lines and compressed air line.
safety observer	a competent person who has been specifically assigned the duty of observing and warning against unsafe approach to the asset.
supervisor	a representative of the principal for a worksite, who has the delegated responsibility for a task or range of tasks being undertaken at the worksite.
underground assets	part of an underground network such as water/drainage/sewerage, electricity, gas or communications etc.
underground services	the supply to individual houses or premises as opposed to underground assets which form part of the utility's distribution system.
works planned or programmed	any work which has followed the normal planning process prior to work commencing ie where the worksite has been physically inspected and assessed in advance of the work crew arriving on site.

2. PLANNING AND PREPARATION



The OHS Act and the OHS Regulation require employers to address workplace health and safety through a process of risk management and consultation.

Under the OHS Act and the OHS Regulation, employers have an obligation to ensure the health, safety and welfare of employees at work and that other people are not exposed to risks to their health and safety. When contracting out work, employers must ensure that contractors are planning and carrying out work in a safe manner. The work should be conducted according to this Guideline.

To effectively implement this Guideline, employers need to be aware of these requirements and have procedures in place to apply them. Employees, self-employed persons, subcontractors and controllers of premises, plant and substances also have responsibilities under OHS legislation. Each individual should ensure that they work safely and that their work does not expose others to health and safety risks.

The way to systematically plan and manage health and safety in the workplace is to build risk management and consultation into all those activities that may have OHS implications. This will involve activities such as purchasing, work methods or procedures, using contractors, reporting OHS problems, investigating incidents and planning emergency procedures.

2.1 UNDERSTANDING RESPONSIBILITIES

2.1.1 Clients

The client's responsibilities under the OHS Act and OHS Regulation will depend on their role in the design and construction. They are usually a "controller of premises" at least to some extent and may also have other roles such as designer, principal contractor or an employer in relation to the project.

The client is also in the best position to influence others to consider that constructability and maintainability are included in the design and thus to reduce construction and ongoing maintenance risks at the design stage. Setting realistic timeframes for tendering, planning and project execution can also assist planning and execution of construction work.

However, the client is not always aware of all the complexities, such as the range of construction techniques, ground conditions and their effect on safety. It is therefore often appropriate for consultation between the client and other parties at an early stage to take advantage of the opportunity to identify the best concept design.

2.1.2 Controllers of work premises, plant or substances



Controllers of work premises, plant or substances also have health and safety legal responsibilities. They must make sure that the premises used as a place of work are safe and without risks to health and that the plant and substances used in the work process are safe and without risks to health when properly used. For persons who have only limited control of the premises, plant or substances, their responsibilities apply only to the matters over which they have control.

Designers should ensure that:

- to the extent that they have control over the design work, the structure (or plant) can be safely constructed, used, repaired, cleaned, maintained, and demolished, such that the health and safety of any person is not put at risk by the design
- information is provided to the client about the health and safety aspects of the design.

Designers should also ensure that, as far as practicable, hazards associated with the following are identified before commencement of the construction work:

- the design of the structure (whether permanent or temporary)
- systems of work required to construct, repair and maintain the structure
- the intended use of the structure
- materials required to be used in the construction of the structure
- the demolition (or abandonment) of the structure.

Note: In relation to the design of plant, the OHS Regulation contains more detailed risk control requirements on designers, manufacturers and suppliers.

Where there is more than one designer, critical aspects of the project should be documented and liaison should occur between the principal contractor and relevant designers so that the work can be coordinated to ensure the safe interaction of the different design aspects. When risks remain in the design work, information should be included with the design to alert others to the risks.

2.1.3 Principal contractors



The principal contractor, whether as an employer or as the person in control of the workplace, must provide and maintain in relation to those matters over which he or she has control, a workplace that is safe and without risks to health for their employees and other persons present at the workplace or affected by the work. To fulfil these obligations the principal contractor must plan for the work to be done safely.

The principal contractor must ensure that a site specific OHS management plan is prepared and documented for each place of work where construction work is to be carried out, before the work commences. This plan must be developed in consultation with the contractor/s and their employees or representatives. The plan must include safe work method statements (SWMS), provided by the contractors where they are used, for all work activities assessed as having risks. It must also include the following details:

- arrangements for OHS induction training
- arrangements for managing OHS incidents including response persons
- site safety rules and arrangements for informing persons affected
- details where persons have specific site OHS responsibilities.

The health and safety management plan must be monitored to ensure that work is carried out safely, according to that plan and that the plan is effective. The plan must be maintained and up to date during the course of the construction work and must be made available for inspection. The principal contractor must stop work immediately, or as soon as it is safe to do so, where there is a risk to the health or safety of a person.

2.1.4 Contractors



The contractor(s) doing the work, whether the principal contractor themselves or sub-contractors, must provide and maintain a workplace that is safe and without risks to health for their employees in relation to those matters over which they have control.

In addition to consultation with the principal contractor in the overall job planning, the contractor must develop written SWMS including an assessment of the risks and the controls used to carry out the work safely.

2.1.5 Employees



Employees must take reasonable care of the health and safety of themselves and others. Employees must cooperate with employers in their efforts to comply with OHS requirements. This means that employees must notify their employer of safety and security hazards, risks and incidents in line with the requirements of the OHS Act. These requirements should be outlined by the employer's OHS policy, procedures and safety related instructions.

Employees must not be required to pay for anything done or provided to meet specific requirements made under the OHS Act or OHS Regulation.

2.1.6 Self-employed persons



Self-employed persons must ensure that their undertakings do not expose others to health or safety risks.

2.2 COORDINATION OF RESPONSIBILITIES

There may be a number of parties involved in a project, such as:

- the client
- the principal contractor
- controllers of premises, plant or substances
- designers
- employers (contractor or subcontractors) who employ persons at the site, including labour hire agencies providing persons to the site
- self-employed persons
- suppliers of plant, materials or prefabricated components.



Where more than one party has responsibilities at a specific workplace, each party retains their legal responsibilities and must discharge their responsibilities in a coordinated manner.

3. CONSULTATION AND RISK MANAGEMENT



The OHS Act and the OHS Regulation require employers to address workplace health and safety through a process of risk management and consultation.

To effectively implement this Guideline, employers need to be aware of these requirements and have procedures in place to apply them.

Employers are advised to consult the OHS Act and the OHS Regulation as well as the *Code of Practice: Occupational Health and Safety Consultation* and the *Code of Practice: Risk Assessment* for details of these requirements and how they can be met. The following information is designed to provide an overview of legislative requirements.

3.1 CONSULTATION AT THE WORKPLACE



Employers must consult with employees when taking steps to assess and control workplace risks.

In order to consult with employees, employers are required to set up consultation arrangements and develop consultation procedures.

3.1.1 Consultation arrangements

The OHS Act provides three options for consultation arrangements:

Arrangement	Workplace	Requirement
OHS Committee	20 or more employees	requested by a majority of employees or direction by WorkCover
OHS Representative	any size	at least one employee requests an election or directed by WorkCover
Other agreed arrangements	any size	agreed to by both the employer and employees (in a small workplace it may be a regular safety meeting with employees)

Before using this Guideline, an employer should ensure that consultation arrangements are in place. An employer may initiate the establishment of an OHS Committee or the election of an OHS Representative if the employees have not made such a request. When the consultation arrangements have been decided, clause 27 of the OHS Regulation requires employers to record them and advise all existing and new employees.

3.1.2 Consultation procedures

After setting up the consultation arrangements employers need to consider when and how these consultation arrangements need to be applied.

3.1.3 When should consultation be undertaken?

Under section 13 of the OHS Act, employers have the general duty to consult employees when decisions are being considered that may affect their employees' health and safety. Therefore, employers are required to consult with their OHS Committee, OHS Representative or other agreed arrangement when such decisions are being considered. Decisions which could affect health and safety include:

- planning for new premises or modifying existing premises
- purchasing new plant, equipment or substances
- planning, designing or changing work tasks or jobs
- using contractors in the workplace
- investigating incidents or accidents
- developing emergency procedures
- determining or reviewing workplace amenities
- determining or reviewing consultation arrangements.

Note: Any procedures that are developed to encompass these activities should incorporate consultation.

It may not be practical or reasonable to involve the OHS Committee or the OHS Representative in every purchase decision or task change. However, the employers and committee or representative should agree on what process is needed to ensure that affected employees are consulted.

3.1.4 How should consultation be undertaken?

When engaged in consultation, the OHS Act requires employers to:

- **share all relevant information with employees.** For example, if an employer is going to change a work task, employees need to be told of any risk to health and safety that may arise and what will be done to eliminate or control these risks.
- **give employees reasonable time to express their views.** Employees need adequate time to assess the information given to them, obtain relevant safety information and consult with fellow employees to enable them to form their views.
- **value the views of employees and take them into account when the decision is made to resolve the matter.** In many cases, agreement will be reached on how the safety issues are to be addressed. When agreement cannot be reached, the employer should explain how the employees' concerns have been addressed.

3.2 RISK MANAGEMENT AT THE WORKPLACE



Employers and self-employed persons must identify any foreseeable hazards, assess their risks and take action to eliminate or control them.

When addressing health and safety issues, besides consulting employees, employers must adopt the process of risk management. This process requires employers to:

3.2.1 Identify hazards

To ensure a safe and healthy workplace, employers must identify all the foreseeable health and safety hazards, which could harm their employees or other persons in the workplace. Hazards may arise from the work process, the equipment and materials in use, the work environment, or other people involved.

3.2.2 Assess risks

Once hazards have been identified the risk they pose to health and safety needs to be assessed. Some hazards pose a greater risk than others do, and the frequency and duration of exposure can also affect the risk. Risk assessment involves considering the likelihood and severity of injury or illness being caused by exposure to the risk. Therefore the factors that need to be considered in a risk assessment should include the:

- harm that can be caused by exposure to the hazard
- number of people and the duration and frequency of exposure to the hazard
- capability, skill and experience of people exposed to the hazard.

The risk assessment process provides information on the factors which contribute to the risk. This information will assist in determining what needs to be done to eliminate or control the hazard.

3.2.3 Eliminate or control the risk

The first responsibility is to investigate how the risk can be eliminated. Before implementing the control measures described in this Guideline, an employer should investigate possible strategies for eliminating the hazard from the work system.

If it is not reasonably practicable to do so, the risks associated with the hazard must then be controlled. This Guideline has been developed to provide advice on the most effective control measures.

3.2.4 Review risk assessment and control measures

Control measures should be reviewed on a regular basis. The frequency of their review should be determined by considering the significance of the risks associated with the hazard. However, a review should be undertaken in the following circumstances:

- new information is made available about the risks associated with the hazard
- an accident or incident occurs
- significant changes are proposed to the workplace or work system.

3.2.5 When must employers undertake risk management?

The OHS Regulation requires employers to incorporate the process of risk management into procedures.

These are the same activities for which employers are required to consult with employees.

3.2.6 Strategies for developing effective risk management procedures

When risk management activities are undertaken the following strategies should be considered to inform the process:

- visual checks through workplace inspections
- analysing the types of work being performed and the way work is performed
- inspections of plant and equipment
- analysing workplace records on accidents, incidents or 'near misses'
- risk management information provided by suppliers or manufacturers of equipment or, in the case of hazardous substances, Material Safety Data Sheets (MSDS)
- industry codes of practice for particular hazards or work processes
- Australian Standards, which set safety standards for a range of equipment products and materials
- guidance material from WorkCover NSW or industry or professional organisations.

Further advice is provided in the *Code of Practice: Risk Assessment.*

3.2.7 Personal protective equipment (PPE)

The use of PPE to control risks is lowest on the hierarchy of control measures. The measures at the lower levels are less effective and they require more frequent reviews of the hazards and systems of work. They should only be used when other control measures are impracticable or when, after implementing other controls, a residual risk remains.

- *PPE selection and suitability*

  Where PPE is to be used it should be appropriate for the risk and comply with the relevant Australian Standard or WorkCover approval. Employees should be competent in the proper selection, use and maintenance of the PPE. There should be sufficient supervision and monitoring conducted to ensure PPE is used and employees are competent in its use. PPE should be regularly inspected, maintained and replaced as necessary.

- *Eye protection*

  Dust, flying objects and sunlight are the most common sources of eye damage in excavation work.

  Where persons are carrying out cutting, grinding or chipping of concrete or metal, or welding they must be provided with eye protection complying with AS/NZS 1337:1992 – *Eye protectors for industrial applications.* Eye protection complying with AS/NZS 1337 should also be provided where persons carry out other work, such as carpentry or handling of chemicals, where there is a risk of eye injury. Selection, use and management systems should comply with AS/NZS 1336:1997 – *Recommended practices for occupational eye protection.*

- *Hearing protection*

  Where personal hearing protection is provided it should conform with AS 1270:1988 – *Acoustics – Hearing protectors.* Control measures including training should comply with AS/NZS 1269.3:1998 – *Occupational noise management – Hearing protector program.*

- *High visibility garments/safety reflective vests*

  Persons working underground or near traffic, mobile plant or equipment under operator control, should be provided with and use high visibility garments. Such garments should be selected, used and maintained in accordance with AS/NZS 4602:1999 – *High Visibility Safety Garments.* Other clothing not covered by the high visibility garment should be light coloured and all garments should be selected for best contrast with the surrounding background.

- *Safety helmets*

  The use of safety helmets may prevent or lessen a head injury from falling objects or a person hitting their head against something. Where there is a likelihood of persons being injured by falling objects and overhead protection is not provided, persons must be provided with and must use an appropriate safety helmet. Appropriate safety helmets should also be provided and used where a person may strike their head against a fixed or protruding object or where there is a risk of accidental head contact with electrical hazards.

  All persons on excavation sites should wear head protection that conforms to AS/NZS 1801:1997 – *Occupational protective helmets* and be used in accordance with AS/NZS 1800:1998 – *Occupational protective helmets – Selection, care and use.*

- *Safety gloves*

  Where there is a risk of hand injury, such as exposure to a harmful substance, excessive heat or cold, or to a mechanical device, hand protection appropriate to the risk and that complies with AS/NZS 2161:1998 – *Occupational protective gloves* should be provided and used.

- *Waterproof clothing*

  Waterproof clothing provided as a system of work relating to weather or site conditions should be effective and suitable for the task. Waterproof clothing should also incorporate light reflective features in accordance with the requirements of the section above.

3.2.8 Incident reporting

Hazards and OHS problems should be reported as soon as they are noticed so that the risks can be assessed and addressed as quickly as possible. Records of reported hazards should be kept and should include details of the action taken to remove the hazard or control the risk arising from the hazard.

The OHS Regulation also prescribes a number of workers compensation and OHS legal requirements concerning incident and injury reporting.

3.2.9 First aid



The OHS Regulation requires that employers must provide first aid facilities that are adequate for the immediate treatment of injuries and illnesses that may arise at the place of work and, if more than 25 people are employed, trained first aid personnel.

To ensure adequate first aid provisions, employers must identify their potential problems, assess their requirements and consult with employees in the process.



When determining the nature, number and location of first aid facilities and the number of trained first aid personnel, employers must take into account the location and type of work being undertaken. The type of work performed will influence the hazards and the possible harmful consequences for employees. For example, office workers will have different first aid requirements from construction workers. Workplaces using hazardous substances may require specialised first aid facilities, such as eyewash stations and emergency showers. The risk assessment process will assist in identifying the particular needs of the workplace.

Further information regarding such matters as contents of first aid kits, who qualifies as 'trained first aid personnel', and other requirements relating to first aid rooms, consult the OHS Regulation or the *First Aid in the Workplace Guide.*

3.2.10 Emergency response



The OHS Regulation specifies that an employer must ensure that, in the event of an emergency at the workplace, arrangements have been made for:

- the safe and rapid evacuation of persons from the place of work
- emergency communications
- appropriate medical treatment of injured persons
- appointment of appropriately trained persons to oversee any such evacuation and, if appropriate, the use of on-site fire fighting equipment.

3.2.11 Record keeping



The OHS Regulation requires records to be kept in the following areas:

- induction training
- hazardous substances
- confined spaces
- plant
- electricity
- asbestos
- atmospheric monitoring
- notification of accidents.

Refer to the relevant chapters of the OHS Regulation for further information.

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4. ACCURATE INSTALLATION AND INFORMATION

4.1 INTRODUCTION

Asset owners are required to capture and maintain accurate and up-to-date (as built) records of their underground assets.

When planning a job requiring excavation, a complete record search must be undertaken by lodging an enquiry with the central call service 'Dial Before You Dig'. Asset owners who are not members of this service must also be contacted. When an asset location is requested, asset owners may provide information on the recommended practices for work near that location or asset.

Lodging an enquiry with 'Dial Before You Dig' is as simple as visiting www.dialbeforeyoudig.com.au, phoning 1100 or faxing an enquiry to 1300 652 077. Once the records are obtained, they should remain in the work area and be accessible to all. When carrying out emergency work, every effort should be made to obtain records as soon as possible. If work must commence prior to the records being obtained, it should be carried out on the basis that underground assets are present even if an Electronic Service Detector gives the 'all clear'.

It should be also remembered that as technologies and work practices change over time, features such as the presence of warning tape may not be where you expect (see Table A). For example, the majority of telecommunication assets at joint locations are now housed in pits or manholes. However, the line between these may not be straight if obstructions were encountered during installation. Direct buried cable in rural areas may be identified by pits/manholes and marker posts. However, it cannot be assumed that a cable follows a direct path between these items.

WARNING: Asset owners' plans may not show the presence of all cables, pipes and plant. They may only show their position relative to road boundaries, property fences etc at the time of installation and the asset owners do not guarantee that such plans are accurate thereafter due to changes that may occur over time.

Do not assume depth or alignment of cables as these vary significantly. For example, road and building alignments and levels may change.

4.2 ENSURING ACCURACY OF PLANS AND RECORDS

Asset owners shall have a system of work which ensures the accuracy of plans. The system of work should be included in the asset owners' audit processes.

Improving the accuracy of existing asset plans relies on cooperation between asset owners and contractors. If during work activities, underground assets are found to be not on the plans or are in a different location, contact should be made with the source of the plans to notify of the missing information.

4.3 UNDERGROUND ASSET OWNERS INCLUDE:

- electricity generation, transmission and distribution
- rail
- Roads and Traffic Authority
- local authorities
- telecommunications
- private (eg privately owned water pipelines)
- gas transmission and distribution
- petrochemical (oil, petrol, LPG etc)
- oil
- water
- drainage
- sewerage.

(See Table A).

4.4 ELECTRICITY CABLES

4.4.1 Cable records

Cable records are in the form of plans drawn to scale or on computer based Geographic Information Systems (GIS).

The detail of the records will vary with the type of installation. For cable installed in a standard allocation, the records may provide only general cross sectional arrangements of cable and conduits together with road crossing and street lighting information.

It is common practice to negotiate a special alignment on the roadway for high voltage transmission cables. For this type of installation, the records are more detailed with reduced level and offset information provided. The details of local area distribution and of transmission cables are typically shown on separate plans.

Older installations may not be accurately recorded or reference details may have changed.

4.4.2 Cable installation

The cover for underground electricity cables and underground control cables may vary in depth. Always assume a cable may be present. See Table B.

Note: Underground electrical cables are not necessarily covered with slabs, marker tapes or other indicators of their presence and are frequently not enclosed in conduits. Some underground electrical cables may have been encased in bitumen. Hence a full risk assessment must be undertaken prior to carrying out any excavation work so as to accurately establish the exact locations of underground electrical cables.

4.4.3 Cable ancillary equipment

Associated with many cable installations are ancillary assets and pits. These may include cable joint pits, cable link pits, oil or gas pits, inspection pits and other ancillary pits. These pits will have cables or pipes that connect them to the main cables and care should be exercised when excavating between the cables and the ancillary pits. The presence of ancillary pits shall be confirmed with the electricity asset owner prior to any work.

4.5 GAS PIPES

4.5.1 Gas reticulation systems

Several methods of gas reticulation are used, from low-pressure services through to transmission systems. These systems have been constructed from materials including coated welded steel, cast iron, and a variety of plastics. In most areas, the systems are buried directly in a suitable stone-free backfill. The systems are not designed to resist the impact of tools or mechanical plant or to be left unsupported over any great distance. The operating pressures range from as low as 2kPa up to as high as 15MPa for a transmission pipeline system.

4.5.2 Pipe records

The records for all high and low pressure gas distribution mains are maintained in the form of plans drawn using Computer Aided Design system (CAD). The detail of the records will show the size of pipe and the type of material, changes in direction. Please note gas consumer services are generally not shown on plans. High-pressure transmission pipelines are generally located within a pipeline easement, therefore records of these pipelines are in the form of alignment sheets specific to the individual pipeline.

The location of high and low-pressure distribution mains on the plans are shown at a nominal distance from the building line. The actual pipe alignment will be shown in text as an offset distance in metres from the Building Line (MBL) – also could be known as the ‘property boundary’. When locating gas distribution pipes always reference the offset distance from the building line as minor changes in alignment will not be shown graphically.

4.5.3 Pipe installation

Most pipes laid in recent years may have a marking tape or polymeric plastic slab laid above the pipes for identification when excavating. However, these tapes or slabs may have been damaged by other excavations in the area since the initial construction and not replaced. For location purposes, plastic pipe may have been laid with a trace wire to enable the main to be located using a cable locator. Again, it is important these tracer wires are not interfered with or broken, as it makes future location of these pipes very difficult. If you do break the trace wire, please ensure that the wire is rejoined and coated with electrical tape. Steel mains and pipelines will not have a trace wire as they are metallic and can be detected. Other structures, such as siphon points, valve pits, regulator pits and other varied components may be installed in the pipeline. Care needs to be taken to locate these before excavation.

While the plans may show the expected location of underground distribution mains, consumer services are not shown. Properties should be checked to ascertain whether gas meters are present. If so, the services normally run at right angles to the distribution main to the service connection at the meter. However, it cannot be assumed that a pipe follows a direct path between these items. Be aware the consumer service may receive its supply from a distribution main on the opposite side of the road. The installed depth of consumer services varies – refer to Table B. In circumstances where the correct depth of cover has not been achievable, mains and services may be encased in concrete or laid in copper pipe.

All high-pressure steel distribution mains and transmission pipelines have corrosion protection systems. These systems form part of the pipeline and incorporate the protective coating, test points and galvanic anodes at various points along its length. If these are broken or damaged, it should be reported to the gas utility immediately. They are easily rectified but can be extremely difficult to locate if the damage is not reported.

4.6 WATER AND SEWER PIPES

4.6.1 Pipeline types

Cast iron and steel pipes are often joined with lead. These and asbestos pipes are easily disturbed and brittle. Mild steel and ductile cast iron pipes have external protective coatings which, when damaged, significantly reduce the life of the pipes. Copper pipes are very soft and easily compressed or bent without necessarily breaking, but their flow capacity can be significantly reduced. Recycled water areas have dual pipe and service systems.

The water supply system in residential areas has traditionally formed part of the multiple earth neutral (MEN) system of the electricity distribution network. More recent use of PVC and polypropylene materials may adversely impact the MEN system. Refer to Section 5 for more information.

4.6.2 Depth and location

Water authorities, developers and local councils maintain records of pipeline locations.

As with other assets, there can be great variations in pipeline depths, depending on their age and the amount of surface reconstruction over the years. More recently, some water assets have been co-located with other assets in shared trenches. This raises the potential problem of simultaneous damage to several assets.

Some pipes may be encased in concrete to provide added support and protection.

4.7 TELECOMMUNICATION CABLES

Telecommunications cables developed for underground installations have changed in line with technology requirements.

Plans provided by Telstra are circuit diagrams only and indicate the presence of telecommunications plant in the general vicinity of the area shown. Due to the nature of the Telstra plant and the age of some cables and records, it is impossible to ascertain the location of all Telstra plant from plans. Telecommunications plant seldom follow straight lines and careful on site investigation is essential to uncover and reveal its exact position.

4.8 ABANDONED AND RETIRED UNDERGROUND ASSETS LEFT IN-SITU

In cases where assets are no longer to be utilised and are to be left in-situ, they are to be disconnected and/or filled, capped, plugged or otherwise rendered safe to avoid any future problems.

All such assets shall be consistent with the following points:

- treated as in-service unless otherwise positively proven out of service
- marked accordingly on the appropriate asset record
- if out of service retired or abandoned assets etc are to be interfered with, the owner of the asset should be contacted and arrangements made to locate the asset
- an asset shall not be used by others without prior agreement with the asset owner. This is so that both organisations' records can be updated
- where an asset is inserted inside an out of service, retired or abandoned conduit, pipe or duct, the records shall show this information
- if assets are sold or disposed of to another owner, then both organisations records should show such information.

4.9 TABLE A: THE INSTALLATION OF VARIOUS TYPES OF UNDERGROUND ASSETS

Assets have been installed underground over the last 150 years. Therefore you may come across a large range of pipe and cable materials, their installation technologies and protection barrier methods. The table below gives an overview of these different techniques. It is not a complete list and it should be remembered that you may come across underground assets that have no barrier protection or other indication of their presence, for example underbores.

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
Electrical cables (power, rail and tram)	Transmission: Extra High Voltage (EHV) Distribution: High Voltage (HV) and Low Voltage (LV) Supervisory and signalling cables	Buried direct, conduits (orange PVC), ductlines, concrete encased, fibro asbestos cement, steel, earthenware or encased in bitumen Protective covers bricks/tiles, terracotta, concrete, polymeric Marker tapes – polymeric	Direct burial in trench, ducts Some thrust boring across roads Marker tape – polymeric Protective covers – polymeric and concrete Surface markers	Trench-less technology including directional drilling Conduits installed by directional drilling. Variations in alignment and depth may occur. Multiple conduits can be installed using this method
	Cathodic protection	May be direct buried	Nil	
	Earthing rods and conductors	Direct buried	Direct buried	
	Conduits and ducts	Orange PVC	Orange PVC	
	Power poles and lattice towers	Risk assess to ensure that 1) structure will not be undermined and 2) cable is not coiled around base of pole		
Gas pipelines	Transmission	Coal tar enamel (warning contains asbestos) coated steel pipe Blue polyethylene coated steel pipe	Yellow polyethylene coated steel pipe Red fusion bonded epoxy coated steel pipe Construction techniques included trenching, cased boring, horizontal directional drilling	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
	Distribution High Pressure	Blue polyethylene coated steel pipe Yellow polyethylene coated steel pipe	Yellow polyethylene coated steel pipe Construction techniques included trenching, cased boring, horizontal directional drilling	High density polyethylene yellow stripe/black pipe
	Distribution Low Pressure	Tar coated wooden pipe Cast iron pipe Blue PVC pipe	Yellow nylon pipe Medium density yellow polyethylene pipe High density polyethylene black and yellow stripe pipe Insertion of disused cast iron pipe with nylon or polyethylene pipe Construction techniques included trenching, cased boring, horizontal directional drilling	
	Consumer services	Cast iron pipe Galvanised steel pipe	Yellow nylon pipe Medium density yellow polyethylene pipe High density polyethylene yellow stripe/black pipe Insertion of disused cast iron or galvernised pipe with nylon or polyethylene pipe Construction techniques included trenching, grundamat boring, horizontal directional drilling	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
Water mains and services	Pipes 15 mm to 3000 mm, valves, hydrants, chambers	Cast iron, steel, cement coated steel, asbestos cement, copper, glass reinforced plastic ductile iron, polyethylene, PVC or concrete encased steel or ductile iron	Pipes usually installed by trenching Pipe cracking and slip lining renewal technique also used Some directional drilling Some thrust boring across roads Surface fittings for access and operation Chambers for valve access	Dual supply mains and services in recycled water areas
	Property connections	Service connections to properties are usually copper in smaller sizes and iron or steel in larger sizes (fire services and industrial)		Dual supply mains and services in recycled water areas
Sewerage mains and services	Pits pipes 15 mm to 1800 mm, tunnels, valves, connections	Cast iron, mild steel, cement lined steel, asbestos cement, copper, glass reinforced plastic, ductile cast iron or PVC, vitreous clay	Pipes installed by trenching Sewer re-lining or replacement using trenchless technologies (eg pipe cracking and slip lining)	On site treatment and reuse systems Jointless systems
Stormwater, grey water and drainage pipelines and services	Pits pipes 15 mm to 1800 mm, tunnels, shafts	Cast iron, mild steel, cement lined steel, asbestos cement, copper, ductile cast iron or PVC reinforced concrete	Installation generally by trenching	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
Communications cables	Phone lines	Fibro asbestos cement (FAC) pipes and ducting. Galvanised iron (GI) pipe – various diameters Rocla concrete pipes Earthenware pipe Tunnels – Sydney CBD and servicing some other major telephone exchanges White PVC pipe 10 mm to 100 mm internal diameter Black PVC Directly buried cables PVC or armored steel sheath Polyethylene	Because of the long operational life of conduits, cables providing new technology services are often hauled into existing conduits All new standard conduit installations are white PVC of internal diameter 20 mm – 100 mm. Galvanised iron (GI) conduits are used for special purpose applications Conduits installed by directional drilling. Variations in alignment and depth may occur. Multiple conduits can be installed using this method Direct drilling technologies	Conduits installed by directional drilling. Variations in alignment and depth may occur. Multiple ducts can be installed using this method
	Co-axial, data and signalling cables	As above	As above	
	Broadband, copper and fibre optic cables	As above	As above Directly buried fibre optic cables will generally have been installed with marker tape above the cable containing a metallic wire Fibre Optic cables in conduits are installed by directional drilling technologies. They do not have marking tapes installed above the cable. In this case there may be no metal marking tapes installed	

Utility/Industry	Asset	Traditional Techniques	Current Techniques	New Technologies
	Conduits and ducts	As above	As above	
Oil transmission pipelines and valves	High Pressure (above 1050 kPa) Regularly signposted	Coal tar enamel (warning contains asbestos) coated steel pipe AS 2885-1997. *Pipelines for Gas & Liquefied Petroleum*	Yellow polyethylene coated steel pipe	
Privately owned pipelines	Chemical	Mostly similar to oil and gas transmission pipelines above (WorkCover Dangerous goods pipelines) Regularly signposted.		

Note: It is essential to treat a cable or pipe as high voltage or high pressure until it has been positively identified as being otherwise.

5. HAZARD IDENTIFICATION

5.1 SAFETY INFORMATION

Consideration must be given to the safety of individuals and the community, especially to provide adequate safety barriers and safe pedestrian access around the worksite. Additionally, PPE applicable to the particular operation must be used.

Excavation within the zone of influence may destabilise the underground asset or supporting structures resulting in damage to the asset.

5.1.1 Some of the dangers when working near underground assets

- *Gas*

  Damage to gas assets can cause gas escapes which may lead to fires or explosions if an ignition source is present. There are two types of leaks following damage to the asset:

  - damage which causes an immediate escape. In this case, there is a risk to those working at the site
  - damage which causes an escape some time after the incident. This may be through damage which weakens the asset casing or the result of poor reinstatement practice. In this instance, the public is mainly at risk.

- *Electricity*

  - an injury resulting from damage to live electricity cables is usually caused by electric shock or the explosive effects of arcing current and by the fire or flames which may follow when the sheath of a cable is penetrated by an object. Damage and injury may also occur if the cable is crushed or contact is made between the individual phases of a cable. The presence of gas or a mixture of gases in a trench could be ignited by an electrical charge or an electrical arc resulting in a fire or explosion, the severity of which depends on the gaseous mixture
  - gas can be present in the ground due to gas pipe damage or leakage, sewage pits, chemical reactions or leaching and the accumulation of airborne gases in low lying areas. Gas can also be introduced by the nature of the work being undertaken such as oxy-acetylene cutting or chemical grouting
  - consideration should be given to conducting a risk assessment to determine if a trench or the work constitutes a confined space.

- *Petroleum or oil pipelines*

  - the result of damaging these assets is similar to that of gas assets. However, there is the additional risk of significant environmental issues such as contamination of waterways.

- *Water pipes and sewers*

  - some pipelines transport water under high pressure. Some older water pipes are also made from asbestos cement. Damaged water pipes have great potential to affect other assets and structures, either directly or by washing away their supports ie thrust blocks

- the main danger from sewer damage is the contamination of a broken water main or asset, damage to the environment or disease from exposure to sewage. Some sewer lines are high pressure. Toxic and explosive gases may also be present in both sewer lines and stormwater drains
- persons working on metallic water pipes are at risk of electric shock due to an electrical fault near a customer's premises or a mains neutral fault in the street. Metallic water pipes are usually bonded to the electrical earthing system and are a path of low resistance. Stray electrical current will often flow through the bonded metallic water pipe. When the pipe is cut or disconnected, either side of the pipe could become live causing a person to receive a serious or fatal electric shock. The consumer is also at risk of an electric shock under the same circumstances.

- *Telecommunications*
  - consequences could be the isolation of whole communities, disruption of interstate and international telecommunications, inability to contact emergency services, loss of telephone, mobile phone, data and television services
  - cables containing optical fibres carry light signals generated by Class 3B lasers that can cause injury to the eye. This infra-red beam is invisible to the naked eye and exposure to it should be avoided. Small optic fibre particles are capable of entering the bloodstream causing injury or death.
- *Pipelines containing hazardous substances and dangerous goods.*

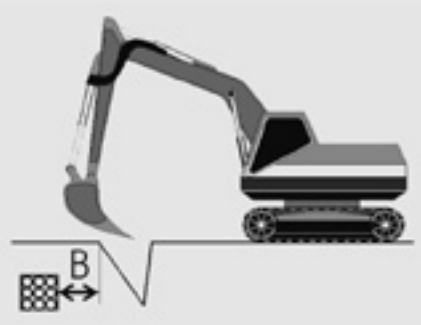
5.1.2 Safety considerations for Low, High or Extra High Voltage electrical cables

- High voltage (HV): same as for low voltage except the approach distances are variable. For more information refer to Table B.
- Extra high voltage cables (EHV): all work in the vicinity of extra high voltage cables must be undertaken with the consent and under the supervision of the asset owner. Contact with extra high voltage electric current will result in serious burns and/or death. For more information refer to Table B.
- Notwithstanding any guidance on the use of blasting as a means of excavation, where blasting is to take place within 200 m of an underground asset, the asset owner should be contacted for any special requirements.

5.1.3 Electrical earthing of metallic pipes

Prior to the removal or the repair/replacement of metallic piping, workers must ensure that an effective electrical bond across the break is maintained at all times.

5.2 TABLE B: TYPES OF ASSETS AND LIMITS OF UNDERGROUND APPROACH

Assets	Clearances	No Go Zone For Powered Excavation	Controls	Typical Depths
Types of underground assets **(Note:** The owners of assets registered with the Dial Before You Dig service and covered by this Guideline require an enquiry through this free service and the compliance with any directive issued with information regarding the asset)	The minimum approach distance for individuals carrying out work near underground assets	Distance 'B' is the minimum approach distance for powered excavating machines  For directional boring across the line of an asset a minimum clearance of **300 mm** from the asset shall be maintained For directional boring parallel to the asset and at the level of the asset, a clearance of **500 mm** shall be maintained from the edge of the nearest asset. It may be necessary to dig trial holes to prove the location of the nearest asset at points along the route. See Section 6.10	If the risk assessment identifies a potential risk of making contact with both underground and overhead assets, two safety observers would be required. One observer to ensure that the machinery maintains a safe distance from underground assets, the other observer to ensure a safe distance from the overhead powerlines In the case of gas or electricity assets, an appropriate fire extinguishing system must be at the worksite If the width and/or depth of the excavation will expose the asset, the asset owner must be contacted prior to commencing work	

Assets	Clearances	No Go Zone For Powered Excavation	Controls	Typical Depths
Low and Medium Pressure services and Low pressure mains	N/A	**300 mm**	Pot-hole to confirm location of service The position of the asset will not appear on the maps	**300 – 450 mm**
Medium Pressure mains	N/A	**300 mm**	Pot-hole to confirm location of asset The code of practice for shafts, tunnels and trenches, and the guide to dangers of poorly ventilated workplaces Only one individual at a time should be excavating if hand excavation is being undertaken in a confined space. Another should act as an observer and be able to operate any breathing, escape or fire equipment required The elimination of an ignition source in the event of an escape Excavation below underground assets should not be undertaken within a distance of **300 mm** below the asset located at the lowest level **Note:** All transmission pipelines involving gas, oil and petrochemical have separate requirements and the asset owners should be contacted.	**450 – 750 mm**

Assets	Clearances	No Go Zone For Powered Excavation	Controls	Typical Depths
High Pressure services, mains and pipelines	**300 mm** with hand tools and supervision from Network Authority	**1000 mm**	Powered excavation within 300 – 1000 mm is only permitted under supervision and with a Permit to Work from Asset Owner Also see **Controls** for medium pressure mains immediately above	**750 – 1200 mm**
Low Voltage Electricity cables – voltages less than or equal to 1000V (1kV)	Close proximity with use of hand tools	**300 mm**	Must contact asset owner for specific conditions	**450 – 750 mm**
Electricity conductors from 11,000V (11kV) up to 33,000V (33kV)	Close proximity with use of hand tools	**600 mm**	Must contact asset owner for specific conditions	**900 mm**
Underground sub-transmission cables 33,000V up to 132,000V (132kV)	Must contact asset owner	Must contact asset owner	Must be carried out under the supervision of the asset owner	**900 mm**
High Voltage Electricity cables – voltages from 1000V (1kV) up to 33kV	Close proximity with use of hand tools	Must contact asset owner	Must contact asset owner for specific conditions	**600 – 1000 mm**
Extra High Voltage Electricity Transmission cables – voltages above (132kV) and 330,000V (330kV)	Must contact asset owner	Must contact asset owner	Work must be carried out under the supervision of the asset owner	**800 – 1200 mm**
Telecommunications cables	Contact asset owner for specific conditions	Contact asset owner for specific conditions	Must contact the asset owner for specific conditions	Typically **450 – 600 mm**, other assets to **1200 mm**
Water pipelines	N/A	**300 mm** (if pipeline is **200 mm** or greater in diameter)	Pot-hole to confirm location of asset	Min **450 mm**
Sewerage pipelines	N/A	**300 mm** (if pipeline is **200 mm** or greater in diameter)	Pot-hole to confirm location of asset	Between **600 mm** to **10 (ten) metres**

5.3 ON-SITE CHECKING

Prior to any excavation work, check at least 100 m along the footpath in each direction and around nearby corners for indications of existing assets. These include:

- indicators or markers for underground assets, drainage pits and manhole covers
- damaged footpaths, driveways or depressions which may indicate the presence of a trench
- cables running up a pole
- overhead cables near the worksite
- control cabinets
- no overhead wires to a building or premise
- above ground connection cabinets
- transformers for cathodic protection on power poles
- light poles without an overhead service
- service pits for gas, water, electricity, communications, sewerage and drainage connections
- down pipes or vent poles
- underground storage tank fill points and venting systems
- kerb markings
- water valves
- fire hydrants and plugs
- sprinkler systems
- road repairs
- trap doors or access-covers for:
    - access to underground electricity substations
    - access to cable jointing pits or tunnels
    - access to sewerage or stormwater trunks
    - access underground gas regulators, siphons and valve assemblies
    - access to shafts
    - link box pits, oil tank pits and other ancillary underground pits.
- domestic service pits
- gas or water meters
- electricity pillars and meter boxes
- any other signs out of character with the surrounding area such as a clearing for an easement.

If such indications exist, the asset must be located by hand or another approved method.

5.4 PLAN OR DRAWING READING

Although each asset owner may have their own type of plan, with special notations and legends, the basic principle of map reading can be applied.

Telecommunications plans, and in some cases electrical plans, may provide a detailed representation of the asset or network. When reviewing the information:

- identify the streets or buildings nearby and position yourself so the streets correspond with the plan/s
- use the scale and measurements indicated on the plan/s to pinpoint your exact location
- remember, drawings may NOT be to scale
- many plans reference the asset location from an adjacent property alignment
- determine if measurements are metric or imperial, or a combination of both
- identify nearby pipes or cables and mark their recorded location
- cross-reference any supplementary plans or details
- identify any of the items listed below and assess their relationship to each other to determine if a measurement has altered:
    - building lines
    - pits and poles
    - offsets
    - turning points.

Note: Inaccuracies can and do occur, both on plans and in the ground. If in doubt, check with the asset owner. Never guess or assume!

Asset owners' plans show only the presence of some cables, pipes and plant. They only show their position relative to road boundaries, property fences etc at the time of installation and the utilities do not warrant or hold out that such plans are accurate thereafter due to changes that may occur over time. DO NOT ASSUME DEPTH OR ALIGNMENT of cables or pipes as these vary significantly. For example, road and building alignments and levels may change.

6. MANAGING THE RISKS

6.1 MANAGING RISKS IN THE WORKPLACE



Employers and self-employed persons must identify any foreseeable hazards, assess their risks and take action to eliminate or control them.

A hazard identification and risk assessment process must be carried out at the planning and preparation stage by the employer/contractor doing the work to determine what risks may arise when the work is being carried out. Safe systems of work must then be put in place to eliminate or control these risks. For tunnel construction work the safe system of work must also be documented in a Safe Work Method Statement (SWMS).

6.1.1 Monitor and review risk assessments and control measures



The OHS Regulation states that employers must review risk assessments and measures adopted to control risks whenever:

- there is evidence that the risk assessment is no longer valid
- an injury or illness results from exposure to a hazard to which the risk assessment relates
- a significant change is planned to the place of work, work practices or work procedures.

6.1.2 Safe work method statements (SWMS)



The OHS Regulation requires SWMS where the cost of the work undertaken exceeds $250,000 or for defined high risk construction work. Construction work in tunnels is defined as high risk construction work, so tunnelling work requires a SWMS.

The SWMS:

- describes how the work is to be carried out
- identifies the work activities assessed as having safety risks
- identifies the safety risks
- describes the control measures that will be applied to the work activities. It also includes a description of the equipment used in the work, the standards or codes to be complied with, the qualifications of the personnel doing the work and the training required to do the work.

A SWMS requires the work method to be presented in a logical sequence. The hazards associated with each process are to be identified and the measures for controlling these hazards specified.

Break down each job into a series of basic job steps to identify the hazards and potential accidents in each part of the job. The description of the process should not be so broad that it leaves out activities with the potential to cause accidents and prevents proper identification of the hazards.

Employees of the workforce should be involved/consulted in the development and implementation of any SWMS.

All persons involved in carrying out the work should understand the SWMS before commencing the work.

6.1.3 Consultation with relevant parties prior to commencing work

The planning before the start of work, which may affect a utility asset, must include but not limited to:

- consultation with local councils
- consultation with asset owners to obtain agreement on the use of out of service, retired or unused assets
- advising affected residents/occupants
- obtaining permit requirements and conditions for undertaking the works
- identifying and determining exact location of assets
- establishing methods to be adopted to protect existing assets
- further consultation as required by the scope of works
- consultation with 'Dial Before You Dig' and the asset registers of other infrastructure owners not registered with 'Dial Before You Dig'
- consultation with roads authority (eg RTA, local council or private body)
- consultation with local councils in terms of storm water assets and work in council owned roads.

Where underground assets exist, the precise location of the assets shall be established in conjunction with the asset owner by pot-holing (or equivalent non-destructive asset location techniques) prior to the principal excavation commencing.

Consideration must be given to the presence of private property assets eg telecommunications, gas, stormwater, sewerage and water assets. These private property assets are unlikely to be found on any plans and are best identified by a visual on-site inspection.

The use of an Electronic Service Detection Device to survey the ground for buried pipes and cables, before commencing excavation, should be considered.

The close out process of the project or scope of work may typically involve recording the 'as constructed' diagram of the asset and providing this record to the appropriate agency with details of:

- finished surface level
- depth of asset
- alignments from property boundary and/or kerb etc
- type of cover or warning device installed eg warning tape, concrete slab, mechanical polymeric protection strip etc
- new ownership details of the asset
- assets retired, removed, declared out of service etc
- type, size, location and installation method of assets

- surface and underground markings installed
- advice to any authorities, agencies etc on the completion of the project or scope of works
- cancellation of any permits, authorities etc
- the provision of a copy of the asset plans to the new owner.

For more information on how to safely dig near an asset, specific information is provided on the Telstra website via the following link www.telstra.com.au/dialb4udig/digging.htm Excavation with hand tools shall be carried out carefully up to but not closer than the minimum distances specified in Table B.

6.1.4 Planning and liaising with other authorities

When planning, it is important to discuss and consider the following areas:

- existing utility assets
- duration of the project and scope of works
- future planned assets
- opportunities for coordination of works
- shared trenching opportunities
- thermal impacts on EHV electricity assets
- changing ground surface levels
- installing heat sources (eg other electricity assets)
- creating underground voids (eg stormwater assets)
- changing backfill materials
- possible limitations in information available
- opportunities to improve information availability
- effect on traffic
- opportunities to isolate or relocate existing assets
- provision of visual identification devices
- asset owner and other authorities' concerns, conditions and expected working procedures
- any requirement/s for the worksite involving:
    - access to assets
    - permit conditions
    - recording of infrastructure, assets locations or relocations
    - financial costs
    - individual, asset or community safety
    - worksite and traffic management requirements and railway safety management requirements
    - reinstatement requirements (this liaison is in addition to the statutory notification required by legislation).

Consideration must be given to the operation of heavy plant over potentially fragile underground assets.

6.2 RAILWAY ASSETS

Rail easements have numerous electrical power, signalling, communication cables, compressed air and drainage lines that are owned and maintained by the Rail Authority. These assets vary in type of construction and are documented to various degrees of accuracy.

Numerous utility service providers and other private parties also jointly use the rail easement. Access to the rail easement is strictly regulated by the requirements of AS 4292.1: 2006 and AS 4799: 2000.

Access to information relating to the location of the various rail assets is issued on application.

6.3 SERVICE TUNNELS

Many utilities own or share service tunnels. These will have shafts plus manholes at the surface or other surface infrastructure supporting the tunnel environment.

6.4 EXCAVATION AND TRENCHING

To maintain essential structural support and the protection of other existing assets, excavations in the vicinity must not disturb the embedment around each asset (see Table B for minimum approach distances and to identify if the asset owner must be contacted for specific approach conditions). This information should be supplied by the asset owner through a 'Dial Before You Dig' request. Where this is not possible, the relevant asset owners must be consulted and their permission first obtained.

- If a cable or pipe is exposed, the contractor must ensure that any angular material such as rock or gravel does not mix into the embedment material
- Excavations in any easement must be backfilled, compacted and re-sealed to the appropriate Authority's standard at the completion of excavation
- Temporary restorations in roads and footways must be of sufficient quality to ensure the safety of pedestrians and vehicles until the final restoration is undertaken. Temporary restorations must be regularly checked by the responsible party to confirm their integrity
- Refer to NSW Code of Practice, *Excavation*
- Refer to:

  AUS-SPEC 306U *Road Openings and Restoration* (2004 and earlier additions)

  AUS-SPEC 7200 C0219 *Construction – Roadways – Road openings and restorations for utilities* (2007).

6.5 ASSETS NEAR BRIDGE APPROACHES

Often underground assets will be congested at the approach to bridges. Assets' typical depths may vary substantially, rising and falling sharply and at much shallower depths than elsewhere as they are channelled into shared allocated spaces on the bridge. Road safety barriers are often very close to heavily congested services at the approaches to bridges. Construction staging and footing design for such barriers should consider impacts on assets and, where possible, construct barriers prior to constructing the assets.

6.6 ASSETS AROUND POLES

Unless otherwise agreed, underground assets and other obstructions around poles are to be kept a minimum distance of 300 mm from the periphery of the pole, to allow inspections by asset owner staff.

No excavation within 10 metres of a Single Wire Earth Return (SWER) transformer pole is to occur without the approval of the local electricity asset owner.

It should be noted that the NSW Service and Installation Rules require a sketch of the underground service/consumers mains to be marked inside the switchboard.

6.7 TRAFFIC CONTROLS

All work carried out on RTA NSW controlled roads must be done in accordance with the RTA's *Traffic Control at Work Sites Manual.* As this manual is considered to be the benchmark for traffic control in NSW, **all** works carried out within the road corridor or on adjacent pathways should be conducted in accordance with this manual.

6.8 EMERGENCY WORK

While there will be times when, due to pressing requirements, the timeframe for starting work will prevent some of the normal controls from being completed, this will not diminish the responsibility of worksite controllers to do everything that is reasonable and practical that is within their power to ensure the health, safety and welfare of persons affected by their actions.

6.9 VERTICAL BORING

For any boring within 500 mm of an underground asset, the location of the asset/s shall first be proved by careful hand digging (pot-holing) or equivalent asset location techniques and:

- a minimum clearance of 300 mm from the edge of the underground asset shall be maintained for pole hole boring
- lead in excavations shall be used.

Note: All transmission assets including EHV electricity cables, pipelines involving gas, oil and petrochemicals have separate requirements and the asset owners should be contacted.

6.10 DIRECTIONAL BORING

- When boring across the line of an underground asset, the location of the asset/s shall be positively proven by hand digging (pot-holing) or proven by another approved method.
- All transmission pipelines involving gas, oil and petrochemicals have separate requirements and the asset owners should be contacted.
- For boring under electricity cables, it is necessary to excavate a slit trench beside the cables to confirm the depth of the cables and ensure the drill is not within the minimum approach distance of the cable specified in Table B.

- Additional precautions and clearances are required for directional boring near or beneath sub-transmission cables, normally located in roadways. If the bore is to pass within 2 metres of any electrical cable or conduit the asset owner must be notified as the clearances for HV and EHV may be significantly greater.

  See Table B for further information on clearances.

6.11 MECHANICAL EXCAVATING PLANT

Reference should be made to WorkCover's *Moving Plant on Construction* Sites code of practice.

Mechanical excavating plant may be used with care up to, but not closer than, the minimum distances as specified in Table B.

- Where the excavation is being carried out parallel to or across underground asset/s, location of the asset/s must be proven by careful hand tool excavation (pot-holing) or another endorsed method used to positively locate the asset prior to mechanical excavation.
- If an excavation must exceed the depth of the asset and will disturb the protective cover, slab, other asset/s or the bedding material around the asset/s, the asset owner/s must be contacted to determine if the asset/s is to be relocated.
- Excavations must be reinstated to comply with the asset owner's requirements.
- **Where plant is required to operate over underground assets, such as in major road reconstruction, the clearances as specified in Table B must be maintained. Alternatively, if Table B cannot be complied with, the asset can be mechanically protected by an engineered structure agreed to by the asset owner.**

Note: All transmission cables, pipelines and petrochemical networks may have separate requirements and the asset owners should be contacted before commencing work.

6.12 EXPLOSIVES

The use of explosives by licensed operators must only be used after a comprehensive risk assessment has been undertaken in consultation with all owners of assets in the vicinity and must be consistent with the requirements of the *Explosives Regulation 2005.*

6.13 PILE DRIVING

Pile driving adjacent to underground assets must not take place without authority from the owner of the assets. The exact location and depth of all adjacent assets shall be physically proved by hand digging (pot-holing) or equivalent asset location techniques prior to commencement of work.

The effects of vibration on the asset must be considered when planning the work.

6.14 IDENTIFICATION OF ASSETS NOT ON PLANS

Where an asset that is not identified on any plans etc is located in the field, work should be suspended until the asset is positively identified and any remedial controls put in place. Depending on the nature of the risk, it may be necessary to notify the asset owner and obtain a revised plan.

6.15 ASSET SEPARATION DISTANCES

To avoid safety and operational conflicts resulting from space infringement issues, refer to the Street Allocation Diagrams in Section 13.

7. SAFE SYSTEMS OF WORK

A critical part of planning safe systems of work is making sure that the plans are accurate. With some assets installed over 60 years ago, it is likely that changes would have been made to the surface of the land at some stage. Road widening and regrading of surfaces are common causes for inaccuracies in records. For this reason, when working from old records, pot-holing and/or pipe and cable locating devices should be used. The relevant authority or asset owner should be told of any inaccuracies in records.

Asset owners typically require notification of a major project or where the project may require supply of a service or product outside normal residential demand.

A safe system of work should be sufficiently robust to include site controls that will ensure assets on construction sites are not damaged. All those who dig the ground should be aware of the assets in the area before they dig and have appropriate controls in place. Particular attention needs to be given to relocated assets and persons new to the site to ensure they are aware of the assets and their locations.

At the project planning stage it is important to consider minimising damage to surface infrastructure and disruption of services to residents, pedestrians and traffic. Any construction or maintenance technique should ensure adequate clearances are maintained between assets and that other assets crossings are identified.

Access to assets must be maintained at all times to ensure emergency and scheduled maintenance activities can be carried out by the asset owner. Contractors should also give consideration at the planning stage for site storage of material and traffic areas associated with construction activities so these do not impede access to or damage assets.

Consideration should also be given to the appropriate level of supervision and training, including specific industry awareness training, for an individual undertaking work near any gas or electrical assets.

7.1 EXCAVATION USING NON-POWERED HAND TOOLS

For more information on how to safely dig near an asset, specific information is provided on the Telstra website via the following link www.telstra.com.au/dialb4udig/digging.htm Excavation with hand tools shall be carried out carefully up to, but not closer than, the minimum distances specified in Table B.

There is a duty of care when excavating near cables, pipes and plant. Before using machines to excavate, **underground assets must first be exposed by pot-holing** with **non-conductive** tools to identify its location. Damage can also result in serious injury or death to workers and widespread disruption to services and traffic.

7.1.1 Work on top of or below an underground asset

No disturbance of the underground assets, including any mechanical cover (eg concrete or polymeric cover slab), should occur without prior notification to the asset owner.

Excavation must not be carried out below an underground asset unless steps are taken to ensure that:

- the asset/s or the integrity of the asset and support material is not damaged

- under-crossing shall be at right angles whenever possible
- such excavation below the asset/s should not come within the distance specified in Table B.

  Note: all transmission cables, pipelines and petrochemical networks may have separate requirements and the asset owners should be contacted before commencing work
- steps must be taken in consultation with the asset owners to ensure the asset is adequately supported.

  Note: Also see Section 6.10 Directional Boring.

7.1.2 Work beside an underground asset

If any excavation beside underground assets comes within the clearances specified in Table B, then the asset owner must be notified prior to work commencing. Measures should be agreed upon to ensure the stability of the surrounding soil or material.

7.2 ACCIDENTAL CONTACT WITH UNDERGROUND ASSETS

In the event of an inadvertent contact with an underground asset, it is essential to notify the asset owner and comply with the reporting requirements under the OHS Regulation (Chapter 12).

7.2.1 Electrical assets

Should contact be made with a live overhead power line or a flash-over occur between a live overhead power line and a crane or an item of mobile plant, the following actions shall be taken:

- an attempt should be made to break the machinery's contact with the live overhead power line by moving the jib or driving the machine clear
- if it is not possible to break the contact with the live overhead power line, the operator of the crane or mobile plant should remain inside the cabin of the crane or on the plant item. The network operator should be called immediately to isolate power to the live overhead power line. The operator must remain in place until the power has been isolated and the 'all clear' given by the network operator



When a crane or item of plant inadvertently contacts overhead power lines, circuit protective devices may operate to automatically turn the power off. However, some protection devices are designed to automatically reclose thereby re-energising the power lines after a short period of time, typically 1–4 seconds.

- if it is essential to leave the cabin or the operator's position due to fire or other life threatening reason, then jump clear of the equipment. Do not touch the equipment and the ground at the same time. When moving away from the equipment, the operator should hop or shuffle away from the plant item (with both feet together) until at least 8 metres from the nearest part of the crane or plant. **Under no circumstances run or walk from the crane or item of plant as voltage gradients passing through the ground may cause electricity to pass through the body resulting in an electric shock**

- warn all other personnel and members of the public to keep 8 metres clear from the crane or item of plant. Do not touch or allow persons to touch any part of the crane or plant item and do not allow persons to approach or re-enter the vehicle until the network operator has determined the site safe. Remember electricity flows through the ground, so an electric shock could be received from walking close to the scene. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site made safe before giving assistance
- untrained, unequipped persons should not attempt to rescue a person receiving an electric shock. All too often secondary deaths occur because others get electrocuted trying to help earlier victims. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site has been made safe before giving assistance.

7.2.2 Gas assets

Should an incident involving gas assets occur, the following actions should be taken:

- all work should cease immediately
- operator is to shut down the plant or equipment UNLESS this process may provide an ignition source for any escaping gas
- it is essential to leave the cab or operator station, trench or enclosure and maintain an exclusion perimeter due to the risk of explosion or fire. Do not attempt to use any instrument which may provide an ignition source near the gas escape. This may include mobile phones, two way radios, etc
- warn all other personnel and/or public to keep clear from the worksite and equipment. DO NOT attempt to approach, re-enter or start the vehicle until the relevant authorities have determined the site is safe
- contact the fire brigade on 000 if life and/or property are threatened
- facilitate First Aid treatment and seek medical aid as required
- advise your organisation's emergency contact and request they immediately notify the relevant authorities, including the relevant asset owner
- initiate the emergency management plan and incident investigation process.

7.2.3 Sewerage assets

Should an incident involving sewerage assets occur, the following actions should be taken:

- cease work, make the site safe and contact the sewerage asset owner as soon as possible. Local circumstances and/or ownership should be considered
- if contaminated, shower or wash down with copious amounts of water. Remove any contaminated clothing as soon as practical
- there is a risk of infection from ingestion or eye contact. If eyes are contaminated, flush with copious amounts fresh potable water. If ingested, seek medical advice
- for skin contact, wash with soap and water. For broken skin and abrasions, also seek medical advice
- protect the public and watercourses from exposure to raw or untreated sewage
- if damage to a sewer pipe occurs during construction works, take appropriate steps to prevent surrounding material entering the pipe.

7.2.4 Water assets

- Cease work, make the site safe and contact the asset owner.

7.2.5 Telecommunications assets

- Report any damage to Telstra assets by phoning **13 22 03**.
- Contact specific asset owner if not owned by Telstra.

7.3 COOPERATION WITH AUTHORITIES

Constructing authorities and others operating in a public road reserve, rail reserve or private property have a duty of care to protect the existing assets of utility providers. It is essential to determine the location of existing assets by obtaining plans and proving the exact location before excavating.

Asset owners may have formal agreements in place describing how work shall be undertaken near each other's assets and these shall be complied with.

7.3.1 Obligations of asset owners and contractors

There is an obligation for all asset owners, contractors and service providers to observe the specifications and separation distances indicated in the Streets Opening Conference diagrams (see Section 13) or those agreed through consultation between asset owners.

All contractors should notify the relevant asset owners if they locate any asset that is not shown accurately on the plans. At no time may an asset be relocated or moved without the prior authority of the asset owner.

7.4 DOCUMENTED SYSTEMS OF WORK

A documented **risk assessment** developed in consultation with those supervising and undertaking the activity is necessary for all activities where excavation and inadvertent contact with underground assets may occur.

A **SWMS** is to be developed in accordance with the OHS Regulation which captures details of the risk assessment and the required training/qualification. All those workers undertaking the activities identified in the SWMS should be made aware prior to commencement of work (eg toolbox talk).

An **excavation permit** is an excellent method of managing the investigation and approval process leading up to the commencement of the excavation. A properly constructed permit will produce a rigorous process that must be followed and completed prior to excavation activities and includes the positive identification of underground assets.

Verification activities such as **audit and inspection** are an excellent means of ensuring that the process has been correctly implemented at a systems level and on the ground before and during the excavation activity.

7.5 TRAINING OF MANAGERS AND EMPLOYEES

Training is an integral component of reducing the risk of inadvertent contact with underground assets.

Managers and supervisors need to be made aware of the hazards and overarching requirements regarding inadvertent contact with underground assets such that they are able to implement safe systems of work and properly plan for and oversee the activities.

Both managers/supervisors and employees will benefit from information and training regarding the use of electronic detection devices, how to use the 'Dial Before You Dig' service and how to read plans supplied by the asset owners and/or 'Dial Before You Dig'.

Employees need to be made aware of the systems in place to minimise the risk of inadvertent contact with underground assets and also the hazards facing them if these systems are not employed.

Site-specific induction systems should include details such as the known location of assets, the site safety rules in relation to excavations (eg no excavations without a permit) and provide inductees access to, or a copy of, the utilities location plan for the work zone.

7.6 ASSET OWNER PLANS AND 'DIAL BEFORE YOU DIG'

A site meeting with the asset owners may be required to determine location/s and procedures for dealing with assets within the scope of work. This issue should be addressed during initial project development to provide time to establish a regime to manage any risks.

Before commencing any excavation work, reference shall be made to the details or plans of the utility or private assets in the proposed excavation area as well as a site inspection to identify any unmarked assets. Plans illustrating the location of known underground assets can be obtained from individual asset owners or the 'Dial Before You Dig' service.

As mentioned, the location of underground assets provided by a service or utility provider may not be accurate for many reasons. As complete accuracy cannot be guaranteed, the position of underground assets must be proven by hand excavation, pot-holing or other approved techniques.

For work in the vicinity of EHV electricity transmission cables it is mandatory to have a meeting with the asset owner prior to any work commencing.

7.7 CABLE/PIPE IDENTIFICATION DEVICES

An electronic pipe or cable locator should be used to more accurately identify the location of the underground asset – as asset owners' plans will not provide exact locations.

Once identified using such electronic device, care should be taken to mark the location of the underground asset on the ground's surface.

7.8 GROUND PENETRATING RADAR (GPR)

Ground penetrating radar (GPR) is emerging within the civil construction industry as an excellent tool for identifying underground assets and mapping assets on a wider scale.

GPR is a non destructive and non invasive technique for rapidly imaging the shallow surface (up to 10 m) and produces high resolution colour section in real time. Parallel images can be used to create a 3D image.

7.9 POT-HOLING

Pot-holing is the use of hand tools to excavate to a pre-determined depth to establish if assets exist in the immediate location. Pot-holing is a proven method of identifying assets.

Never assume that underground assets are positioned in the location as depicted on the plans or in the depth suggested. All underground assets should be positively identified prior to commencing excavation.

Pot-holing should be undertaken along the length of the proposed excavation to identify the path of underground assets and their depth. The information contained on the asset owner's plans and gathered during electronic identification methods helps in this process.

- careful digging (ie pot-holing) is the only sure way to identify the depth and alignment of underground pipes and cables
- pot-holing must be undertaken with reference to plans and other information provided by pipe and cable owners.

The amount of pot-holing should be determined with reference to the risk assessment for the site. Excavators should also pay attention to pot-holing requirements included in work practices provided with the network plans and onsite by a representative of the pipe and cable owner.

7.10 AIR AND WATER LANCING

Air/water lancing techniques may be used in some circumstances, but the advantage of these needs to be assessed against any inherent safety and environmental risks, eg dust generation, contaminated water runoff and possible damage to underground assets.

7.11 TRENCHLESS TECHNIQUES

Pot-holing must be used to locate existing underground assets to ensure adequate clearances are maintained between assets and to locate other asset crossings. Pot-holing at each asset crossing and at regular spacing along assets is recommended.

Where high risk assets are identified, consultation with the asset owner is required. Consultation is also required when using directional boring across existing utility lines. Where clearances required by other assets cannot be achieved at the proposed depth of asset installation, alternative solutions should be sought in consultation with the relevant parties.

It is crucial to provide the "as constructed" details on this type of installation for future reference because:

- the ground above the bore is typically undisturbed, not offering any indication of previous works
- of the inability of directionally-bored installations to provide warning tape or mechanical protection above the asset
- the bore may not follow a direct route.

7.12 SAFETY OBSERVERS

Excavation work around underground assets should only be undertaken with the assistance of a competent safety observer.

The safety observer/s should be given sufficient control of the activity to call for a cessation of work in the event of system failure or observation of unsafe practice which may give rise to an inadvertent contact with an underground or overhead asset.

When excavating near or adjacent to underground assets it is important to be aware of overhead hazards such as overhead powerlines. Risk assessment may dictate a requirement for more than one safety observer for such activity, eg one observer to mitigate inadvertent contact with underground hazards and the other to mitigate inadvertent contact with overhead hazards.

7.13 CONFINED SPACES

Excavations are generally not confined spaces. However, confined space provisions may apply to certain excavations where the excavation enters foul or contaminated ground or opens a live sewer. Also, where the atmosphere can be altered by exhaust gases or other contaminants, the excavation is to be treated as a confined space. Further information is given in WorkCover's *Code of Practice: Excavation,* Section 4.

7.14 GLOBAL POSITIONING SYSTEM (GPS)

GPS technology provides an excellent opportunity to plot the location of underground assets and maintain that information for the duration of the project. This is especially important in maintenance and long term projects.

GPS locations, when captured, should be noted on relevant plans. This information should also be provided to asset owners for any as built/modified infrastructure or previously unidentified underground assets.

7.15 ABOVE GROUND IDENTIFICATION DEVICES

Previously in this document, many above ground identification devices have been discussed that may assist identifying underground assets.

The Western Sydney Orbital Project (M7) successfully implemented a process where different coloured conduits (according to the nature of the asset) were temporarily inserted into the pot-hole directly onto the underground asset. These conduits, when back filled, extended approximately 1-1.5 metres above the ground and were plugged on top to prevent dirt and debris entering the conduit. These above ground locators enabled easy visual identification of the path of known underground assets and, when a measuring tape was inserted into the conduit, provided the exact depth of the asset.

8. TRAINING, INSTRUCTION AND INFORMATION



The OHS Act requires employers to provide such information, instruction, training and supervision as may be necessary to ensure the health, safety and welfare of their employees while at work.

In addition, some activities are restricted to persons holding the relevant certificate of competency, for example scaffolding and operation of cranes and some load shifting equipment. See the OHS Regulation or the *Industrial Certification Manual* for a full list of such activities.

8.1 TRAINING REQUIREMENTS

In addition to the requirements of construction training, all persons undertaking work involving underground assets must be instructed, trained and assessed as competent for the tasks they are undertaking.

Training includes but is not limited to:

- induction
- general health and safety induction training
- work activity health and safety induction training
- site specific health and safety induction training (Clause 216 OHS Regulation)
- risk assessment methodology
- training in the use of SWMS
- plan/map reading
- utility specific statutory training.

8.2 INDUCTION TRAINING



The OHS Regulation requires that employees receive OHS induction training, including general health and safety induction training, work activity based induction training and site specific induction training, and that this training covers the topics set out in the *Code of Practice: Occupational Health and Safety Induction Training for Construction Work 1998.* The training must cover the following points:

- arrangements for the management of OHS, including arrangements for reporting hazards to management
- health and safety procedures relevant to the work of the employee, including the use and maintenance of risk control measures
- how to access any health and safety information that the employer is required to make available to each employee
- any other induction training relevant to the place of work (eg confined spaces entry training), having regard to the competence, experience and age of the new employee.

8.3 TRAINING TOPICS

Training should draw on knowledge of the known hazards and risks in your operations, including matters described in this Guideline. The source of risks should be pointed out and the adverse outcomes that have been experienced by others should be used to stress the importance of safety.

The training provided and the instruction given should at least include all safe work methods to be used on the job and matters described in this Guideline, that is, all hazards, risks and control measures for control of hazards.

8.4 WHO SHOULD RECEIVE TRAINING?

The target groups for training at a workplace include but are not limited to:

- managers and supervisors of employees and/or other persons undertaking work considered at risk of injury and/or who have responsibility for implementing safe operating procedures
- OHS committees and OHS representative/s
- staff responsible for the purchasing and maintenance of plant, PPE and for designing, scheduling and organisation of work activities
- persons undertaking risk assessments or preparing SWMS
- employees and subcontractors undertaking the work, including employees of labour hire organisations.

As the needs of each target group are different, the content and methods of presenting training material should be tailored to meet the specific needs of each group.

8.5 PROVISION OF INFORMATION AND INSTRUCTION

Information may include:

- the results of any applicable risk assessment
- SWMS
- a review of such a risk assessment and/or SWMS or operating procedure
- any other relevant OHS information.

Employers should brief each employee as to the contents of risk assessments and SWMS when each employee and/or other person first begins to perform tunnelling work, at regular intervals thereafter, and whenever there are changes to risk assessments or new information about health and safety risks becomes available.

Employees and other workers should have, on request, ready access to risk assessments and SWMS.

9. CASE STUDIES AND CHECK LISTS

9.1 REPAIRING SEWERAGE PIPES

A reactive dig and repair job was commenced by a work crew of a sewage and drainage authority following the internal surcharge of a sewer line at a preschool adjacent to the worksite. CCTV was used to identify the repair location of the sewer. Damage to the sewer pipes apparently occurred during the laying of electrical conduits approximately 20 years ago and a contractor had carried out a repair of that damage. The repairs appear not to have been referred back to the responsible sewerage authority and eventually resulted in the internal surcharge at the preschool.

The work crew did not find indicator plates or markers identifying underground power in the immediate area, and, because locating equipment was not readily available, made a decision not to delay the work and to commence excavating with a mechanical excavator. The excavator uncovered bricks marking an electricity asset directly over a conduit. Marker tape was found but was not immediately obvious.

An incident was declared by the work crew and work stopped when the conduits were uncovered. The asset owner was called to the site and supervised the remainder of the repairs. An insulated spud bar was used to break up concrete that was placed around the pipe in the original repair. The pipe was replaced, work completed and the excavation backfilled. The incident was reported as a near miss.



The hazards shown here include a broken sewer pipe and high voltage cables.

The risks were electric shock, contaminated and hazardous atmosphere (from sewer gases) and possible infection.

Failure to identify the presence of these cables before work commenced exposed the workers to the risk to health and safety.

Once the risk was identified, the controls included the use of insulated tools to excavate under the supervision of an authorised person from the asset owner.

9.2 COUNTRY TELECOMMUNICATIONS CABLE DAMAGE CASE STUDY



At this location, a contractor working for a telecommunication carrier performing combined pre-ripping and plough operation to install new optic fibre cable, damaged the Telstra major interstate fibre cables.

The new route was being installed through rural paddocks and properties by D7 dozer and trenching machinery. The route was being installed parallel to the existing Telstra major fibre route.

At the manhole, approx 20 metres from the damage location, a 30 fibre cable, 16 fibre cable and a 30 pair copper cable left the manhole at right angles following the fence line. The contractor failed to identify the break off from the manhole shown on the plans. These cables were subsequently damaged during the pre-ripping procedure near the fence line.

The contractor believed the main cables where in another location, the one they had been following, and they had not noticed the manhole (located approximately 20-30 metres from the pre-ripping process) until after the damage had occurred. Two markers on either side of the manhole were clearly visible from a distance.

Site observations

- The Telstra fibre cable route was clearly marked with Telstra yellow concrete markers, which was easily visible.
- The manhole was marked with a yellow concrete marker post at either end of the manhole.
- The cable route was clearly shown on Telstra plans that the contractor obtained from the 'Dial Before You Dig' service.
- There was no visible sign of asset location (pot-holing) on the ground such as markers, paint, peg lines, markings on the ground etc.
- There were deficiencies with the safe system of work used on the project.

9.3 CITY TELECOMMUNICATIONS CABLE DAMAGE CASE STUDY

A contractor in the west of Sydney drilling pier holes for the construction of townhouses caused significant damage to telecommunication cables resulting in severe disruption to telecommunication services in country NSW.

An auger operated by an excavation contractor made a direct hit on a telecommunications cable route. Thousands of telephone lines, mobile phone towers, EFTPOS terminals and data lines went dead all over NSW instantly.

The auger, a giant drill, severed six fibre optic cables running between 12 and 60 fibres each and a 2400 copper pair cable, about seven kilometres from the Parramatta exchange.

Physical cable damage was not confined to the one hole in the ground – it wrenched and ripped cables clean out of manholes for hundreds of metres on either side.

One of the cables was the main feed to the Bathurst and Orange area, others carried mobile phone traffic. Almost all the copper lines were in use by local households and businesses and, not least of all, the main ATM (asynchronous transfer mode) internet backbone running to the south and west out of Sydney. At one ISP alone, more than 100,000 customers across four states were unable to log on to the internet for hours. Also 250,000 Foxtel service subscribers were disconnected, some for nearly 12 hours.

It was not just the phone services that went down. EFTPOS services died, and staff from a Bathurst supermarket were reduced to hunting around other businesses for manual transfer forms for more than a day so customers could buy groceries and debit their bank accounts. E-mail access in Bathurst was out too.

Had the 'Dial Before You Dig' service been contacted on 1100 and the appropriate plans used, the damage could have been avoided.

If there is any doubt at all about cable location, Telstra will send staff to show contractors and property owners how to check for stray lines. However, there was no call placed to the 1100 service for this damage.

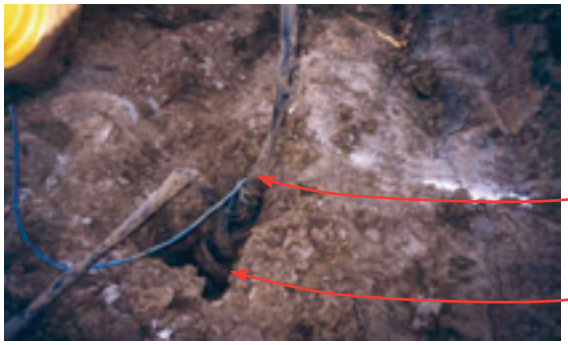
When people in west Sydney picked up their phones and found no signal, they might have expected their mobiles or other carrier services to fill the gap. But Telstra, Optus, AAPT, Vodafone and Primus were all affected to some extent.

This incident was the cable cut of all cable cuts, but cut and flooded cables take down parts of the telephone and data network every day.

It took 50 technicians until 11.00 that night just to restore all the services, and two-and-a half days to finish all the work.



Sub-ducts and cables laying on the construction site, pulled out by an auger.



Twisted sub-ducts and optical fibre.

One of the bored holes where the cables and conduits had been pulled out.



Twisted sub-ducts and optical fibre.

Through these bored holes large amounts of cables and sub-ducts had been pulled out. Thus, causing major damage to cables and joints in the Telstra Network.

9.4 EXAMPLE OF AN INCIDENT REPORT USED BY AN ELECTRICITY ASSET OWNER

'Excavator operator injured when hitting 11,000 volt underground cable'

Date:	07/10/05
Incident occurred at a place of work (refer OHS Act 2000)	[✗] (Construction site)
System voltage involved:	11,000 kV
Address:	Northumberland Road
Work being done for:	[✗] Contestable work done for customer
Category:	[✗] General public (workers – non networks worker)
Category type:	[✗] Electric shock
Treatment:	[✗] Medical treatment given (Hospital)
Description of injuries:	Excavating for ASP to relocate 11,000 volt UG cables, excavator hit cable causing explosion and feeder trip. Victim received shock from excavator and was taken to hospital for check up. No permanent injuries
Network element involved in incident:	[✗] Underground mains
Object involved in incident:	[✗] Excavator
Location of incident:	[✗] Urban
Location type:	[✗] Public Roadway (including footpaths to property boundary)
	[✗] Accident area exposed to weather (ie outdoors)
Possible causes of incident:	[✗] Failure to follow written procedures
Briefly describe possible causes of incident in more detail:	Workers had located cable via searches but proceeded to dig with excavator beyond marker tape and hit cable
Initial corrective action:	ASP and excavator operator advised of the dangers associated with excavation near cables. Advised that any work beyond covers or marker tapes can only be done using hand tools
Corrective action taken:	• excavator operator advised of his responsibilities when working near underground assets • ASP reminded of his responsibilities in regard to site supervision and the need to consult plans before commencing any excavation work
Follow up:	Cable isolated and repaired by IE. 50 customers interrupted for 5.2 hours

9.5 CASE STUDY: CONSTRUCTION OF THE M7 MOTORWAY

The Abi Leighton Joint Venture (ALJV) conducted an extensive risk assessment before commencing on the project and services both above and below the ground were identified as a major risk.

The ALJV consulted with the asset owners who identified an extensive number of assets in the M7 corridor and local road upgrades.

Plans were obtained from 'Dial Before You Dig' and from the asset owner. Electronic services detection was also conducted. These assets were then surveyed and non-destructive digging conducted to positively identify each asset. Colour coded conduits were then placed on top of the assets.

The ALJV still recorded hits to the assets as not all assets were identified on the plans or by 'Dial Before You Dig'.

Meetings were arranged by the ALJV with management and field staff, asset owners, subcontractors and 'Dial Before You Dig'. From these meetings the ALJV developed the following procedures through consultation to reduce the possibility of impacting on these assets:

- a request to de-energize high risk electrical assets where possible was made to the asset owner. A training course was developed and delivered by the ALJV and Integral Energy to approximately 500 ALJV and subcontractor employees on the project
- permits to excavate and work around assets were reviewed and developed with input from all stakeholders. The mandatory exclusion zones for underground assets were doubled
- colour coded conduits were used to identify the type of asset, location and depth
- when working in the asset zones, only toothless buckets were permitted to be used on plant
- banners, posters, stickers and signage were extensively used to remind all personnel of the procedures.

The ALJV, in consultation with a manufacturer, developed a GPS backpack to identify a known asset by comparing it to the ALJV survey database. This allows the ALJV to mark out existing assets and make this information more accessible and easier to understand.

By consulting and training all stakeholders, the ALJV was able to implement safe work methods and dramatically reduce the number of incidents impacting on assets.



Colour Coded Conduits used to identify assets



Manufacturer's backpack being used by ALJV survey staff



The manufacturer's pocket PC allows quick recognition of underground assets by touch screen technology. This identifies the type of asset and its approximate location.

10. FURTHER INFORMATION

10.1 AUSTRALIAN STANDARDS

- AS 2648.1 *Underground marking tape*
- AS 4026 *Electrical cables for underground residential systems*
- AS 1345 *Identification of the contents of pipes, conduits and ducts*
- AS 2566.2 *Buried flexible pipelines*
- AS 4271 *Interim – Geographic information data dictionary*
- AS 1742.3 *Traffic control devices for works on roads*
- AS/NZS 4360 *Risk management*
- AS 4799 *Installation of underground utility services and pipelines within railway boundaries*
- AS 4292.1 *Railway safety management*
- AS 2865:2001 *Safe working in a confined space*
- AS 1165 *Traffic hazard warning lamps*
- AS 1345:1995 *Identification of the contents of pipes, conduits and ducts*
- AS 1742.3 *Traffic control devices for works on roads*
- AS 1743 *Road signs – specifications*
- AS 1744 *Forms of letters and numerals for road signs*
- AS 1906 *Retroreflective materials and devices for road traffic control purposes*
- AS HB81 *Field guide for traffic control at works on roads:*

  (HB81.1 Short term urban works – daytime only

  HB81.2 Short term rural works – daytime only

  HB81.3 Mobile works

  HB81.4 Short term night works

  HB81.5 Works on unsealed roads

  HB81.6 Bituminous surfacing)

Australian Standards are available from SAI Global **www.saiglobal.com/shop**
email sales@sai-global.com or phone 13 12 42.

10.2 WORKCOVER NSW CODES OF PRACTICE

- *Code of Practice: Work Near Overhead Power Lines*
- *Code of Practice: Excavation*
- *Code of Practice: Moving Plant on Construction Sites.*

10.3 OTHER STANDARDS AND REFERENCES

- Streets Opening Conference (2007) *Guide To Codes and Practices for Streets Opening*
- Streets Opening Conference (1999) *Model Agreement for Local Councils and Utility Service Providers*
- *Service and Installation Rules of New South Wales* (2006)
- AUS-SPEC 306U AUS-SPEC *Road Openings and Restoration* (2004 and earlier additions)
- AUS – SPEC 7200 C0219 *Construction – Roadways – Road openings and restorations for utilities* (2007).

  For Streets Opening Conference enquiries, contact The Secretariat, Institute of Public Works, Engineering Australia (NSW Division)
  Phone 02 9267 6677 Fax 02 9283 5255 email ipwea@ipwea.org.au

  For AUS–SPEC enquiries contact: Manager Specifications, Standards Australia,
  286 Sussex Street Sydney NSW 2000. GPO Box 476 Sydney NSW 2001
  Phone 02 8206 6713 Fax 02 8206 6021 email aus-spec@standards.org.au

10.4 LEGISLATION

- *Electricity Supply Act 1995*
- *Electricity (Consumer Safety) Act 2004*
- *Gas Supply Act 1996*
- *Occupational Health and Safety Act 2000*
- *Pipelines Act 1967*
- *Sydney Water Act 1994*
- *Hunter Water Act 1991*
- *Roads Act 1993* and *Road Regulations 1994 (as amended)*
- *Local Government Act 1993*
- *Contaminated Land Management Act 1997*
- *Telecommunications Act 1997.*

11. APPENDIX A – UNDERGROUND ASSET LOCATION CHECKLIST

Worksite location: _____

(street name, cross street, landmarks)

_____

Plans provided by: Dial Before You Dig ☐ Yes ☐ No Contractor ☐ Yes ☐ No
Asset owner ☐ Yes ☐ No

Underground assets located:

Utility (Note Utility from which plans were obtained)	Plans received as per dial before you dig information	Plans current Check dates	Plans indicate assets in vicinity	Assets checked	Pot-holing req'd	Pot-holing done	Stand-by req'd	Site marking completed	(sketch on rear of sheet)
	✓	✓	✓	Y/N	Y/N	Y/N	✓	Y/N	Y/N
Communications									
Electrical									
Water									
Sewerage									
Gas									
Other									
Other									

Sketch worksite and Utility locations on reverse side of page

Additional Comments:

_____

_____

_____

_____

Plans verified and confirm all assets as located? ☐ Yes ☐ No

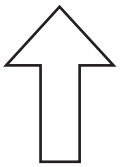
Person locating asset	**Person carrying out work**
Signed	Signed
Name (Print) ..... Business Name	Name (Print) .....
Date completed checks ...../...../.....	Date received checked results ...../...../..... Completed Checklist and Utility Plans included in job-pack. ☐ **Yes** ☐ **No**

SAMPLE ONLY

Underground Asset Location Checklist – SAMPLE ONLY

Diagram of UG Assets as located on site

Indicate the north point with an arrow



SAMPLE ONLY

Drawn by

Name _____

Sign _____

Date _____ / _____ / _____

The above sketch should contain the following details:

- street alignments (where applicable)
- lot boundaries (where applicable)
- name of street and suburb
- north point
- nearest cross street
- distances from relevant assets/boundaries
- depth of cover (only if available)
- signature and name (drawn by).

12. APPENDIX B – WORKERS COMPENSATION INSURANCE



Anyone who employs workers, and in some cases engages contractors, must maintain a current workers compensation insurance policy. Penalties apply for failing to have a current policy in place.

All employers have a legal liability to pay workers compensation to workers who are injured in the course of their work, and employers are required by law to hold a workers compensation insurance policy from a licensed WorkCover insurer to cover that liability.

For workers compensation insurance purposes the *Workplace Injury Management and Workers Compensation Act 1998* (the Act) defines a worker, subject to certain specified exceptions, to mean:

A person who has entered into or works under a contract of service or a training contract with an employer (whether by way of manual labour, clerical work or otherwise, and whether the contract is expressed or implied, and whether the contract is oral or in writing).

In addition, the Act deems certain other persons to be workers for workers compensation purposes, eg some types of contractors.

For assistance in clarifying your obligation, contact your insurer or the WorkCover Assistance Service on **13 10 50**.

13. APPENDIX C – TYPICAL FOOTWAY ALLOCATIONS FOR UTILITY SERVICES AND DEPTH OF COVER IN ROAD RESERVES

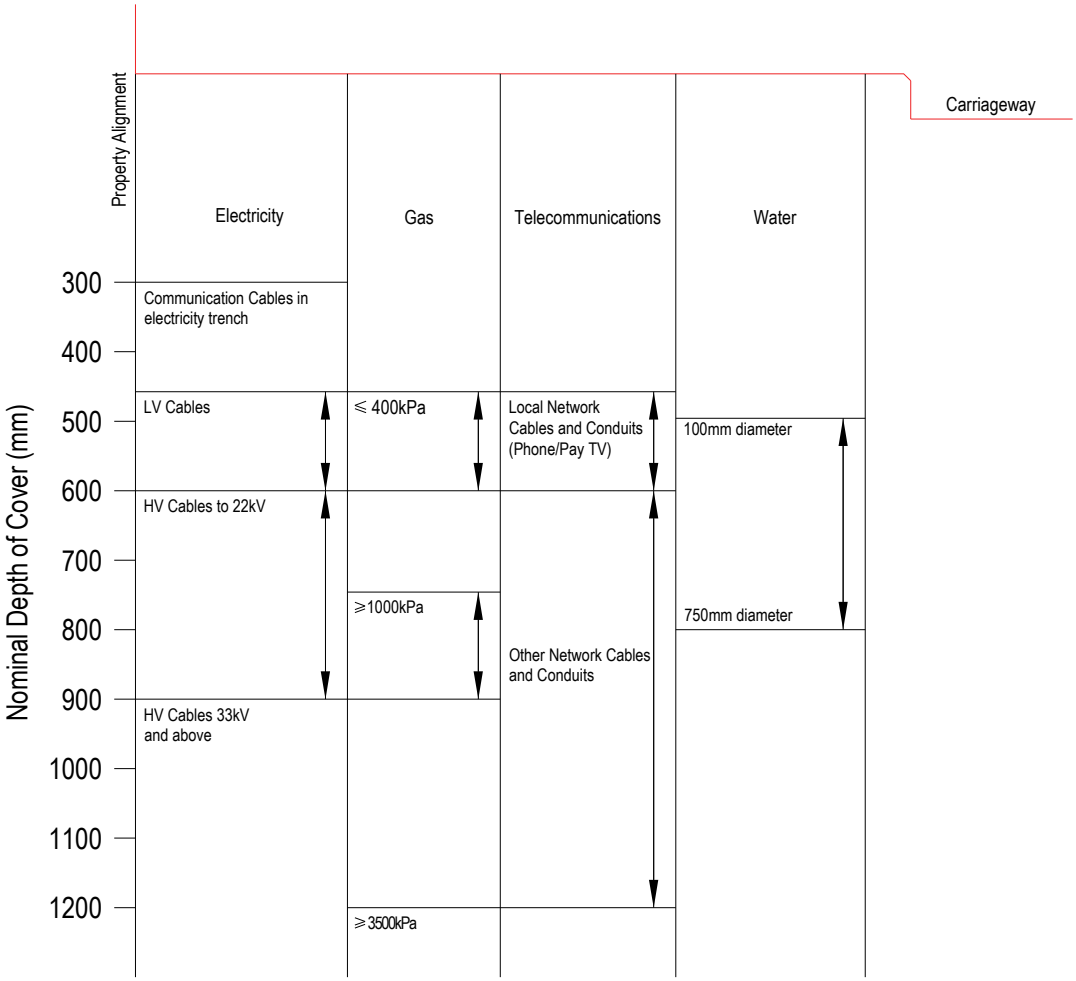
The diagrams in this section have been sourced from the publication entitled *Guide to Codes and Practices for Streets Opening 2007* published by the NSW Streets Opening Conference (SOC). These diagrams are typical examples only, and may not be up-to-date. The current edition of the SOC document should always be consulted prior to undertaking work that impacts on underground services to ensure that the information used is up-to-date.

Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

For the purpose of this section, note that sewer lines have not been specifically identified.

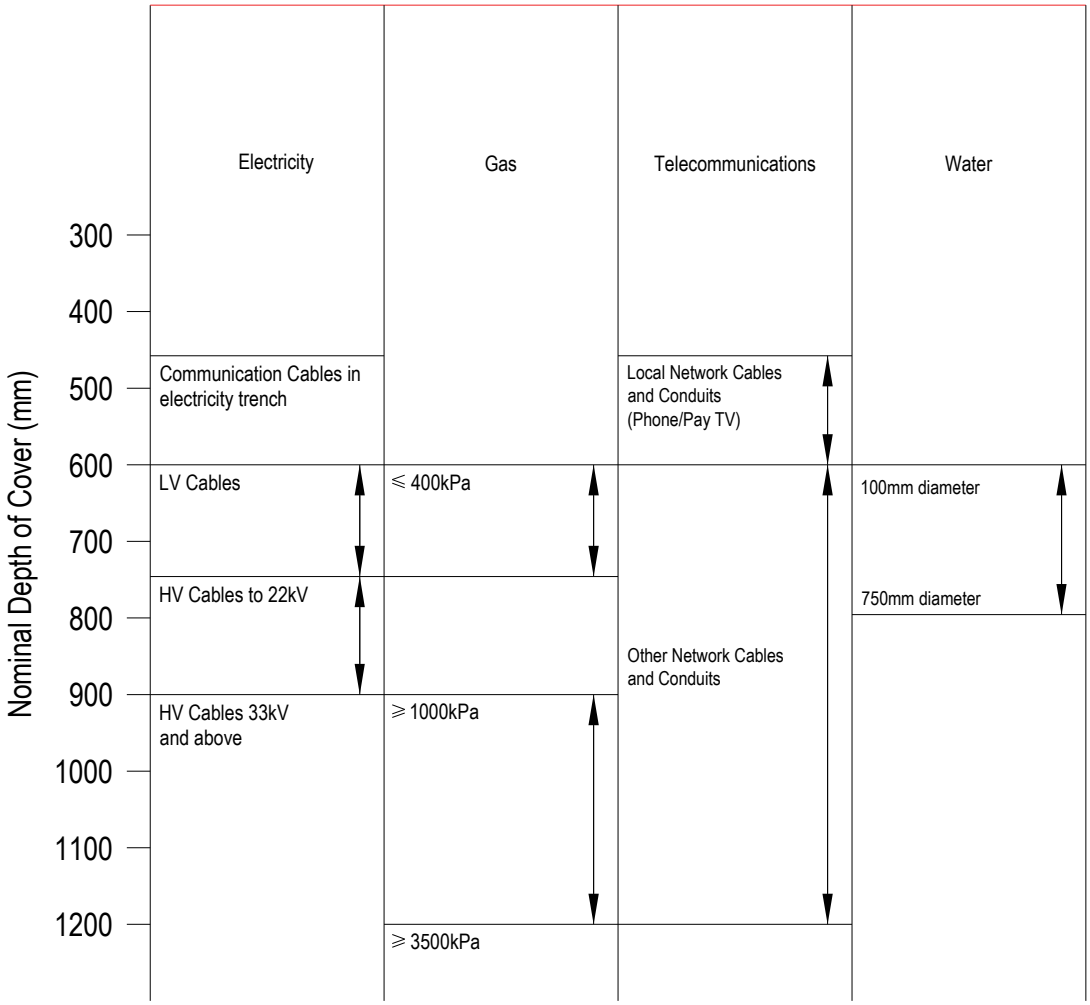
13.1 NOMINAL DEPTH OF COVER OF UTILITY SERVICES IN ROAD RESERVES

13.1.1 In footways



Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

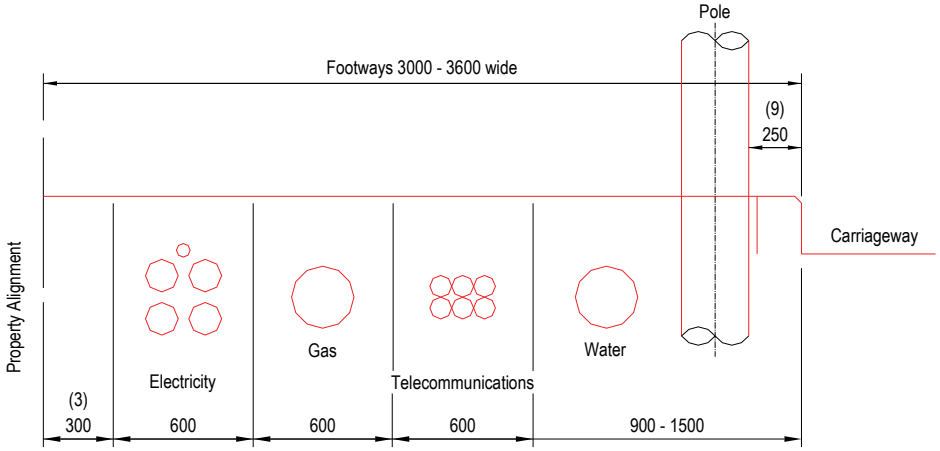
13.1.2 In carriageways

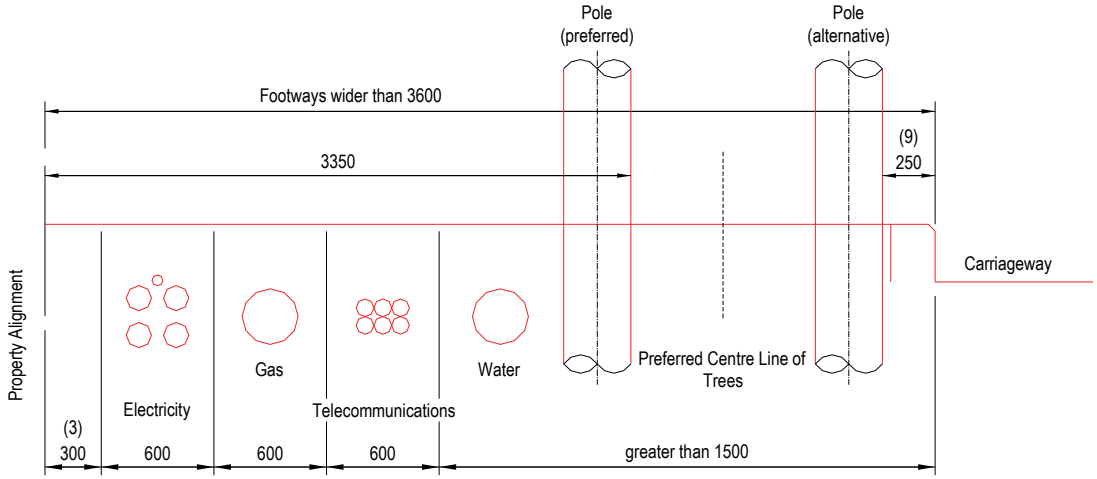


Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

13.2 UTILITY/SERVICE PROVIDER ALLOCATION OF SPACE IN FOOTWAYS

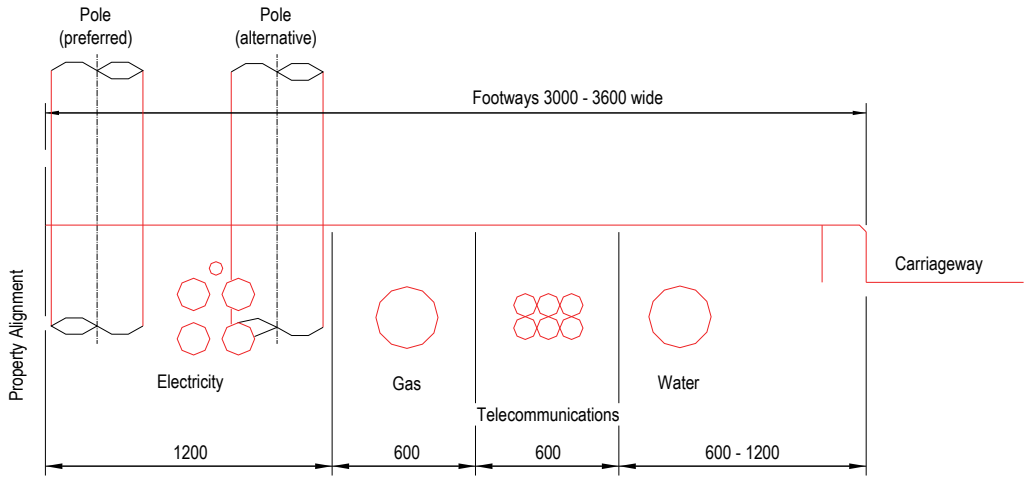
13.2.1 Streets dedicated prior to 1 January 1991

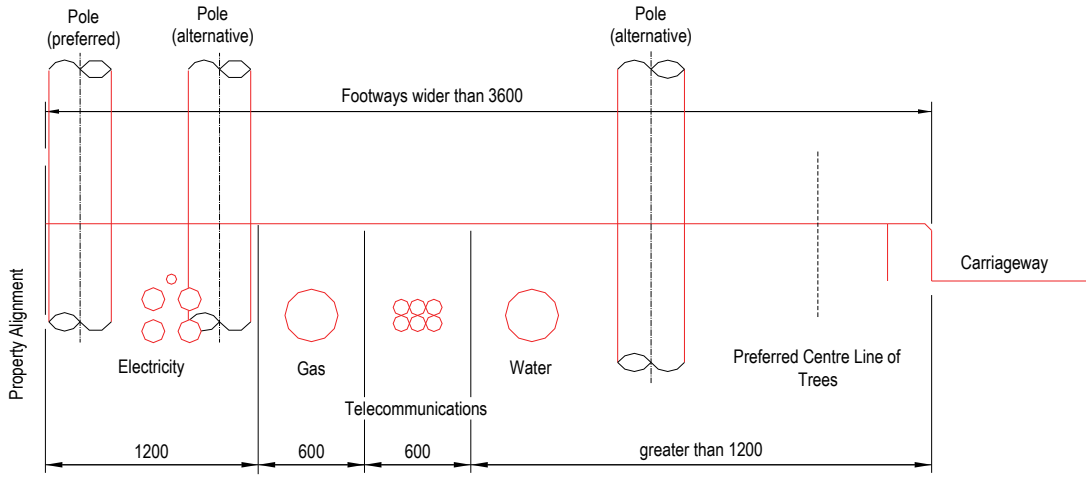




Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

13.2.2 Streets dedicated after 1 January 1991

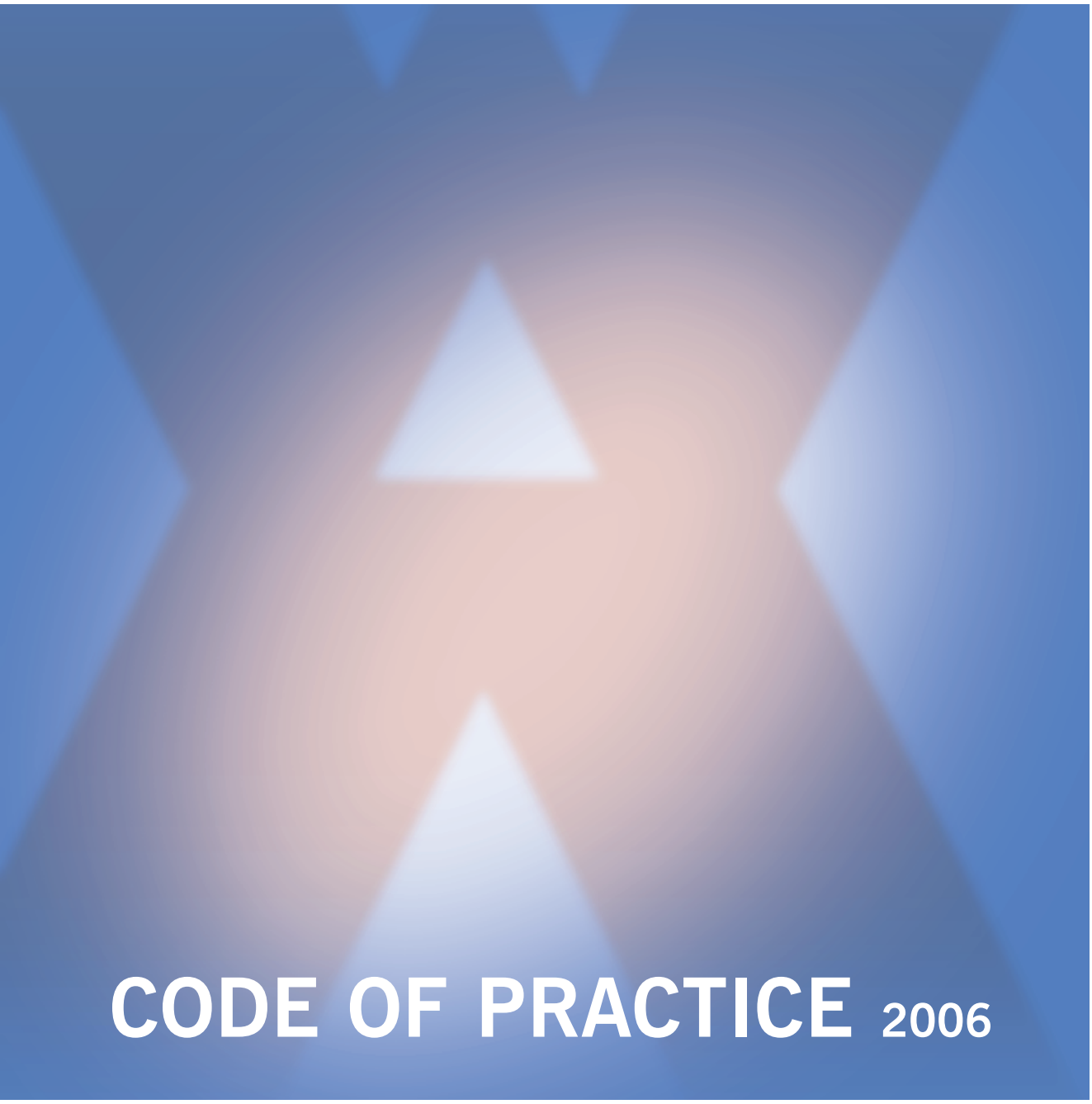




Source: NSW Streets Opening Conference: Guide to Codes and Practices for Streets Opening 2007

WorkCover
NEW SOUTH WALES

WORK NEAR
OVERHEAD POWER LINES



CODE OF PRACTICE 2006

WorkCover. **Watching out for you.**

New South Wales Government

Disclaimer

This publication may contain occupational health and safety and workers compensation information. It may include some of your obligations under the various legislations that WorkCover NSW administers. To ensure you comply with your legal obligations you must refer to the appropriate legislation.

Information on the latest laws can be checked by visiting the NSW legislation website (www.legislation.nsw.gov.au) or by contacting the free hotline service on 02 9321 3333.

This publication does not represent a comprehensive statement of the law as it applies to particular problems or to individuals or as a substitute for legal advice. You should seek independent legal advice if you need assistance on the application of the law to your situation.

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WHAT IS AN INDUSTRY CODE OF PRACTICE?

An approved industry code of practice is a practical guide to employers and others who have duties under the *Occupational Health and Safety Act 2000* (OHS Act) and the *Occupational Health and Safety Regulation 2001* (OHS Regulation) with respect to occupational health, safety and welfare.

An industry code of practice is approved by the Minister administering the OHS Act. It comes into force on the day specified in the code or, if no day is specified, on the day it is published in the NSW Government Gazette. An approved industry code of practice may be amended from time to time (or it may be revoked) by publication in the Gazette.

An approved industry code of practice should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare at work is being followed.

An approved industry code of practice is intended to be used in conjunction with the requirements of the OHS Act and the OHS Regulation but does not have the same legal force. An approved industry code of practice is advisory rather than mandatory. However, in legal proceedings under the OHS Act or OHS Regulation, failure to observe a relevant approved industry code of practice is admissible in evidence to establish an offence under the OHS Act or OHS Regulation.

A WorkCover Authority inspector can draw attention to an approved industry code of practice in an improvement or prohibition notice as a way of indicating the measures that could be taken to remedy an alleged contravention or non-compliance with the OHS Act or OHS Regulation. Failure to comply with an improvement or prohibition notice without reasonable excuse is an offence.

In summary an approved **INDUSTRY CODE OF PRACTICE**:

- ✓ gives practical guidance on how health, safety and welfare at work can be achieved;
- ✓ should be observed unless an alternative course of action that achieves the same or a better level of health, safety and welfare in the workplace is being followed;
- ✓ can be used in support of the preventive enforcement provisions of the *Occupational Health and Safety Act*;
- ✓ can be used to support prosecutions for failing to comply with or contravening the OHS Act or OHS Regulation.

PREFACE

The aim of this code of practice is to protect the health and safety of persons from the risks arising when they are working near overhead power lines and associated electrical apparatus. It provides practical advice on implementing the requirements of the *Occupational Health and Safety Act 2000* and the *Occupational Health and Safety Regulation 2001*.

This code of practice provides practical guidance on the risk control measures, competency requirements and approach distances for workers working near overhead power lines. It applies to people with varying levels of qualification, training or knowledge.

This code of practice will assist employers, self-employed persons, employees, contractors and other parties involved in managing electrical risks associated with work near overhead power lines.

Use this code of practice to assess the effectiveness of your present arrangements when working near overhead power lines, and to check that all risks have been identified, assessed and eliminated or controlled.

This code of practice has been developed in consultation with members of the NSW electricity supply industry, including relevant unions and employer bodies. It is based on the earlier Electricity Association of N.S.W publication, *Interim Guide for Operating Cranes & Plant in Proximity to Overhead Power Lines*, and the Australian Standard *AS 2550.5 – 2002 Cranes, hoists and winches – Safe use Part 5: Mobile and Vehicle Loading Cranes*, which was gazetted as an approved industry code of practice on 21 September 2001 in the *Code of Practice: Technical Guidance*. In the event of any inconsistencies between the Standard and this code, the code shall prevail.

WHAT IS WORK NEAR OVERHEAD POWER LINES?

There are legislative obligations on employers, self-employed persons and controllers of premises in regard to undertaking work in close proximity, or at an unsafe distance, to overhead power lines. The term ‘near’ is utilised as a reference point for persons planning and undertaking this work.

Work ‘near’ overhead power lines means a situation where there is a reasonable possibility of a person, either directly or through any conducting medium, coming closer than the approach distances specified in this code. For the purposes of this code the term ‘near’ can be interchanged with other legislative or commonly used industry terms ie ‘close proximity’, ‘unsafe distance’ or ‘in the vicinity of’.

PERSONNEL WORKING NEAR OVERHEAD POWER LINES

This code of practice is based on the assumption that without appropriate technical knowledge and experience of electricity distribution networks and associated electrical apparatus, untrained personnel working or operating cranes or plant near overhead power lines will not be able to identify the operating voltage concerned, and will therefore not be able to recognise and avoid the inherent dangers of live overhead power lines. These personnel are termed ***ordinary persons***.

The approach distances specified in this code of practice take account of differing levels of technical knowledge, and are substantially greater for ordinary persons than for personnel who have been trained and assessed as having the necessary technical knowledge. These personnel are termed **accredited persons**.

HOW CAN WORKING NEAR LIVE OVERHEAD POWER LINES BE DANGEROUS?

Overhead power line contact is one of the largest single causes of fatalities associated with mobile plant and equipment.

Contact with live overhead power lines is a serious risk because any voltage that causes sufficient current to pass through the heart is potentially injurious or even fatal.

Contact with live electricity can also cause serious burns arising from the discharge of electrical energy. Other risks include fires and explosions that may immobilise the equipment involved.

You don't have to have a direct contact with a high voltage overhead power line to receive a fatal electric shock. ***Simply being too close can kill***.

WHAT DO THE SYMBOLS IN THE CODE OF PRACTICE MEAN?

To help you work out what you require, a number of symbols are used to highlight things you need to take into account and tools to help you do the job.



Consult and communicate with employers



Legal obligations that must be followed



The process of finding things that cause harm, working out how big a problem they are and fixing them.



Assess the risks in your workplace



Tools that can help you work out your plan

ACKNOWLEDGEMENT

In developing this code of practice WorkCover NSW has drawn on information contained in a number of codes of practice and industry guidelines issued by other State regulators or organisations. WorkCover NSW acknowledges the following publications, which have been incorporated in parts of this code.

- *Code of practice – Working near exposed live parts* – Queensland, Department of Industrial Relations, and
- *Framework for undertaking work near overhead and underground assets* – WorkSafe, Victoria, and
- *NENS 04-2003 National guidelines for safe approach distances to electrical apparatus* – Energy Networks Association.

CHAPTER 1 – ESTABLISHMENT

1.1 Title

This is the Code of Practice – Work near Overhead Power Lines.

1.2 Purpose

This code of practice provides practical guidance in order to protect the health and safety of persons working near overhead power lines and associated electrical apparatus. It provides guidance on the risk control measures, competency requirements and approach distances to live electrical conductors, including no go zones for cranes and plant (and their loads), as well as for vehicles, individuals and hand-held tools. It applies to persons with varying levels of qualification, training or knowledge.

This code of practice should be used instead of the *Interim Guide for Operating Cranes and Plant in Proximity to Overhead Power Lines – ISSC 26* issued by the Electricity Association of NSW in September 2001.

1.3 Scope

This code of practice applies to work, which is carried out near overhead power lines and associated electrical apparatus excluding:

- work on electricity network assets where the work is carried out in accordance with the requirements of the *Electricity Supply (Safety and Network Management) Regulation 2002* and the work is either:
    - by or for an electricity network operator, or
    - by an accredited service provider, or
    - by a telecommunications network operator.
- mobile plant or vehicles operating on a public road where the design envelope is not greater than the transit envelope and is in any case not greater than 4.6 metres in height (eg a side loading waste collection vehicle collecting waste bins from the side of a public road under overhead power lines);
- when the crane or item of plant is correctly stowed for travelling on a public road;
- work on a mine site;
- work involving low flying aircraft (eg crop dusting, pesticide or herbicide spraying, etc);
- work carried out by emergency services personnel, including state emergency service, fire, police, volunteer rescue association and ambulance personnel during a declared emergency or other local emergency incident. In this situation the agency should advise the network operator of the circumstances of the emergency work and ensure a safe system of work is applied by those emergency services personnel undertaking the work.

This Chapter 1 is introductory, describes the purpose of this code, and provides definitions. Chapter 2 explains the regulatory principles in the occupational health and safety legislation, which this code is intended to complement. Chapter 3 describes a framework for work near overhead power lines by outlining general risk management principles, competency requirements and approach distances for the work. More detailed risk management requirements for specific workplace activity are set out in Chapters 4 to 9 inclusive.

1.4 Authority

This is an industry code of practice approved by the Minister for Commerce, under section 43 of the *Occupational Health and Safety Act 2000*, on the recommendation of the WorkCover Authority of New South Wales ('WorkCover NSW').

1.5 Commencement

This code takes effect on [Gazettal /date]

1.6 Interpretation

1.6.1 Recommended practices

Words such as 'should' indicate recommended courses of action. 'May' or 'consider' indicate a possible course of action the duty holder should consider. However, you may choose an alternative method of achieving a safe system of work. For a further explanation, see 'What is an industry code of practice'.

1.6.2 Legal obligations

Words such as 'must', 'requires' and 'mandatory' indicate obligations, which must be complied with. Failure to comply with the code can be used as evidence in proceedings for an offence against the OHS Act or OHS Regulation (where the code is relevant to any matter, which it is necessary for the prosecution to prove to establish the commission of the offence).

1.7 Applicable legislation



Consult the OHS Act and the OHS Regulation for the specific legal requirements regarding occupational, health and safety responsibilities for work near overhead power lines.

Specific responsibilities:

Clause 41(4) of the OHS Regulation requires a controller of premises to ensure that persons working in, or undertaking maintenance on, the premises (apart from those undertaking electrical work) are prevented from coming within an unsafe distance from any overhead power lines or live electrical installations unless a risk assessment determines otherwise.

Clause 64(2)(e) of the OHS Regulation requires employers to ensure that persons at work, their plant, tools or other equipment and any materials used in or arising from the work do not come into close proximity with overhead electrical power lines (except if the work is done in accordance with a written risk assessment and safe system of work and the requirements of the relevant electricity supply authority).

Other significant legislation:

The *Electricity Supply (Safety and Network Management) Regulation 2002*, which is administered by the Department of Energy, Utilities and Sustainability, requires that a person must not carry out work on or near a network operator's transmission or distribution system and a network operator must not allow a person to carry out work on or near its transmission or distribution system unless the person is qualified under the relevant requirements of the network operator's network management plan, to carry out the work; and the work is carried out in accordance with the relevant requirements of that plan.

1.8 Definitions

The following definitions are used for the purposes of this code of practice:

access authority means a written authorisation, issued by a network operator, which allows persons to work within the no-go zone.

accredited person means a person who has successfully completed a recognised training course relating to work near overhead power lines that has been conducted by a registered training organisation.

accredited service provider means a person who has been accredited by the Department of Energy, Utilities and Sustainability to undertake work on the electricity network.

approach distance means the minimum separation in air from an exposed overhead conductor that must be maintained by a person, or any object held by or in contact with that person. **Note:** Refer to Chapter 3 for relevant approach distances.

approved means approved in writing. This can be achieved by any, or a combination, of the following:

- providing a paper document;
- sending a facsimile;
- other equivalent means (eg e-mail).

authorised person means a person with technical knowledge or sufficient experience who has been approved by the network operator.

authorised representative of an industrial organisation of employees means an officer of that organisation who is authorised under the *Industrial Relations Act 1996*.

competent person for any task means a person who has acquired through training, qualification, experience, or a combination of them, the knowledge and skills to carry out the task.

conductor means a wire, cable or form of metal designed for carrying electric current.

construction work means any of the following:

(a) excavation, including the excavation or filling of trenches, ditches, shafts, wells, tunnels and pier holes, and the use of caissons and cofferdams,

(b) building, including the construction (including the manufacturing of prefabricated elements of a building at the place of work concerned), alteration, renovation, repair, maintenance and demolition of all types of buildings,

(c) civil engineering, including the construction, structural alteration, repair, maintenance and demolition of, for example, airports, docks, harbours, inland waterways, dams, river and avalanche and sea defence works, roads and highways, railways, bridges and tunnels, viaducts, and works related to the provision of services such as communications, drainage, sewerage, water and energy supplies.

control measures measures taken to minimise a risk to the lowest level reasonably practicable.

crane	means an appliance intended for raising or lowering a load and moving it horizontally, and includes the supporting structure of the crane and its foundations, but does not include industrial lift trucks, earth moving machinery, amusement devices, tractors, industrial robots, conveyors, building maintenance equipment, suspended scaffolds or lifts.
de-energised	means not connected to any source of electrical supply but not necessarily isolated.
earthed	means directly electrically connected to the general mass of earth so as to ensure and maintain the effective dissipation of electrical energy.
earth moving machinery	means an operator controlled item of plant used to excavate, load or transport, compact or spread earth, overburden, rubble, spoil, aggregate or similar material, but does not include a tractor or industrial lift truck.
electrical apparatus	means any electrical equipment, including overhead power lines and cables, the conductors of which are live or can be made live.
electricity network	means transmission and distribution systems consisting of electrical apparatus which are used to convey or control the conveyance of electricity between generators' points of connection and customers' points of connection. **Note:** Overhead power lines on private property come under the control of the controller of the premises.
elevating work platform	means a telescoping device, scissor device or articulating device, or any combination of those devices, used to move personnel, equipment or materials to and from work locations above the support surface.
envelope	means the space encapsulating a plant item, including attachments such as rotating / flashing lights or radio aerials and is categorised as: **Design:** the space encapsulating all possible movements of the plant and any load attached under maximum reach. **Transit:** the area encompassing the normal height and width of a vehicle or plant when traveling to or from a worksite.
employee	means an individual who works under a contract of employment or apprenticeship.
employer	means a person who employs persons under contracts of employment or apprenticeship. **Note:** In some chapters of the OHS Regulation, the term 'employer' includes a self-employed person in relation to duties to other persons. See the definition of 'employer' in clause 3 of the OHS Regulation.
energised	means connected to a source of electrical supply.
exposed conductor	an electrical conductor that is hazardous because it has not been protected by a barrier of rigid material or by insulation that is adequate for the voltage concerned, under a relevant Australian Standard specification.
hazard	means anything (including work practices and procedures) that has the potential to harm the health or safety of a person.

high-risk construction work means any of the following construction work,

- involving structural alterations that require temporary support
- at a height above 3 metres
- involving excavation to a depth greater than 1.5 metres
- demolition work for which a licence is not required
- in tunnels
- involving the use of explosives
- near traffic or mobile plant
- in or around gas or electrical installations
- over or adjacent to water where there is a risk of drowning.

high voltage (HV) means a nominal voltage exceeding 1,000 V a.c. or exceeding 1,500 V d.c.

hoarding for the purposes of this code is containment sheeting positioned on the external face of a scaffold that serves as a physical barrier between a worker and live overhead power lines and associated electrical apparatus.

insulated means separated from adjoining conducting material by a non-conducting substance which provides resistance to the passage of current, or to disruptive discharges through or over the surface of the substance at the operating voltage, and to mitigate the danger of shock or injurious leakage of current.

Interim Guide means the *Interim Guide for Operating Cranes and Plant in Proximity to Overhead Power Lines – ISSC 26* issued by the Electricity Association of NSW.

isolated means disconnected from all possible sources of electricity supply by means which will prevent unintentional energisation of the apparatus and which is assessed as a suitable step in the process of making safe for access purposes.

live means connected to any source of electrical supply or subject to hazardous induced or capacitive voltages.

low voltage (LV) means a nominal voltage exceeding 50 V a.c. or 120 V d.c. but not exceeding 1000 V a.c. or 1500 V d.c.

LV – ABC (Aerial Bundled Cable) means an insulated cable system used for low voltage overhead distribution of electricity that is manufactured in accordance with the Australian Standard, AS/NZS 3560.

mobile crane means a crane capable of travelling over a supporting surface without the need for fixed runways (including railway tracks) and relying only on gravity for stability, that is, with no vertical restraining connection between itself and the supporting surface and no horizontal restraining connection (other than frictional forces at supporting-surface level) that may act as an aid to stability.

mobile plant	includes plant that: (a) moves either under its own power, or is pulled or pushed by other mobile plant (b) moves on or around the work site, enters or leaves the site, or moves past the site (c) includes road vehicles operating at a worksite **Note:** This definition has been adopted for the purposes of this code of practice. This includes items such as earthmoving machinery, concrete boom pumps and tipper trucks operating at a worksite.
near	means a situation where there is a reasonable possibility of a person, either directly or through any conducting medium, coming closer than the relevant approach distances specified in this code.
network operator	means the owner, controller or operator of an electricity network also known as an electricity supply authority.
no go zone	means the area around overhead power lines into which no part of a person or material or cranes or vehicles or items of mobile plant may encroach without the approval of the network operator. **Note:** • person includes hand tools, equipment or any other material held by a person. • plant includes the load, controlling ropes and any other accessories.
occupier	of premises includes: (a) a person who, for the time being, has (or appears to have) the charge, management or control of the premises, or (b) a person who, for the time being, is in charge (or appears to be in charge) of any operation being conducted on the premises.
operating voltage	means the a.c. voltage (phase to phase RMS) or d.c. voltage by which a system of supply is designated.
ordinary person	means a person without sufficient training or experience to enable them to avoid the dangers which overhead power lines and associated electrical apparatus may create.
overhead power line	means any bare or covered aerial conductors and other associated electrical parts that make up an aerial line for the distribution and transmission of electrical energy.
personal protective equipment (PPE)	items that workers can use to protect themselves against hazards. PPE includes insulating gloves, mats or sheeting, glasses and face protection. **Note:** A number of items of PPE are made and tested to Australian Standards. PPE that is not designated as meeting a recognised Standard may be unreliable in service, as its performance is unknown.

place of work	means premises where persons work.
plant	includes any machinery, equipment or appliance. **Note:** For the purposes of this code the definition includes a broad range of machinery and equipment, but not limited to, cranes, mobile plant, scaffolding, load shifting equipment, industrial lift trucks, earth moving machinery, amusement devices, tractors, rural machinery, vehicles, conveyors, building maintenance equipment, suspended scaffolds or lifts, implements or tools and any component or fitting of those things.
premises	includes any place, and particularly includes: • any land, building or part of a building • any vehicle, vessel or aircraft, or • any installation on land, on the bed of any waters or floating on any waters, or • any tent or movable structure.
OHS Act	means the *Occupational Health and Safety Act 2000*.
OHS Regulation	means the *Occupational Health and Safety Regulation 2001*.
safety observer	means an accredited person specifically assigned the duty of observing and warning against unsafe approach to overhead power lines and associated electrical apparatus, or other unsafe conditions.
safe work method statement (SWMS)	means a statement that: • describes how the work is to be carried out • identifies the work activities assessed as having safety risks • identifies the safety risks; and • describes the control measures that will be applied to the work activities, and includes a description of the equipment used in the work, the standards or codes to be complied with, the qualifications of the personnel doing the work and the training required to do the work.
self-employed person	means a person who works for gain or reward otherwise than under a contract of employment or apprenticeship, whether or not they employ others.
tiger tails	means pipe type cable covers, used as a warning to visually indicate the position of overhead power lines. **Note:** A tiger tail is also known as a torapoli pipe.
vehicle	means a truck (non tipping), car or utility, or other general purpose conveyance used for the carriage of persons, materials or goods.
voltage	means a potential difference between conductors or between conductors and earth.
work	means work as an employee or as a self-employed person.

CHAPTER 2 – CONSULTATION AND RISK MANAGEMENT



The OHS Act and the OHS Regulation require employers to address workplace health and safety through a process of risk management and consultation.

To effectively implement this code, employers need to be aware of these requirements and have procedures in place to apply them. Employers are advised to consult the OHS Act and the OHS Regulation as well as the *Code of Practice: Occupational Health and Safety Consultation* and the *Code of Practice: Risk Assessment* for details of these requirements and how they can be met. The following information is designed to provide an overview of legislative requirements.

The OHS Regulation requires employers (and self-employed persons) to identify hazards and to ensure that any risk of injury from electricity at a place of work is eliminated, or if elimination is not reasonably practicable, the risk is controlled.

Other legislative requirements particularly relevant to this code are clause 64 of the OHS Regulation, which requires that employers must ensure that persons at work, their plant, tools or other equipment and any materials used in or arising from the work do not come into close proximity with overhead power lines.

Controllers of premises also have obligations under section 10 of the OHS Act and clause 41 of the OHS Regulation for work that is carried out near overhead power lines.

This code of practice provides guidance on ensuring these requirements are met and should be implemented within a risk management framework. Risk management is a way of organising your efforts to determine safe systems of work. Following this procedure will help you identify the safety issues for work that is to be carried out near overhead power lines.

The following information is designed to provide an overview of:

- consultation
- risk management
- information, instruction, training and supervision

2.1 Consultation at the workplace



Employers must consult with employees when taking steps to assess and control workplace risks.

In order to consult with employees, employers are required to set up consultation arrangements and develop consultation procedures.

2.1.1 Consultation arrangements

The OHS Act provides three options for consultation arrangements under sections 16 and 17:

Arrangement	Number of employees	Requirement
OHS committee	20 or more employees	• requested by a majority of employees, or • directed by WorkCover
OHS representative	any size	• at least one employee requests an election, or • directed by WorkCover
Other agreed arrangements	any size	agreed to by both the employer and employees (in a small workplace it may be a regular safety meeting with employees)

Before using this code, an employer should ensure that consultation arrangements are in place. An employer may initiate the establishment of an OHS Committee or the election of an OHS Representative if the employees have not made such a request. When the consultation arrangements have been decided, clause 27 of the OHS Regulation requires employers to record them and advise all existing and new employees.

2.1.2 Consultation procedures

After setting up the consultation arrangements, employers need to consider when and how these consultation arrangements need to be applied.

2.1.3 When should consultation be undertaken?

Under section 13 of the OHS Act, employers have a general duty to consult employees when decisions are being considered that may affect their health, safety and welfare at work. Therefore, employers are required to consult with their OHS Committee, OHS representative or other agreed arrangement when such decisions are being considered. Decisions, which could affect health, safety and welfare for work near overhead power lines include:

- eliminating or controlling risks to health and safety from work
- assessing, reviewing and monitoring risks to health and safety from work
- planning, designing or changing work tasks or jobs
- purchasing new plant and equipment or substances
- using contractors at the workplace
- investigating incidents or accidents
- developing emergency procedures
- determining or reviewing consultation arrangements

Note: Any procedures that are developed to encompass these activities should incorporate consultation.

It may not be practical or reasonable to involve the OHS committee or the OHS representative in every decision. However, the employers or committee or representatives should agree on what process is needed to ensure that affected employees are consulted.

2.1.4 How should consultation be undertaken?

When engaged in consultation, section 14 of the OHS Act requires employers to:

- Share all relevant information with employees – for example, if an employer is going to change a work task, employees need to be told of any risk to health and safety that may arise and what will be done to eliminate or control these risks.
- Give employees reasonable time to express their views – employees need adequate time to assess the information given to them, obtain relevant safety information and consult with fellow employees to enable them to form their views.
- Value the views of employees and take into account when the decision is made to resolve the matter – in many cases, agreement will be reached on how the safety issues are to be addressed. When agreement cannot be reached, the employer should explain how the employee's concerns have been addressed.

2.2 Risk management at the workplace



Employers and self-employed persons must identify any foreseeable hazards, assess their risks and take action to eliminate or control them. Employees must be consulted as part of this process.

A hazard identification and risk assessment process must be carried out at the planning and preparation stage by the employer/contractor, in consultation with the persons doing the work near overhead power lines to determine what risks may arise when the work is being carried out. Safe systems of work must then be put in place to eliminate or control these risks. **Note:** For some work activities carried out near overhead power lines the safe system of work must also be documented in a safe work method statement. Refer to section 2.4.1.

The process of risk assessment and control is made up of the following steps:

- identify the hazards
- assess the risk(s) to the health and safety of persons arising from the hazards
- use appropriate control measures to eliminate or control the risk(s)
- monitor and review the control measures to ensure on-going safety.

2.2.1 Identify hazards

To ensure a safe and healthy workplace, employers must take reasonable care to identify all the foreseeable health and safety hazards, which could harm their employees or other persons in the workplace. Hazards may arise from the work process, the equipment and materials in use, the work environment, or other people involved.

Live overhead power lines are a potential hazard posing substantial risk of death or serious injury. In addition to electrical shock and electrocution, contact with overhead power lines, can result in:

- the electrifying of other objects such materials, tools and items of plant, with the potential for electric shock or electrocution;
- a rain of molten metal caused by contact between an energised conductor and another conducting medium;
- fire;

- explosion; or
- swift, unpredictable power line whiplash.

2.2.2 Assess risks

Once hazards have been identified, the risk they pose to health and safety needs to be assessed. Some hazards pose a greater risk than others do, and the frequency and duration of exposure can also affect the risk. Risk assessment involves considering the likelihood and severity of injury or illness being caused by exposure to the risk. Therefore the factors that need to be considered in a risk assessment should include the:

- harm that can be caused by exposure to the hazard
- number of people and the duration and frequency of exposure to the hazard
- capability, skill and experience of people exposed to the hazard.

The risk assessment process provides information on the factors, which contribute to the risk. This information will assist in determining what needs to be done to eliminate or control the hazard.

2.2.3 Eliminate or control the risk

The OHS Regulation prescribes the following hierarchy of controls that must be used to eliminate or control a risk to health and safety in the workplace. Refer to the following chapters of this code of practice to see how this must be applied to work near overhead power lines. In particular, consider the following:

Level 1: Eliminate the hazard by:

- discontinuing the work activity or arranging for the de-energising of the overhead power lines during the work or re-routing the overhead power lines away from the work activity.

Level 2: Minimise the risk by:

- substituting the system of work or plant (with something safer that does not come near the overhead power lines). This could mean using an alternate crane or mobile plant, which cannot encroach the approach distances specified in this code.
- separating the hazard. This could mean erecting a physical barrier to prevent a person or anything held by a person, or attached to the person, coming near the overhead power lines.
- introducing engineering means. This could mean substituting with a less hazardous process or modifying an item of plant or equipment to ensure it does not come near the overhead power lines.
- adopting administrative controls, by example, signage, warning barriers marking the worksite, safe work procedures such as maintaining a safe distance from overhead power lines and using a safety observer to warn people before they encroach the approach distances specified in this code.
- using personal protective equipment (PPE). (eg insulating gloves, safety helmets, eye protection).

The control measures at Level 1 give the best results and should be adopted where possible. The Level 2 measures apply in descending order of effectiveness and require more frequent reviews of the hazards and systems of work. In some situations a combination of control measures may be used such as engineering means and administrative controls.

2.2.4 Review risk assessment and control measures

Control measures should be reviewed on a regular basis. The frequency of their review should be determined by considering the significance of the risks associated with the hazard. However, a review should be undertaken in the following circumstances:

- new information is made available about the risks associated with the hazard
- an accident or incident occurs
- significant changes are proposed to the workplace or work system.

2.3 Information, instruction, training, and supervision



The OHS Act requires employers to provide such information, instruction, training and supervision as may be necessary to ensure the health, safety and welfare of their employees while at work.

Work near overhead power lines should not be performed unless those performing the work have received appropriate instruction and training. For example, the operator of any crane or mobile plant and the safety observer who carry out work within the accredited person zone specified in this code must have received training for work near overhead power lines conducted by a Registered Training Organisation. Refer to Appendix 4.

Employers must provide appropriate supervision and should recognise their supervisor's role in the management of the risks and the protection of employees. Close liaison between supervisors and employees is vital in ensuring the work is carried out in a safe manner.

Supervision of crane and plant operators working near overhead power lines should ensure that the control measures are fully implemented and followed at all times by employees. If you are supervising, it is your responsibility to ensure that the situation is safe for everyone.

The level and extent of supervision required will vary according to the safety aspects of each task and the skills of the worker. In determining the necessary level of supervision, an employer should consider:

- the complexity of the job environment in which the job is being done;
- the hazards at each work site;
- the worker's level of competence, experience and age.

The levels of supervision required for various tasks need to be described in policies and procedures.

2.4 Provision of information

Health and safety information may include:

- the results of any applicable written risk assessment;
- requirements of safe work method statements;
- a review of the written risk assessment and/or safe work method statements and standard operating procedures;
- any other relevant OHS information, such as type test information, documentation and signage.

Persons working near overhead power lines should always have, on request, access to written risk assessments and safe work method statements at the work site. Employers should brief employees and other workers as to the contents of written risk assessments and safe work method statements when work begins near overhead power lines, at regular intervals thereafter, and whenever there are changes to written risk assessments or new information about health and safety risks becomes available.

The employer should consult with their employees to ensure that such information and training is in a form that is accessible and easily understood. This is important where employees are from a non-English speaking background and/or have special needs or disabilities, and may have specific language or literacy requirements.

2.4.1 Safe work method statements

Chapter 8 of the OHS Regulation requires that safe work method statements (SWMS) be used for high risk construction work.

High-risk construction work may include, for example the following activities that may occur near overhead power lines:

- construction work involving structural alterations that require temporary support;
- construction work at a height above 3 metres;
- construction work involving excavation to a depth greater than 1.5 metres;
- demolition work for which a licence is not required;
- construction work involving the use of explosives;
- construction work near traffic or mobile plant;
- construction work in or around gas or electrical installations.

An example of a safe work method statement is included at Appendix 3 to assist in this.

2.5 Preparation for work to commence

Careful planning and preparation is an essential step to ensure that work is done safely. When preparing for the commencement of work all controls indicated by the risk assessment(s) and safe work method statement(s) as applicable must have been put in place and that no new hazards exist, or have been created.

Preparation should include:

- nature of the work planned and ways of dealing with changes as the work proceeds;
- the possible hazards and risks associated with the work;
- consultation with the network operator;
- communication and interaction between workers at the site;
- training, qualifications and competency of workers;
- checking the operation of plant and equipment, including the operation of limiting devices;
- proximity of persons, cranes, mobile plant, material and tools to overhead powerlines;
- proximity of persons to cranes and mobile plant;
- specific instructions for employees;
- workplace access and egress;
- emergency procedures, including first aid, evacuation and rescue; and
- environmental factors.

CHAPTER 3 – APPROACH DISTANCES WHEN WORKING NEAR OVERHEAD POWER LINES

3.1 Scope

This Chapter introduces a framework for work near overhead power lines. It provides guidance on general risk management principles, competency requirements and approach distances to live electrical conductors, including no go zones for cranes and plant (and their loads), as well as for vehicles, individuals and hand-held tools. It applies to persons with varying levels of qualification, training or knowledge.

This Chapter should be read in conjunction with the following Chapters, which provide risk management requirements for various types of workplace activity, including scaffolding (Chapter 6) and work near low voltage overhead service lines (Chapter 8), which specify a different set of approach distances to those described in this Chapter.

3.2 Basis of approach distances

This code is based on the assumption that without appropriate technical knowledge and experience of electricity distribution networks, workers that have not received training in overhead power line electrical hazards (ordinary persons) will not be able to identify the operating voltage of the live overhead power lines. When working near or operating cranes or plant near live overhead power lines such persons will not be able to recognise and avoid the inherent electrical hazards.

The approach distances specified in this Chapter take account of differing levels of technical knowledge and items of plant, and are substantially greater for ordinary persons than for personnel who are accredited. The approach distances for ordinary persons and accredited persons are based on those specified in the *National Guidelines for Safe Approach Distances to Electrical Apparatus*. In the National Guidelines, the approach distances were derived by –

- determining a distance to avoid electrical flashover; and
- providing additional allowance for inadvertent movements of the person, crane or plant relative to the overhead power lines, or the movement of the overhead power lines relative to the person, crane or plant.

3.2.1 Assessing the relevant approach distance

Prior to the start of any work near overhead power lines it is essential that the height and voltage of the overhead power lines (and if applicable the horizontal safety clearance) be assessed at the worksite. When assessing the relevant approach distances for the work a number of factors must be taken into account including,

- the possibility of errors in estimating distances, especially at higher voltages, where the approach distance is large. It may be necessary either to allow more clearance or to use methods that provide more accurate estimation of distances, for example, an ultrasonic cable height indicator, which provides a safe and accurate method of estimating distances near overhead power lines. If the height or voltage of the overhead power lines cannot be accurately determined consult the network operator.

WARNING

Do not attempt to directly measure the height of overhead power lines. Do not use conductive metallic objects or measuring devices such as metal tape measures for estimating the height of overhead power lines.

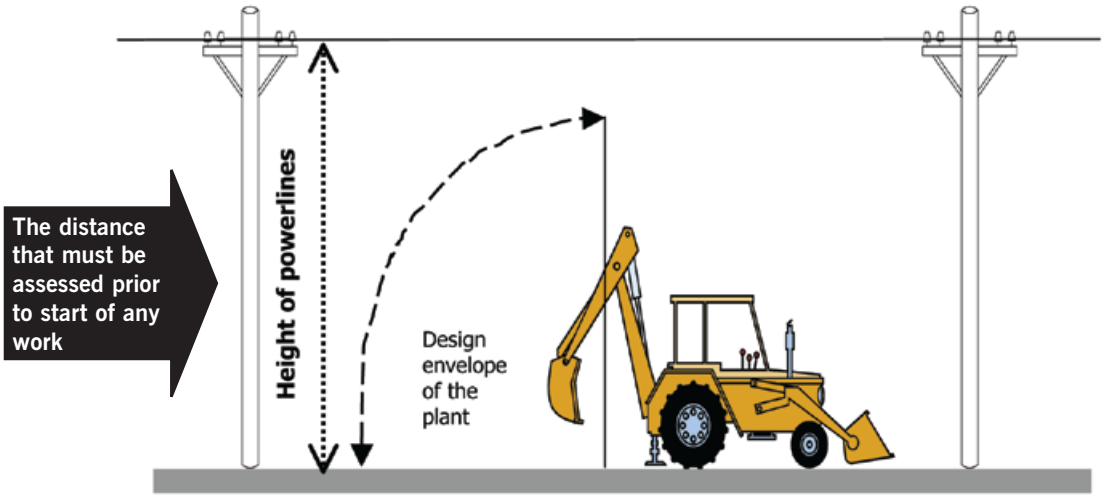


Figure 1: Distance that must be assessed for each worksite

- overhead power lines are made of metal and are therefore subject to expansion and contraction when heated and cooled. This can be a direct result of high ambient air temperature and/or excessive electrical load current passing through the conductors. Regardless of the cause, any expansion will result in gravity causing the power lines to sag downwards. Wind can also cause the power lines to swing from side to side. For this reason the approach distances must be increased either vertically or horizontally by the amount of conductor sag or swing at the point of work. Refer to Figure 2.

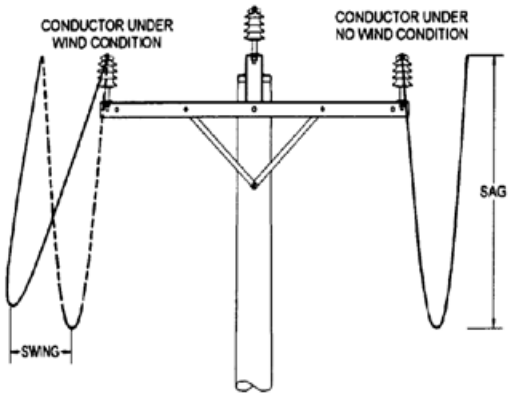


Figure 2: Illustration of overhead power line 'sag or swing'

- where more than one voltage is present, eg overhead power lines where two or more circuits operating at different voltages are supported on the same poles, the approach distance appropriate to each voltage must be maintained independently.
- increased clearances must be allowed where a risk assessment identifies a reasonable possibility of the load or lifting gear (crane hook, chains, slings, etc) moving or swinging towards the overhead power lines or associated electrical apparatus when the crane or item of mobile plant is operated.

3.2.2 Increases to approach distances

It is recognised that certain Australian Standards and industry practice in some States require greater approach distances than those described in this code. For certain types of work or classes of authorisation and competency, greater distances than that described in this code may be appropriate.

For example, the approach distances shown in Table 1 are less than those described in the Australian Standard AS 2550.5 Cranes, hoists and winches – Safe use Part 5: Mobile and Vehicle Loading Cranes, which is also gazetted as an approved industry code of practice. In the event of any inconsistencies between the Australian Standard and this code the approach distances specified in this code shall prevail.

Employers, self-employed persons and controllers of premises should determine the applicability of the approach distances described in this code for particular work circumstances and, if considered appropriate, specify greater approach distances for the work.

3.2.3 How close can I go to overhead power lines?

Once an assessment has been carried out of the worksite and the overhead power lines, a decision can be made on the approach distance for the proposed work. The approach distances and work zones described in this Chapter and illustrated in Figure 3 vary with the voltage of the overhead power lines and the level of accreditation of the person/s performing the work. The relevant approach distances are set out in the following tables:

- Table 1 provides the approach distances for ordinary persons. These are workers who have not received training in overhead power line electrical hazards and are restricted to work in the ordinary person zone. Refer to Section 3.3 and Figure 3.
- Table 2 provides reduced approach distances for accredited persons. These are workers who have successfully completed a recognised training course in overhead power line electrical hazards and are therefore permitted to work closer to the overhead power lines in the accredited person zone. Refer to Section 3.4 and Figure 3.
- Table 3 provides the approach distances for vehicles that are driven under overhead power lines. Refer to Section 3.6.

The approach distances vary with the voltage. They apply to:

- any part of a crane or item of mobile plant, including vehicles,
- any load being moved, including the slings, chains and other lifting gear,
- any person working at heights eg from an elevating work platform, scaffold, or other structure, or
- any hand tools, hand control lines, equipment or other material held by a person.

Note: Special approach distances apply for scaffolding work (Chapter 6) and work near low voltage overhead service lines (Chapter 8).

3.3 Ordinary Person Zone

Table 1 provides approach distances for:

- ordinary persons performing work near overhead power lines, (including plant, hand tools, equipment or any other material held by a person); or
- cranes (and their loads) and items of mobile plant operated by an ordinary person near overhead power lines.

Note: Where a written risk assessment determines it necessary, the use of a safety observer should also be considered for work performed by ordinary persons working outside but up to the approach distances specified in Table 1. The duties of the safety observer are described in Section 3.8.

TABLE 1

Approach distances for work performed by Ordinary Persons

Nominal phase to phase a.c. voltage (volts)	**Approach distance (m)**
Up to and including 132,000	3.0
Above 132,000 up to and including 330,000	6.0
Above 330,000	8.0
Nominal pole to earth d.c. voltage (volts)	**Approach distance (m)**
Up to and including +/- 1500 Volts	3.0

Note: Special approach distances apply for scaffolding work (Chapter 6) and work near low voltage overhead service lines (Chapter 8).

3.4 Accredited Person Zone

Table 2 provides approach distances for:

- accredited persons, with a safety observer who are performing work near overhead power lines (including plant, hand tools, equipment or any other material held by a person); or
- cranes (and their loads) and items of mobile plant operated by an accredited person with a safety observer near overhead power lines.

The approach distances in Table 2 are based on

- completion of a written risk assessment prior to the commencement of work,
- application of a safe system of work, which includes the use of a safety observer, and
- if determined by the written risk assessment, consultation with the network operator regarding the proposed work and compliance with any conditions imposed by the network operator for the work.

TABLE 2

Approach Distances for work performed by Accredited Persons, with a Safety Observer

Nominal phase to phase a.c. voltage (volts)	**Approach distance (m)**
Insulated low voltage cables up to 1000, including LV ABC	0.5
Un-insulated low voltage conductors up to 1000	1.0
Above 1000 up to and including 33,000	1.2
Above 33,000 up to and including 66,000	1.4
Above 66,000 up to and including 132,000	1.8
Above 132,000 up to and including 220,000	2.4
330,000	3.7
500,000	4.6
Nominal pole to earth d.c. voltage (volts)	**Approach distance (m)**
Up to +/- 1,500	1.0

Note: Special approach distances apply for scaffolding work (Chapter 6) and work near low voltage overhead service lines (Chapter 8).

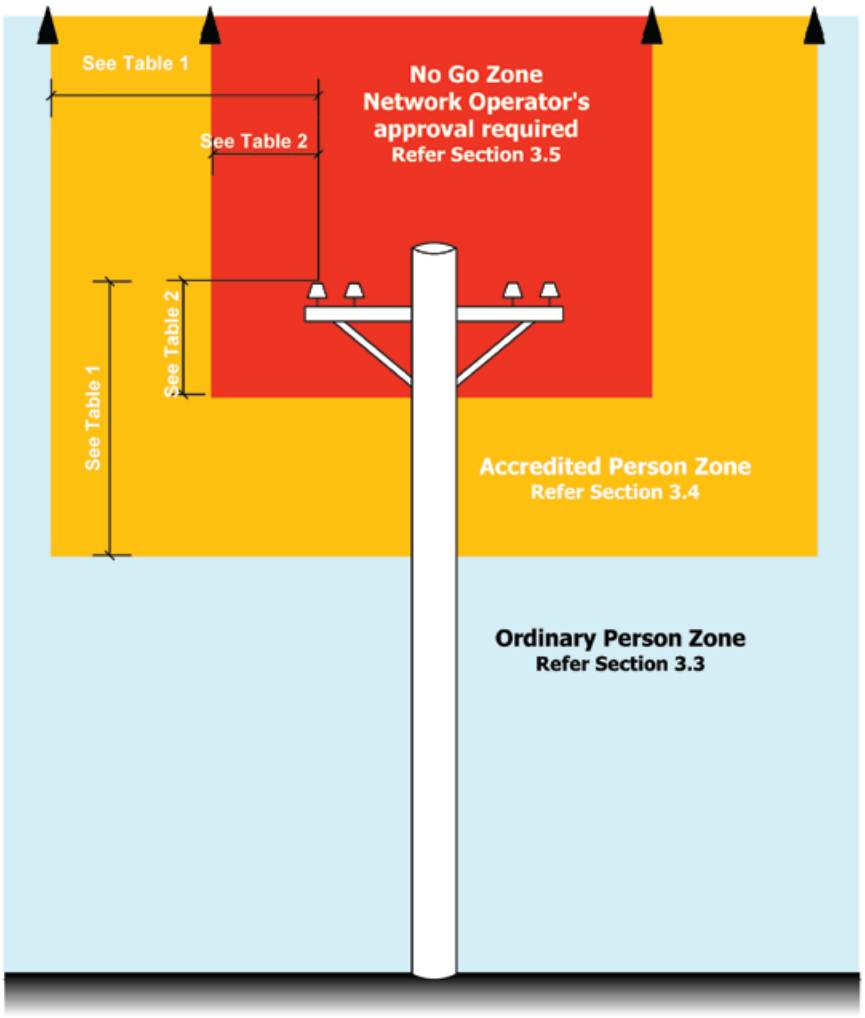


Figure 3 – Approach distances and work zones near overhead power lines

3.5 Work inside the No Go Zone – Approval of the network operator

The no go zone is the area around overhead power lines into which no part of a person or material or cranes or vehicles or items of mobile plant may encroach without the approval of the network operator.

Note:

- person includes hand tools, equipment or any other material held by a person.
- plant includes the load, controlling ropes and any other accessories associated with the plant.

If the work cannot be carried out without coming inside the no-go zone (closer than the approach distances listed in Table 2 or above the overhead power lines), prior to commencing work the employer must consult with and obtain the written approval of the network operator.

Note: The written approval should be available at the worksite and be able to be produced to a WorkCover Inspector, Principal Contractor, elected OHS representative, authorised representative or network operator.

3.6 Approach Distances for Vehicles

Table 3 provides approach distances for vehicles, mobile plant stowed for transit or with a design envelope up to an including 4.6 metres in height, which are driven by or operated by persons under overhead power lines.

When assessing the approach distance for a vehicle driven under overhead power lines a number of factors should be taken into account including:

- the approach distances specified in Table 3 are based on the fact that the design or transit envelope of the vehicle does not allow any part of the vehicle to come closer than the approach distances specified. This includes the load, exhaust pipe and attachments such as rotating/flashing lights or radio aerials. Refer to Figure 5 below.

Figure 5: Transit envelope – The maximum overall height of the vehicle



- where a work activity involves a person working from, standing on or walking across the top of a vehicle the relevant approach distance specified in either Table 1 or Table 2 must be maintained. This may include for example the driver of a livestock transporter who may need to access the top of the vehicle to check livestock.
- where, as a result of the work being performed the distance between the conductors and the ground may decrease (for example when constructing a road or levee bank beneath overhead power lines or where the ground level is raised during the work), then the distance between the vehicle must be continually re-assessed to ensure that the relevant approach distances are being maintained.
- any additional assessment factors that may be relevant for the operation of the vehicle as described in section 3.2.1.

TABLE 3

Approach Distances for Vehicles

Nominal phase to phase a.c. voltage (volts)	**Approach distance (m)**
Low voltage conductors up to 1000	0.6
Above LV, up to and including 33,000	0.9
Above 33,000 up to and including 132,000	2.1
Above 132,000 up to and including 220,000	2.9
330,000	3.4
500,000	4.4
Nominal pole to earth d.c. voltage (volts)	**Approach distance (m)**
Up to and including +/- 1500 Volts	0.9

3.7 Work near overhead power lines – General risk management principles

The approach distances set out in this Chapter are only part of an overall safe system of work, which must be implemented by employers and self-employed persons working near overhead power lines and associated electrical apparatus. In implementing a safe system of work consideration should be given to the following risk control measures:

- The employer has in place an effective risk management process, as part of a systematic occupational health and safety management system.
- Appropriate workplace hazard identification and written risk assessments are carried out as required by the OHS Regulation in consultation with the workers performing the work.
- Consultation with the network operator regarding the proposed work and compliance with any conditions imposed by the network operator for the work.
- The approach distances used are appropriate for the levels of accreditation of the workers performing the work. Refer to Sections 3.3 and 3.4
- Operators and other workers are provided with information and instruction about the safety precautions needed and the requirements of this code, as well as appropriate training, supervision and safe work practices and procedures.
- An essential requirement of a safe system of work is that workers are competent to carry out the work concerned. This code specifies the competency requirements (in respect of overhead power line electrical safety awareness) for crane and mobile plant operators and safety observers. Refer to Sections 3.8 and 3.9.
- An effective communication system is in place for the personnel performing the work.
- An effective process is in place to monitor compliance with the adopted risk control measures, safe work practices and procedures for work carried out near overhead power lines and associated electrical apparatus.

3.8 Competence and knowledge of this code

In order to carry out work at distances less than the approach distances specified in Table 1 the following workers must be accredited in accordance with Section 3.9 of this code,

- the operator of a crane,
- the operator of mobile plant (including an elevating work platform),
- a safety observer.

3.8.1 Training and Competence – Accredited Person

Accredited persons such as operators of cranes, mobile plant and elevating work platforms who carry out work closer than the approach distances specified in Table 1 and safety observers who observe the work must have successfully completed an appropriate training course (eg Crane and Plant Electrical Safety Course) relating to work near overhead power lines that has been conducted by a registered training organisation. Refer to Appendix 4 of this code for a training course framework, which is recognised by WorkCover NSW and network operators.

Note: 'Successful completion' includes a satisfactory competency assessment.

The registered training organisation, which provides the training and competency assessment required by this code must provide the person concerned with a statement of attainment or written certification of his/her successful completion of assessment, that has an identifying number particular to that person.

Employers should maintain appropriate training and assessment records for 'accredited persons' and other employees who carry out work near overhead power lines.

3.8.2 Maintenance of competency

The employer of accredited persons must ensure that those persons are either re-assessed or re-trained annually to ensure their on-going competency to perform activities associated with work near overhead power lines.

Re-assessment or re-training must cover as a minimum the knowledge and skills necessary to ensure safe work practices near overhead power lines, approved resuscitation procedures and emergency procedures to be followed in the event of an accident.

Following re-assessment, persons who have failed to maintain competency through the regular on the job application of learnt skills and knowledge must undertake refresher training and competency assessment.

3.9 Safety Observer – General requirements

The safety observer is a person specifically assigned the duty of observing the work near live overhead power lines and associated electrical apparatus in order to –

- warn personnel or the crane or plant operator so as to ensure the approach distances are being maintained, and
- warn of any other unsafe conditions.

The safety observer must –

- be used whenever the work activity is likely to be performed in the Accredited Person Zone.

Note: Where a written risk assessment determines it necessary, the use of a safety observer should also be considered for work outside but up to the Accredited Person Zone.

- be positioned at a suitable location to effectively observe both the overhead power lines and plant;
- be able to immediately and effectively communicate with the operator of the crane or mobile plant, or other personnel if required;
- ensure that all personnel stay outside the specified approach distance (unless performing a rescue in accordance with approved procedures or carrying out a specific task that is described in the safe work method statement eg a crane dogman holding a non-conductive tag line attached to a load suspended from a mobile crane);
- not carry out any other work while acting as a safety observer, which includes the passing of tools, equipment or materials directly to the personnel performing the work;
- not observe more than one work activity at a time; and
- continue to monitor the work activity being carried out and have the authority to suspend the work at any time.

CHAPTER 4 – OPERATING CRANES AND MOBILE PLANT NEAR OVERHEAD POWER LINES

4.1 Scope

In addition to the general requirements described in Chapter 3, this chapter details any variations applicable where a person operates a crane or an item of mobile plant near overhead power lines, including, but not limited to the following items of mobile plant:

- cranes (including mobile cranes and vehicle loading cranes);
- concrete placing booms;
- elevating work platforms (EWPs);
- mobile plant (including truck operators engaged in tipping loads, restraining loads or other associated work);
- load shifting equipment (including forklifts).
- excavation and earthmoving equipment
- high load transportation vehicles

However, the application of this Chapter is not limited to any particular type or class of mobile plant or equipment.

Note: This chapter is not intended to cover cranes and mobile plant when they are retracted and correctly stowed when travelling on a public road or where the design envelope of the crane or item of mobile plant is less than 4.6 metres in height.

WARNING

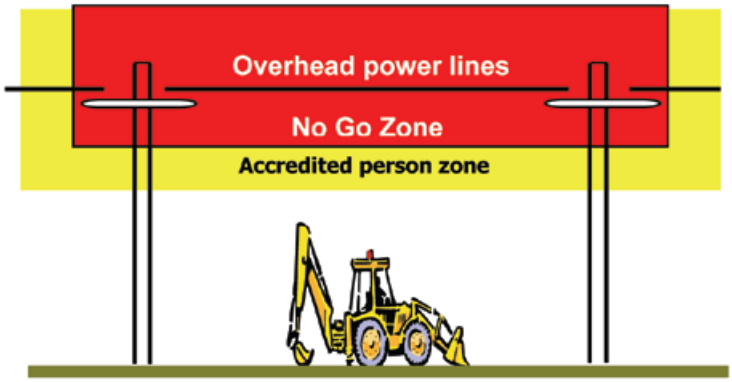


For the operation of cranes, mobile plant and other types of load shifting equipment the approach distances specified in this code of practice are greater than those described in the National Certificate of Competency – Assessment Instruments. Where any discrepancy exists between the National Assessment Instruments and this code, the code shall prevail.

4.2 Hazard identification

Before operating a crane or item of mobile plant, the operator or other person in control of the work must take reasonable care to inspect the workplace to identify potential hazards, including any live overhead power lines or other associated electrical apparatus in the vicinity of the workplace.

All overhead power lines should be treated as live unless the operator of the crane or mobile plant has received an access authority or other form of written documentation from the network operator.



Mobile plant including cranes, excavators, EWPs, earth moving machinery, tipper trucks and concrete placing booms whose design envelope is within the approach distances specified in Table 1 must be controlled by safe systems of work as described in this chapter.

Figure 6: Cranes and mobile plant working near overhead power lines

4.3 Risk assessment



Risk assessment involves looking at the:

- likelihood (which is a combination of length of time and frequency of exposure); and the
- likely severity, of any injury or illness that may occur.

If you have identified a hazard involving overhead power lines where it is foreseeable that the work activity, crane or item of mobile plant will be required to or might inadvertently encroach on the approach distances specified for ordinary persons set out in Table 1, a written risk assessment must be completed which considers the following factors:

- consulting the network operator regarding the proposed work;
- can the electricity supply be de-energised?
- the location and voltage of the overhead power lines;
- the number of people involved and their individual needs;
- the nature of work undertaken;
- the nature, size and shape of the load to be moved, eg dimensions, surface area and whether the load is conductive;
- the setting up and packing up processes;
- the safe work practices and procedures in use;
- the type of crane, mobile plant, machinery and equipment to be used and its design envelope;
- site conditions, stability of crane or mobile plant and suspended loads;
- the potential for inadvertent movement of the crane or mobile plant, the load, persons and electrical equipment in the area;
- the qualifications, competency, skill and experience of people doing the work;
- vehicular traffic, pedestrians, or livestock that could interfere with the work;
- prevailing or unexpected wind strength and direction and weather conditions;
- foreseeable abnormal conditions that may exist at the worksite.

Having assessed the risks, action must now be taken to ensure that the risks are eliminated or controlled. Employers need to ensure adequate supervision of workers to make sure that control measures are applied.

Listed below in section 4.4 are steps to consider. Every workplace is different, so select the controls that are the right ones for you.

4.4 Control measures for cranes and mobile plant operating near overhead power lines

The highest practical level of control should be used. This does not preclude the additional use of appropriate lower level controls. In determining the control measures appropriate for a particular task consideration must be given to the terrain and ground conditions, weather conditions, lighting, and other work in the vicinity as well as the nature of the actual task to be carried out.

4.4.1 Elimination

Eliminate the risk of electrocution, electric shock or burns by arranging for the network operator to isolate the electricity supply for the duration of the work. Consideration may also be given, following consultation and agreement of the network operator, to re-route the overhead power lines away from the crane or mobile plant or replace existing overhead powerlines with underground cables.



WARNING

Even if it is believed that the supply has been isolated, it must be assumed that all conductors and components are live until an access authority or other form of written documentation has been received from the network operator.

The employer, self-employed person or operator of the crane or mobile plant should:

(a) discuss options for de-energising or re-routing the electricity supply with the network operator or in the case of work involving private overhead power lines, the person in control of the premises;

(b) consider working at another time when the electricity supply can be isolated; and

(c) investigate whether the section of the overhead power lines that needs to be de-energised can be isolated, while leaving the remainder connected.

4.4.2 Separation

If the risk cannot be eliminated, then separate the hazard from the crane or mobile plant and the personnel by:

(a) using an alternative crane or mobile plant which cannot encroach on the approach distances;

(b) limiting the hoisting, slewing or other movements of the crane or mobile plant such as:

- mechanical stops or interlocking of the motion of the crane or mobile plant to prevent it from being moved by power within the approach distance;
- mechanical constraints on the jib, boom, or other part of the crane or mobile plant likely to contact live overhead power lines or associated electrical apparatus as a result of surge or backlash;
- using cranes or mobile plant fitted with programmable zone limiting devices.

(c) setting up the crane or mobile plant in a position that keeps the design envelope outside the approach distance.

Note: Consideration should be given to any loads suspended by the crane or mobile plant or when being moved by load shifting equipment.

(d) minimising unexpected movement of the crane or mobile plant through:

- additional outriggers, supports or packing to increase the stability of the crane or mobile plant;
- preparation of the ground or surface, or adjustment or servicing of the crane or mobile plant, to minimise surge or backlash;

Increased clearances must also be allowed where there is a reasonable possibility the load or lifting gear (crane hook, chains, slings, etc) moving or swinging towards the overhead power lines or associated electrical apparatus when the crane or item of mobile plant is operated.

(e) providing marking barriers to define areas that the crane or mobile plant should not enter such as by:

- using rigid or tape barriers to mark off areas under overhead power lines;
- arranging for the network operator to mark the limit of the approach distance with high visibility 'bunting' or similar. Refer to Figure 7 below.



Figure 7: Illustration of a visual tape bunting fitted under overhead power lines.

(f) providing electrical separation between the people and hazard in accordance with the guidance outlined in Section 4.5 – Workers in contact with the crane, load or mobile plant.

4.4.3 Administrative controls

Support elimination and separation controls by taking the following precautions:

(a) managing and supervising the work to ensure that:

- the work is done very carefully and in an un-hurried, considered manner (haste can be dangerous);
- the employer's safe work method statements are rigorously followed;
- the appropriate persons involved in the work are accredited in accordance with the requirements of Section 3.8 of this code.

(b) making the hazard visible by arranging for the network operator to effectively identify exposed live low voltage conductors (up to an including 1000 volts) by using approved visual indicators such as sheeting or sleeves eg 'tiger tails'. In this situation the 'tiger tails' should extend a minimum distance of 5 metres beyond the extremities of where the crane or item of mobile plant will be operating. A competent person should visually inspect the tiger tails each day prior to commencing the crane, or mobile plant operations. If they have moved or been damaged the network operator should be contacted to ensure the tiger tails are replaced or located in the correct position. Refer to Section 9.1 of this code.

(c) planning for emergencies including:

- having fire-fighting equipment that is suitable for electrical fires at the site and readily accessible;
- having an appropriate first aid kit available at the worksite.

(d) ensuring that a safety observer is used whenever a crane, mobile plant or load is in motion and is likely to come closer than the approach distances listed in Table 1 and illustrated in Figure 3. The duties of the safety observer for work involving cranes and mobile plant is described in Section 3.9 of this code.

(e) considering the fitting of a warning device to the crane or mobile plant that alerts the operator when the crane or mobile plant has entered energised high voltage overhead power line zones. Warning: These devices are not a substitute for the proper management of safe work practices and procedures.

(f) using warning signs to indicate the location of overhead power lines and/or defined work areas. Refer to Figure 8 below.



Figure 8: Overhead power lines warning sign

4.5 Workers in contact with the crane, load or mobile plant

No-one may remain in contact with any part of a crane, load or mobile plant and the ground or other earthed situation while the crane or mobile plant is being operated closer than the approach distances listed for ordinary persons in Table 1 of this code, unless additional precautions are taken to prevent electric shock, as follows.

4.5.1 Operators

The operator may handle the controls of a crane or item of mobile plant while standing on the ground or while in an earthed situation only if -

- the controls are effectively insulated (consultation with the network operator will be necessary to verify effective insulation); or
- are wireless remote control; or
- the operator wears low voltage insulating gloves – provided that the live electrical apparatus is low voltage; or
- for low voltage, the operator stands on a rubber insulating mat 900mm x 900mm x 6 mm thick that is clean and dry; or
- the operator stands on an 'equipotential conductive mat' which is electrically connected to all metalwork associated with the controls.

4.5.2 Other workers

Other workers at the workplace may contact the crane, mobile plant or load while standing on the ground or while in an earthed situation only if one of the following control measures is observed -

- they wear low voltage insulating gloves – provided that the overhead power lines or electrical apparatus is low voltage; **or**
- effective insulation is provided on the overhead powerlines or electrical apparatus, or the crane, load or mobile plant or it's parts to ensure that even if it contacts the overhead powerlines or electrical apparatus, no–one would receive an electric shock; **or**
- control of the load by non-conductive tail ropes whenever uncontrolled motion could allow it to come within the approach distance (as long as the insulating properties of the rope are appropriate to the operating voltage), **or**
- they are positioning or removing lifting gear from a crane hook or the load while it is stationary; **or**
- they are adjusting outriggers, jacks, packing's, chocks or similar, as long as the crane, load or mobile plant is not being moved.

4.6 Competency requirements

In order to carry out crane and mobile plant operations closer than the approach distances specified in Table 1, the following personnel must be accredited as described in section 3.8 of this code,

- the operator of a crane,
- the operator of mobile plant (including an elevating work platform),
- a safety observer.

4.7 Safety observer for crane and mobile plant operations

A safety observer as described in Section 3.9 must be assigned the duty of observing the approach of a crane or mobile plant (and its load) to the live overhead power lines and associated electrical apparatus.

The safety observer must –

- be used whenever the crane, load, mobile plant or persons working from the plant are in motion and are likely to come closer than the approach distances specified in Table 1;

Note: Where a written risk assessment determines it necessary, the use of a safety observer should also be considered for work performed by ordinary persons working outside the approach distances specified in Table 1.

- be positioned at a suitable location to effectively observe both the overhead power lines and plant;
- be able to immediately and effectively communicate with the operator of the crane or mobile plant, or other personnel if required;
- ensure that all personnel stay outside the specified approach distance (unless performing a rescue in accordance with approved procedures or carrying out a specific task that is described in the safe work method statement eg a crane dogman holding a non-conductive tag line attached to a load suspended from a mobile crane);
- not carry out any other work while acting as a safety observer, which includes the passing of tools, equipment or materials directly to the personnel performing the work;
- not observe more than one crane or item of mobile plant at a time; and

- continue to monitor the work activity being carried out and have the authority to suspend the work at any time,

In addition to the above requirements, the safety observer must not be located on the workbasket of an elevating work platform while observing the work being undertaken from that workbasket.

A safety observer is not necessary in the following circumstances –

- for an item of stationary plant, once completely erected, if it is not located below the overhead power lines or electrical apparatus and is located horizontally outside the approach distances specified in Table 2;
- if an effective limiting device has been set to prevent any component of a crane, mobile plant or load coming closer than the approach distances in Table 2, as long as the limiting device is effective under stress conditions and is regularly inspected and tested by a competent person; or
- where, the design of the crane or mobile plant limits movement so that no part of the crane, mobile plant or load can come closer than the approach distances specified in Table 2.

4.8 Earthing systems for cranes and mobile plant

The chassis of a crane or item of mobile plant may, where practical, be earthed and bonded. A system of work must be adopted that ensures workers are kept clear of cranes and mobile plant when work is carried out near live overhead power lines and workers be advised of the effectiveness of the earthing system.

For specific advice and guidance about the earthing of a crane or item of mobile plant consult with the network operator.

4.9 Notices to be fixed to cranes and mobile plant

Cranes or items of mobile plant intended for use, or used, near live overhead power lines must be fitted with a warning notice or label, conforming to Appendix 1 of this code, listing the approach distances for ordinary persons as set out in Table 1.

The notice or label must be maintained in a legible condition and be displayed at each set of controls and must be readily visible to the operator.

Note: Where a crane or item of mobile plant is fitted with notices in accordance with the Interim Guide, the existing notices may be retained provided the plant is operated to the distances shown on the notice. Only columns described in the Table A notice for 'non-electrical work' or Table B for 'unqualified personnel' must be applied in relation to work under this code.

CHAPTER 5 – TREE AND VEGETATION MANAGEMENT NEAR OVERHEAD POWER LINES

5.1 Scope

In addition to the general requirements described in Chapter 3, this chapter details any variations applicable where a person works on trees such as, cutting, trimming, treating with chemicals or other processes, trees and other foliage near live overhead power lines where:

- a person or something the person is holding or is in contact with or could come closer than the relevant approach distance specified in either Table 1 or Table 2 of this code or;
- the work creates risk of damage to overhead power lines or electrical apparatus.

Tree and vegetation management carried out by or for network operators is excluded from this section as it is covered by the requirements of the *Electricity Supply (Safety and Network Management) Regulation 2002*.

5.2 Hazard identification and risk assessment

When carrying out the work, live overhead power lines are a potential hazard posing substantial risk of death or serious injury.

During tree and vegetation management electrical hazards can be encountered through a variety of circumstances. These include but are not limited to:

- branches or other vegetation falling onto power lines during trimming operations
- tools such as power saws or power trimmers coming into direct contact with power lines or other associated electrical apparatus
- mobile plant, for example an elevating work platform (EWP), coming into contact with overhead power lines or other associated electrical apparatus
- power lines becoming broken and falling on the ground, footpath or road
- wind blowing branches or limbs against overhead power lines
- high winds resulting in the loss of control while lowering materials
- unexpected movement of the worker, mobile plant or the vegetation relative to the worker.

If a hazard involving tree management work near overhead power lines has been identified, a written risk assessment must be undertaken by the employer to determine the risk to persons encroaching within the relevant approach distances. This step will help determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk.

5.3 Eliminating or controlling risks – General risk factors

The risks associated with electrical hazards arise from coming near live conductors. The best means of eliminating the risks is to prevent people, their plant and equipment, as well as any materials from coming close enough to live conductors for direct contact or flash over to occur.

Care needs to be taken in planning the work to identify the ways in which people may be exposed to electrical hazards when the work is undertaken and determine the most effective means to ensure the approach distances are maintained from the live overhead power lines.

In addition to ensuring that the work near overhead powerlines is avoided, other factors should be considered:

- always assume an overhead power line or associated electrical apparatus to be energised or 'live' unless an access authority or other written documentation is received from the network operator.
- if a telecommunication cable is encountered, never assume that the operating voltage is harmless.
- a tree or branch of a tree can conduct electricity even in dry conditions. Never assume that a tree branch can safely rest on or against overhead power lines. If the tree or branch has the potential during the felling or cutting process to come closer than the approach distances specified in Table 1 the overhead power lines should be de-energised.
- trees that have grown into contact with live overhead power lines must not be cut by a person who is in an earthed situation (such as a standing on the ground or working from within the tree) unless a safe system of work is used that meets the requirements of the network operator.
- plant that comes near an overhead power line may become energised and pose a serious danger to the operator and any bystanders. Ensure that when operating plant (ie any machines (including chain saws), tools or equipment) near live overhead powerlines that the relevant approach distances are maintained. Operations should cease where trees or persons are in danger of coming closer than the relevant approach distances.
- manage traffic and pedestrians at the worksite to ensure approach distances are maintained and that members of the public are kept at a safe distance. If the work near overhead power lines requires a change in traffic direction or vehicle speed limits, full traffic control is required in accordance with the Roads and Traffic Authority's requirements.
- assess the weather conditions, including electrical storms, significant rain or excessive wind velocities that could impact on the proposed work.

5.4 Requirements for Ordinary Persons carrying out tree and vegetation management

An ordinary person must not:

- climb a tree closer than 3 metres to live overhead power lines, or cut any branch that may come closer than 3 metres to live overhead power lines as a result of the work, or
- allow any part of their body or anything they are holding or that is attached to their body, or anything they are using, to come closer than the approach distances specified in Table 1 of this code when carrying out the work near live overhead power lines.

Ensure the work is not carried out above overhead power lines or where any part of the tree or vegetation could fall or otherwise be carried closer than the approach distances specified in Table 1.

If there is a reasonable possibility of the work being carried out above overhead power lines or coming closer than the approach distances specified in Table 1 the work must be carried out by accredited persons who have been trained and have current competency to carry out 'tree and vegetation management' near live overhead power lines. See Section 5.5 of this code.

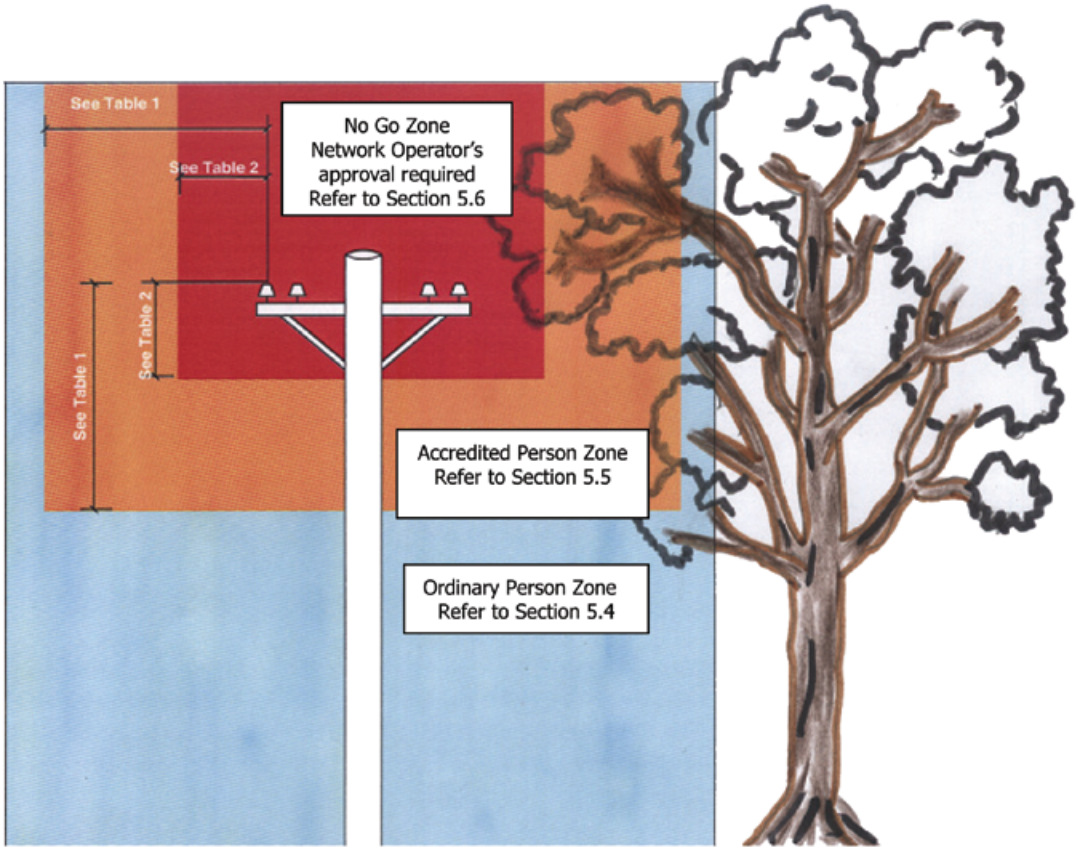


Figure 9 – Work zones for tree management near overhead power lines

5.5 Requirements for Accredited Persons carrying out tree and vegetation management

Accredited persons who have current competency to carry out 'tree and vegetation management' near live overhead power lines may carry out the work in accordance with the approach distances specified in Table 2 of this code provided the following requirements are observed,

- a written risk assessment is completed for the work and a safe system of work is implemented, which includes a safety observer, and
- if determined by the written risk assessment, consultation with the network operator regarding the proposed work and compliance with any conditions imposed by the network operator for the work.

Note: Training and assessment requirements for accredited persons, which include safety observers are described in Sections 3.8 and 3.9 of this code.

5.6 Tree management inside the No Go Zone – Approval of the network operator

The no go zone is the area around overhead power lines into which no part of a person or material or cranes or vehicles or items of mobile plant may encroach without the written approval of the network operator.

- person includes hand tools, equipment or any other material held by a person.
- plant includes the load, controlling ropes and any other accessories associated with the plant.

Work required on tree and vegetation that is inside the no-go zone (closer to live overhead power lines than the approach distances specified in Table 2 of this code) must only be performed by authorised persons approved by the network operator.

5.7 Trees or branches contacting live overhead power lines

While it is not permitted to work on trees where they (or their branches) may fall on overhead power lines, it is important to know what action to take if a branch or tree comes into contact with a live overhead power line, whether through pruning, wind, storm or other damage.

When this situation arises, *do not touch any part of the branch or tree*. If any part of a branch is touching live power lines, the entire branch may be 'live', including the leaves. Contact with any part of it may result in electric shock, burns or electrocution.

Immediately contact the network operator and keep all persons clear of the area while waiting for assistance.

Other aspects of tree and vegetation management safe work practices and procedures can be found in the *Code of Practice – Amenity Tree Industry.*

CHAPTER 6 – WORK INVOLVING SCAFFOLDING NEAR OVERHEAD POWER LINES

6.1 Scope

In addition to the general requirements described in Chapter 3, this chapter details any variations applicable where the work involves the erection, dismantling and use of fixed scaffolding near overhead power lines and associated electrical apparatus with an operating voltage up to and including 33 kV a.c. For scaffolding work above this voltage the network operator must be consulted and any special conditions imposed by the network operator complied with.

The guidance provided in this Chapter should be read in conjunction with AS/NZS 4576 – Guidelines for Scaffolding, which is an approved industry code of practice. In the Standard a 4 metre approach distance is provided for metallic scaffolding used near overhead power lines. This approach distance is used as a reference point for persons planning and undertaking scaffolding work as described in this Chapter.

For work involving the use of mobile aluminium scaffolding refer to the risk control measures for mobile plant that are described in Chapter 4 of this code.

6.2 Hazard identification

Before undertaking any scaffolding work where the work might come closer than the 4 metre approach distance specified in AS/NZS 4576 – Guidelines for Scaffolding, an inspection must be carried out at the worksite and reasonable care taken to identify any potential hazards.

Hazards may include:

- live overhead power lines and associated electrical apparatus;
- deteriorated or broken down insulation on the conductors or electrical apparatus;
- scaffolding coming into contact with overhead power lines; and
- possibility of hand held tools, equipment or materials coming into contact with overhead power lines.

6.3 Risk assessment

If a hazard involving overhead power lines has been identified, a written risk assessment must be undertaken by the employer to determine the risk to persons encroaching within the 4 metre approach distance. This step will help determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk. If the scaffolding work is above 3 metres in height it must also be supported by a safe work method statement for the work. Refer to Appendices 2 and 3 of this code.

The following factors may be included in the risk assessment:

- the type of work activities being undertaken, tools, equipment, scaffolding and materials being used;
- proximity of the work activity or scaffolding to the overhead power lines;
- environmental conditions, such as rain, wind or uneven terrain, which may be bring a risk of unexpected movement of tools, equipment, scaffolding or material held by workers.

6.4 Eliminating or controlling risks – general risk factors

Once the hazards associated with scaffolding work near the overhead power lines have been identified and assessed, then control measures must be implemented to eliminate the risk. If it is not practicable to do so, the risks associated with the hazard must then be controlled.

The use of specific control measures to eliminate or control identified risks should be done on the basis of the risk assessment. In particular, consider the following:

1. Eliminating the hazard. This could involve de-energising the overhead power lines during the work. Consideration may also be given, following consultation and agreement of the network operator, to re-route the overhead power lines away from the scaffolding or replace existing overhead powerlines with underground cables.
2. Separating the hazard. This could mean erecting a physical barrier on the scaffold to prevent a person or anything held by a person, or attached to the person, encroaching with the 4 metre approach distance.
3. Minimising the risk by engineering means. This could mean substituting the scaffold with another means of access and egress, such as an elevated work platform or using an insulated fibreglass extension handle on a paint roller, instead of a conductive aluminium extension handle.
4. Introduce administrative controls. This may include planning and where relevant documenting the safe work method statements before starting work or using a safety observer to warn people before they encroach within the 4 metre approach distance. The duties of a safety observer are outlined in Section 3.9 of this code. Making the hazard visible by arranging for the network operator to effectively identify exposed live low voltage conductors (up to an including 1000 volts a.c.) by using approved visual indicators eg 'tiger tails'. Refer Section 9.1 of this code.
5. Use appropriate personal protective equipment. This includes the use of electrically tested insulating gloves by anyone who may be at risk of coming closer than the 4 metre approach distance.

A combination of the above control measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.

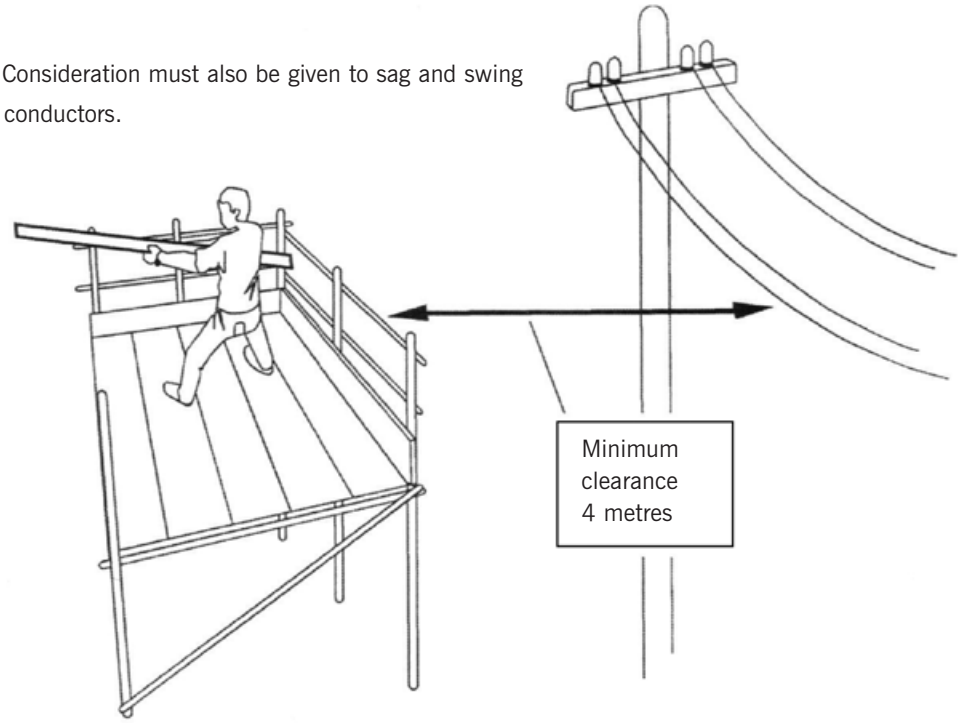
6.5 Control measures for the erection and dismantling of scaffolding near overhead power lines up to and including 33kV

(a) Ensure a thorough examination and assessment is undertaken of the surroundings prior to the erection or dismantling of the scaffold near overhead powerlines. No scaffold work should commence until the presence, location, type and operating voltage of all overhead power lines are determined by a competent person.

(b) Overhead powerlines should be de-energised and an access authority or other form of written documentation obtained from the network operator if the scaffold and the overhead powerlines is or has the potential to come within the 4 metre approach distance. Refer to Figure 10 below.

(c) If there is the risk that the 4 metre approach distance cannot be maintained, the network operator must be contacted and a written risk assessment and safe work method statement including safe systems of work developed for the activities associated with the erection, use and dismantling of the scaffolding.

Note: Consideration must also be given to sag and swing of the conductors.



Note: End protection omitted for clarity

Figure 10 – A 4 metre approach distance applies in any direction where metallic scaffold is erected, used or dismantled near overhead power lines.

(d) Where low voltage overhead powerlines (up to and including 1000 volts) cannot be de-energised and isolated, 'tiger tails' should be provided and installed by the network operator for the full length of the scaffolding plus a minimum distance beyond each end of the scaffolding of 5 metres. A competent person should visually inspect the tiger tails each day prior to commencing scaffolding operations. If the tiger tails have moved or been damaged the network operator must be contacted to ensure the tiger tails are replaced or located in the correct position.

Note: Tiger tails may be used to provide a useful visual indication to people working in the area of overhead power lines. They should not be regarded as providing protection against mechanical interference nor should they be regarded as providing electrical protection from electrical hazards. Refer to Section 9.1 of this code for further guidance.

(e) Electrical wires or apparatus that pass through a scaffold must be de-energised or fully enclosed to the requirements of the network operator. These requirements must incorporate full enclosure of the wires or electrical apparatus by a non-conductive material such as moisture resistant flooring – grade particle board, dry timber, dry plywood or similar dry non-conductive material as approved by the network operator. Refer to Section 6.6 and Figure 11.

(f) To prevent a person or anything held by a person, or attached to the person, coming closer than the 4 metre approach distance the network operator may require the erection of a hoarding on the external face of the scaffolding and, if applicable a suitable enclosure on the internal side of the scaffold. Refer to Section 6.6 and Figure 11.

Example of live low voltage overhead power lines passing through a scaffold that has been fully enclosed in a non-conductive material to the requirements of the network operator.



Figure 11 – Enclosure of overhead powerlines

6.6 Erected Scaffolding – Use of a hoarding and enclosure for reduced safety clearances

This section describes the requirements for the use of a hoarding and, if applicable, a suitable enclosure between an erected scaffolding and a live overhead power line when a non-conductive hoarding and enclosure is used to provide an impenetrable barrier to persons, tools, materials and equipment.

The A and B clearances shown in Figure 12 are horizontal safety clearances and vertical mechanical clearances from the conductors and will be advised by the network operator prior to the erection of the scaffolding near the overhead power lines.

The following installation conditions apply for the use of a hoarding and enclosure for reduced safety clearances,

- Gaps between fitted sheets of plywood must not exceed 3mm.
- No exposed cut or drilled holes are permitted in the sheets of plywood.
- Scaffolder is responsible for attaching plywood to the scaffold, and ensuring that the arrangement can sustain an appropriate wind load.
- Warning signs must be affixed to the safe side of the hoarding warning of the presence of the electrical hazard on the other side of the hoarding and warning that the hoarding must not be removed.
- A competent person should visually inspect the hoarding and, if applicable the enclosure on a daily basis to ensure the hoarding and enclosure are in a satisfactory condition and remain impenetrable.

Further guidance on the erection, dismantling and use of scaffolding can be found in the Australian Standard AS/NZS 4576 – Guidelines for Scaffolding.

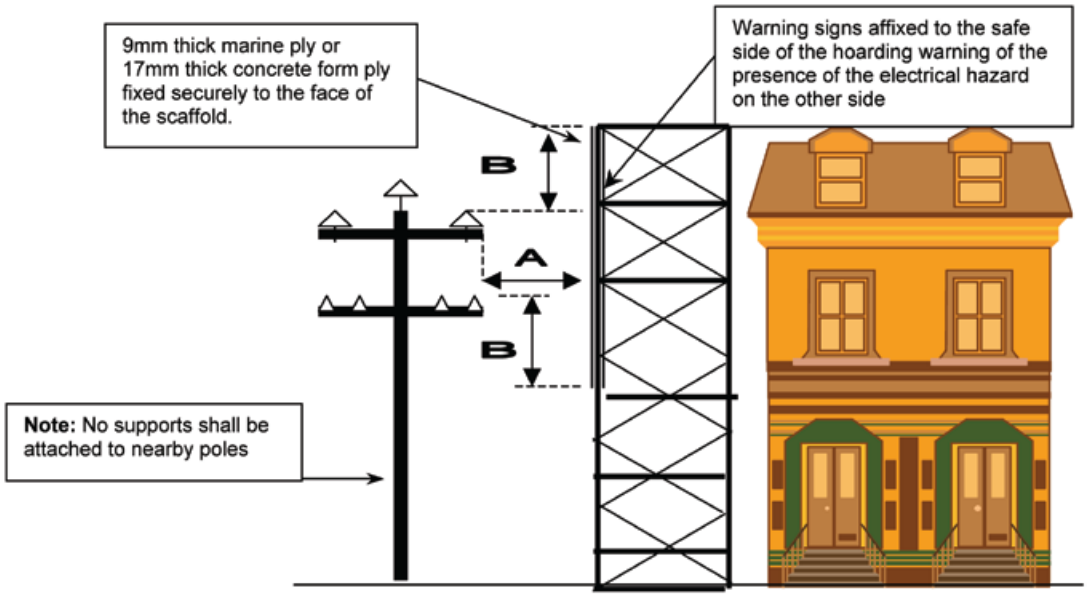


Figure 12 – Scaffolding with hoarding

CHAPTER 7 – AGRICULTURAL WORK NEAR OVERHEAD POWER LINES

7.1 Scope

In addition to the general requirements listed in Chapter 3, this chapter details any variations applicable where work is being conducted at rural workplaces where:

- the person or something the person is operating or holding could contact overhead power lines or come closer than the approach distances specified in Table 1 of this code or;
- the work creates risk of damage to overhead power lines or electrical apparatus.

Examples of such work include:

- the use of lifting or elevating plant or agricultural plant such as grain augers, hay bale elevators, cotton harvesting equipment, tipper and livestock transport trucks, travelling irrigators or harvesters under or near overhead power lines;
- handling irrigation pipes under or near overhead power lines;
- moving or relocating agricultural plant, such as folding cultivators, where the transit (stowed) height of the equipment is greater than its operating height;
- any other work that involves the risk of a person or anything attached to or held by a person, coming into contact with overhead power lines.

7.2 Hazard identification

Many people have been killed by electrocution when metal parts of agricultural plant (such as augers, field bins, harvesters or tip trucks) have come into contact with or close to live overhead power lines. Such accidents usually occur when the operator has not lowered the equipment before moving it or has raised the item of mobile plant upwards into the live overhead power lines. For example,

- working near and in the process may come into contact with machinery operating near overhead powerlines;
- driving machinery with tall attachments through paddocks where overhead powerlines exist; or
- operating or moving tipper trucks, mobile silos, field bins, harvesters or other large rural machinery (cotton harvesters, field irrigators) under or near live overhead power lines; or
- moving or re-arranging long metallic irrigation pipes.

Where work is carried out near live overhead power lines, the height and location of the power lines needs to be identified as part of an overall site hazard identification process. Contact should be made with the electricity network operator who can assist with this process.

Operators of agricultural plant and equipment also must be made aware of the design height and the transit (stowed) height of the mobile plant they operate.

7.3 Risk assessment

If a hazard involving overhead power lines has been identified, a written risk assessment must be undertaken to determine the risk of any part of the agricultural plant or equipment coming near or into contact with the overhead power lines. This step will help to determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk.

The following factors may be relevant to the risk assessment:

- the type of work activities being undertaken or agricultural equipment being used;
- proximity of the work to the overhead power lines and the height of the overhead power lines;
- environmental conditions, such as rain, wind or uneven terrain, which may bring an increased risk;
- visibility of the overhead power lines and their supporting structures;
- location of overhead power lines supporting structures such as poles and towers in relation to the agricultural work to be performed;
- how often the work will need to be done near the overhead power lines;
- proximity of stationery or fixed plant and equipment to overhead power lines.

7.4 Control measures for agricultural work near overhead power lines

Once the hazards associated with agricultural work near overhead power lines have been identified and assessed then control measures must be implemented to eliminate the risk. If it is not practicable to do so, the risks associated with the hazard must then be controlled.

The use of specific control measures to eliminate or control identified risks should be done on the basis of the risk assessment. In particular, consider the following:

1. Eliminating the hazard. Identify the location of overhead power lines and relocate the plant and equipment, such as a mobile silo or tipper trucks away from the overhead power lines. Lower augers before transporting to eliminate the risk of contacting overhead power lines. Keep mobile irrigator sprayed water at least 8 metres away from overhead power lines. Consideration may also be given, following consultation and agreement of the network operator, to relocating the overhead power lines or having them run underground. In this case consult with the network operator.
2. Separating the hazard. This could mean erecting a physical barrier to prevent any part of the agricultural plant encroaching the approach distance specified in Table 1.
3. Minimising the risk by engineering means. This could mean substituting with a less hazardous material, process or equipment. This could mean, for example, filling a silo through a ground-level filler pipe on the silo rather than using a truck-mounted auger or limiting the height of all mobile plant in order to maintain safety clearances from overhead power lines.
4. Introduce administrative controls. These include:
    - planning and documenting a safe system of work before starting work;
    - developing work procedures and travel routes for equipment and vehicles that ensure workers, their equipment and containers such as field bins, stock and tipper trucks do operate near or under live overhead power lines;
    - using another worker (to act as an observer) to ensure the work activity does not come closer than the approach distances specified in Table 1

- installing warning signs on gates to paddocks or on roadways where overhead power lines exist, (Refer to Figure 13 below);



Figure 13 – Overhead power lines warning sign

- having markers installed on overhead powerlines to make them easier to see and locate.

5. Use appropriate personal protective equipment. This includes the use of rubber soled boots, gloves and safety helmets when agricultural plant or equipment is being operated near overhead power lines.

A combination of the above control measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.

CHAPTER 8 – WORK NEAR LOW VOLTAGE OVERHEAD SERVICE LINES

8.1 Scope

In addition to the general requirements listed in Chapter 3, this chapter details any variations applicable where an ordinary person is required to carry out work near low voltage overhead service lines where the work involves:

- Minor building work such as painting; or
- Operation of motor vehicles (concrete trucks, furniture removal vans, etc); or
- Any other non-electrical work where there is a risk of contact with low voltage overhead service lines.

For the purposes of this code 'low voltage overhead service lines' covered by this chapter and illustrated in Figure 14 are:

- insulated low voltage aerial conductors and associated electrical apparatus that are connected from the point of supply (either the overhead power pole located on the street or the consumer's boundary) and terminated on the consumer's building, pole or structure at the point of attachment, or;
- insulated low voltage aerial consumers mains and associated electrical apparatus forming part of the consumer's electrical installation.

Note: For work involving cranes or mobile plant or work where any metal material is being handled (scaffolding, roofing materials and guttering) the risk control measures and increased approach distances described in other chapters of this code must be applied to the work.

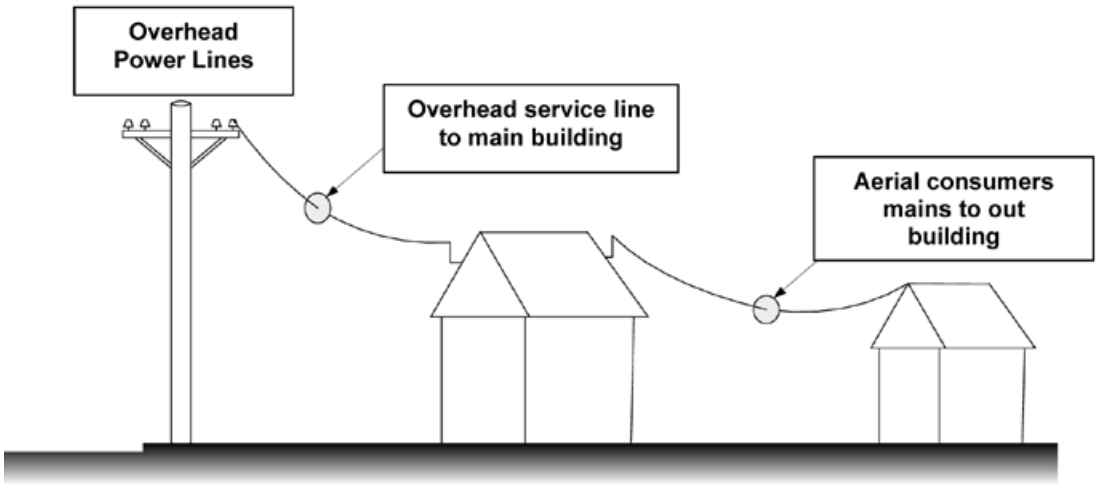


Figure 14 – Low Voltage Overhead Service Lines

8.2 Approach distances for work near low voltage overhead service lines

Table 4 provides approach distances for ordinary persons:

- performing minor building work near low voltage overhead service lines, (including hand tools held by a person); or
- operating cranes (and their loads) and items of mobile plant near low voltage overhead service lines; or
- handling metal materials near overhead service lines (such as scaffolding, roofing materials and guttering); or

- handling non-conductive materials near overhead service lines (such as timber, plywood, PVC pipes and guttering, etc); or
- driving or operating a vehicle under overhead service lines. **Note:** the approach distance specified in Table 4 is based on the fact that the design or transit envelope of the vehicle does not allow any part of the vehicle to come closer than the 0.6 metre approach distance specified.

TABLE 4

Approach distances for work near low voltage overhead service lines

Ordinary Persons (m)				
Hand held tools	**Operation of crane or mobile plant**	**Handling of metal materials (Scaffolding, roofing, guttering, pipes, etc)**	**Handling of non-conductive materials (Timber, plywood, PVC pipes and guttering, etc)**	**Driving or operating vehicle**
0.5	3.0	4.0	1.5	0.6

8.3 Work inside the relevant approach distances

If the work cannot be carried out without coming inside the relevant approach distance (ie closer than the approach distances listed in Table 4), prior to commencing work the employer or self-employed person must comply with the following requirements:

- identify the hazards,
- complete a written risk assessment for the proposed work,
- apply a safe system of work, and
- meet the requirements of the relevant network operator or in the case of overhead service lines forming part of the consumer's electrical installation, the controller of the premises.

8.4 Hazard identification

Before undertaking any work where the work might come closer than the specified approach distances an inspection of the worksite must be carried out and reasonable care taken to identify any potential hazards. Hazards associated with the low voltage overhead service lines may include:

- bare exposed live conductors;
- deteriorated or broken down insulation;
- damaged overhead service line mains connection box or damaged insulation around conductor clamps;
- deterioration of earthing of exposed conductive parts that are required to be earthed;
- voltage of the line is higher than the expected low voltage (240 / 415 volts a.c.); and
- possibility of hand held tools and equipment coming into contact with exposed live parts.

8.5 Risk assessment

If a hazard involving low voltage overhead service lines has been identified, a written risk assessment must be undertaken to determine the risk to persons encroaching within the specified approach distance for the work. This step will help determine the level of risk associated with the identified hazards and establish a priority list based on the level of risk.

The following factors may be relevant to the risk assessment:

- The type of work activities being undertaken, including how safe access and egress will be made to the work area;
- Tools or equipment being used, and the risk of mechanical damage to the low voltage overhead service lines if inadvertent contact is made with the conductors and electrical apparatus; Examples may include:
    - Handling a sheet of roofing material that inadvertently comes into contact with the service lines.
    - Use of cutting or grinding tools where the operator could loose control and come within the 0.5 metre approach distance.
- Proximity of the work to the low voltage overhead service lines;
- Environmental conditions, such as rain, wind or uneven terrain, which may bring a risk of unexpected movement of tools or equipment held by workers.

8.6 Control measures for work near low voltage overhead service lines

Once the hazards associated with work near low voltage overhead service lines have been identified and assessed then control measures must be implemented to eliminate the risk. If it is not practicable to do so, the risks associated with the hazard must then be controlled.

The use of specific control measures to eliminate or control identified risks should be done on the basis of the risk assessment. In particular, consider the following:

- Eliminating the hazard. This could involve de-energising the low voltage overhead service lines by arranging for the Network Operator or in the case of overhead service lines forming part of the consumer's electrical installation the controller of the premises to isolate the supply for the duration of the work or arranging for the re-routing of the low voltage overhead service lines away from the work area.
- Separating the hazard. If work has to be carried out in close proximity to the point of attachment and the power cannot be isolated, arrange for the Network Operator to fit insulated matting and 'tiger tails' at the point of attachment and over the overhead service lines before the work commences. Refer to Figure 15 below.



Figure 15 – Insulated matting and tiger tail fitted to overhead service line

- Minimising the risk by engineering means. This could mean substituting with a less hazardous material, process or equipment, for example, using an insulated fibreglass extension handle on a paint roller, instead of a conductive aluminium extension handle. Or carrying out sanding by hand near the point of attachment rather than using an electric disc sander.
- Introduce administrative controls such as planning and documenting the work procedures before starting work. Another administrative control could be using another worker (to act as an observer) to warn people before they encroach into the relevant approach distance.
- Use appropriate personal protective equipment. This includes the use of electrically tested insulating gloves by anyone who may be at risk of encroaching into the relevant approach distance.

A combination of the above control measures is required to be taken to minimise the risk to the lowest level reasonably practicable if no single measure is sufficient for that purpose.

CHAPTER 9 – ADDITIONAL CONSIDERATIONS FOR WORK NEAR OVERHEAD POWER LINES

9.1 Tiger tails

Tiger tails may be used to provide a useful visual indication to crane, mobile plant operators and other persons working in the area of live overhead power lines, however, they do not protect people from the risk of electrocution or electric shock.



Figure 16 – Tiger tails fitted to overhead power lines

They are **not** to be regarded as effective insulation against contact by cranes or items of mobile plant and are not to be relied upon for mechanical protection. They should not be regarded as providing protection from electrical hazards. As such, the approach distances specified in this code are to be adhered to.

Tiger tails must only be fitted to overhead power lines by an electrically qualified person who is authorised by the network operator.

A competent person should visually inspect tiger tails at the worksite on a regular basis and prior to commencing crane, scaffolding or mobile plant operations. If the tiger tails have moved or been damaged the network operator must be contacted to ensure the tiger tails are replaced or located in the correct position.

WARNING

Tiger tails do not provide protection from electrical hazards and must only be fitted to the overhead power lines by an electrically qualified person who is authorised by the network operator.

9.2 Notification of incidents

The OHS Act and the OHS Regulation require employers to notify certain classes of workplace incidents.

Whether you are an employer, self-employed person and/or occupier you are required by law to notify incidents to WorkCover NSW and/or your workers compensation insurer as soon as practicable after becoming aware of the incident.

An occupier (of premises/workplaces) is someone who, manages or has responsibility for a workplace or a particular operation at a workplace, even though they may not be the employer.

Depending on the type of incident you may need to notify WorkCover and/or your workers compensation insurer. Some incidents classified as 'serious incidents' must be notified to WorkCover immediately. These 'serious incidents' include, but are not limited to the following;

- An incident where there has been a fatality,
- An incident where there has been a serious injury, and
- An incident where there is an immediate threat to life but result in no injury or illness.

In addition to the above, the OHS Act and OHS Regulation requires that certain occurrences that occur at the work place are not to be disturbed for 36 hours, (unless performing a rescue or permission has been given by WorkCover).

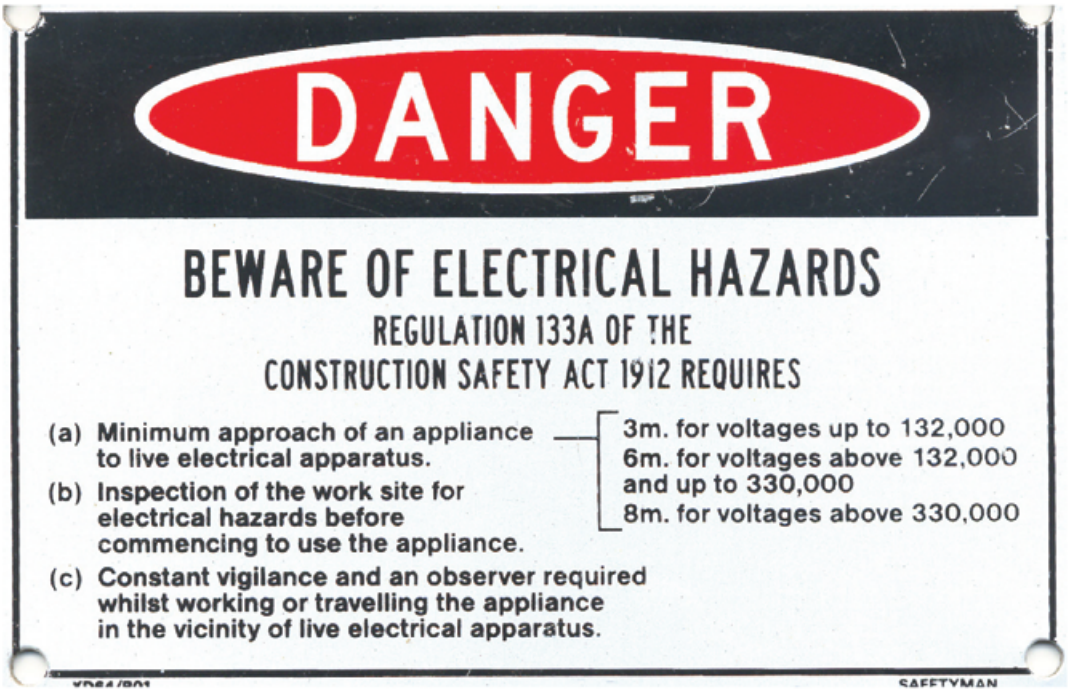
Working near overhead powerlines can be a high-risk activity and any contact with overhead power lines must be notified to WorkCover NSW and the relevant network operator in accordance with the requirements of the relevant legislation.

Serious incidents can be notified to WorkCover on **13 10 50** as an urgent investigation may be needed.

For more information regarding your legal obligations to notify incidents please refer to the OHS Act and OHS Regulation.

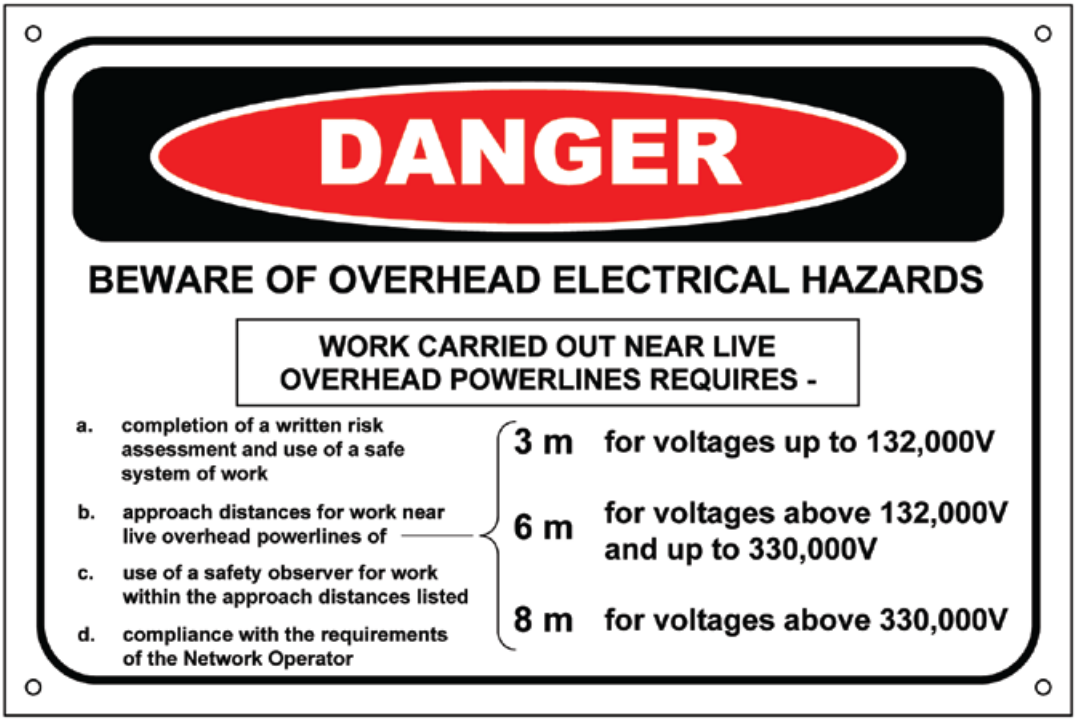
APPENDIX 1– WARNING NOTICE FOR OVERHEAD ELECTRICAL HAZARDS

(Dimensions 150 mm wide, 100 mm high, except if small plant item)



Notice that may remain fitted to cranes and mobile plant commissioned before 1 September 2001 (ie existing Notice as at the date of introduction of the OHS Regulation 2001)

Alternative Notice or Label for cranes and mobile plant commissioned after 1 September 2001



APPENDIX 2 – EXAMPLE OF A RISK ASSESSMENT CHECKLIST

Cranes and mobile plant working near overhead power lines risk assessment checklist

Worksite location:.....

Employer / Principal contractor:.....

Crane / Plant contractor:.....

Site Supervisor:.....

Network Operator:..... Contact phone:.....

This checklist is designed to help identify the hazards associated when operating cranes or mobile plant near overhead power lines that may encroach on the approach distances specified in Table 1 of this code. The checklist covers the main items described in Chapter 4 of this code. This checklist is not designed to cover all of the risks of working near overhead power lines and should be adapted as appropriate to meet the particular circumstances.

If you mark a NO box on the checklist, you need to take appropriate action to eliminate or control the hazard.

Section 1. PROJECT PLANNING AND INITIAL ASSESSMENT	**Yes**	**No**
Has the network operator been consulted regarding the proposed work?		
Do you know the height of the overhead power lines at the worksite?		
Is the voltage of the overhead power lines and associated electrical apparatus known?		
Can the overhead power lines be safely de-energised to allow work to proceed?		
Can the work be rescheduled to another time so that the overhead power lines can be de-energised?		
Has the network operator agreed to de-energise the overhead power lines and issued you with a documented clearance (access authority) so that work may proceed? Record N/A if not applicable.		
Have you ensured appropriate traffic management is in place at the worksite? Record N/A if not applicable.		
Have you assessed environmental conditions, including visibility and wind that could exist for the duration of the project that may adversely affect the work?		
Have you assessed the design and transit envelope of the crane or item of mobile plant being used for the proposed work in relation to the height of the overhead power lines at the worksite?		
Have you assessed the worksite where the crane or item of mobile plant is to be set-up, used and dismantled in relation to the location of overhead power lines?		
Additional planning and assessment factors:		

Section 2 – CONTROL MEASURES – OPERATING A CRANE OR ITEM OF MOBILE PLANT NEAR LIVE OVERHEAD POWER LINES	Yes	No
Have you completed a written risk assessment and identified all electrical hazards and non-electrical hazards, both actual and potential? All materials should be regarded as conductive unless you have definite knowledge to the contrary.		
Have you developed a safe system of work for the proposed work and determined the control measures required to eliminate or control the risks?		
Have you met the requirements of the network operator for the proposed work?		
Are workers trained, competent and confident in applying the particular procedures or techniques that are required for the task at hand?		
Do workers carrying out prescribed work tasks hold the relevant certificates of competency, eg crane operator, dogman, scaffolder, rigger, EWP operator?		
Have workers been authorised by the employer or person in control of the premises to work near live overhead power lines?		
Has a safe work method statement (SWMS) been completed for the task? Note: High-risk construction requires that an SWMS is completed for the work. Refer clause 209 of the OHS Regulation for further information.		
Is the work area clear of obstructions and is there a safe entry and exit?		
Are the necessary first aid and emergency facilities provided and accessible?		
Will an Accredited Safety Observer be present during the work task and assigned the duty of observing and warning against unsafe approach to overhead power lines?		
Additional control measures for the work:		

Section 3 – AFTER COMPLETING THE WORK	Yes	No
Have all workers been advised to treat the power lines as being live from this time?		
Has the network operator and all other relevant parties been advised that the work is completed?		
Additional measures following completion of work:		

_____ _____ ____ /____ /____

Checklist Completed By | Signature | (Date)

APPENDIX 3 – EXAMPLE SAFE WORK METHOD STATEMENT

Safe Work Method Statement (Part 1)			**Accepted:** Yes / No
Employer / Contractor: *Enter the name of the employer or contractor*			**Signed off:** *Enter the name of the person approving the SWMS*
Project: *Enter the name of project*			**Date:**
Job Description: *Enter the task to be undertaken*			
Procedure (in steps):	**Possible Hazards:**	**Safety Risks:**	**Control measures:**
1. *Write out the job step by step (Include all major phases of the work to be done)*	*Include all possible hazards. Some examples of hazards are: such as* • *Working near live overhead power lines* • *Falls from heights* • *Working near moving plant*	*High, Medium or Low*	*List all safety controls such as:* • *Access authority* • *Safety Harness* • *Mechanical Controls / PPE* • *Safety Observer required*
2.			
3.			
4.			
5.			

Points to remember when writing out your work method statements:

- **Write out the job procedure step by step**
- **Put the main idea first**
- **Start each step with an action word. For example Isolate, erect**
- **Use active, not passive voice. For example check approach distance, erect ground barriers**
- **Keep sentences short and clear**
- **Choose words carefully**
- **Keep it simple**
- **Get somebody who does not know the job to read the work method statement to check if they understand the job.**

Write all your work method statements after consulting the workers who are going to use them. You may then need to redraft them to include their suggestions. They may see a better and safer way of doing the job.

Note: The possible hazards, safety risks and control measures are placed side by side. This will make it easier for you to consider the possible hazards for each step and decide on the appropriate controls to over come each hazard.

Safe Work Method Statement (Part 2)

Project: *Enter name of project here*

Personal Qualifications and Experience	**Personnel, Duties and Responsibilities**	**Training required to complete proposed work**
Enter all the qualifications for everybody to undertake the tasks: *WorkCover Certificates, Training Certificates, Network Operator Certificates, experience in doing the tasks that may not require certificates.*		• *Safe electrical approach training*
Engineering Details / Certificates / Approvals	**Legislation / Codes of Practice / Standards**	
Enter details of certification that may be required to undertake tasks. Engineers Certificates for major lifts, plant usage eg EWP's.		
Plant / Equipment	**Maintenance Checks**	
List all major items of Plant and Equipment that will be used during the duration of the task. Eg: Mobile Crane, EWP, Vehicle loading crane, etc.		
Read and signed by all employees on site:		

Enter details of duties and responsibilities of Supervisors, Plant Operators and other employees. Enter such things as daily safety checks, weekly site inspections.

Detail here the training required by all personnel before the activity is commenced.

Enter here all Legislation, Codes of Practice and Standards that is relevant to the work to be undertaken. Refer to the requirements when completing the safe work method statements.

Detail here the system in place to ensure plant and equipment is serviced and maintained. Enter details of tagging for lifting equipment.

Safe Work Method Statement (Part 3) **Read and signed by all employees on site:**			
Project:	*Enter name of project here*		
Job Description:	*Enter the task to be undertaken*		**Revision No.:**
Name	**Company**	**Date Inducted**	**Signature**

APPENDIX 4 – MODEL TRAINING COURSE GUIDELINES – SAFE ELECTRICAL APPROACH TRAINING

Introduction

This model training course framework provides information for registered training organisations (RTO's) wanting to develop a competency assessed training course for non electrical persons wanting to acquire the necessary knowledge and skills of an 'Accredited Person' as described in this code.

The suggested minimum structured learning time for new students is approximately 12 hours, which includes a 2 hour assessment. The subject areas listed should be considered as the minimum course requirements; RTO's may wish to add additional topics as appropriate.

Persons successfully completing the training course are to be awarded a statement of attainment or certificate from the RTO that indicates the person's name and an identifying number particular to the holder of the qualification. The name and contact details of the RTO should also be displayed on the statement of attainment or certificate.

Unit 1 **Preparation to work safely near live overhead power lines as a non electrical worker**	Identification of the relevant legislative requirements including OHS Act 2000 and OHS Regulation 2001 including the Code of Practice – Work near overhead powerlines. Ordinary and Accredited Persons. Principles of electricity, 3 phase power system. Electric shock and resuscitation. Safe work practices and procedures. Identification and confirmation of the approach distances for safe work and access near live overhead power lines and associated electrical apparatus. Identification and implementation of safe systems of work including safe work method statements. Hazard identification, risk assessment and control options prioritised. Development of risk assessment documentation and safe work method statements. Permit systems and established supporting procedural systems. Responsibilities identified for the safety observer, crane and plant operator in accordance with requirements and established procedures /systems of work to ensure safety measures are followed in the event of an incident. Reporting and notification procedures for work closer than the approach distances identified in the Code of Practice – Work near overhead powerlines. Identification of electricity infrastructure for low voltage and high voltage overhead power lines. Relevant approach distances as defined in the Code of Practice – Work near overhead powerlines.

Unit 2 **Carry out the work safely near live overhead power lines as a non electrical worker**	Application of OHS principles and practices to reduce risk of incidents with overhead powerlines. Process for monitoring and reporting hazards and OHS risks to immediate authorised personnel for directions according to established procedures. Non routine events. Emergency procedures in the event of and responding to an incident. Working safely in accordance with instructions and established routines/ procedures.
Unit 3 **Complete the work safely near overhead power lines as non electrical worker**	Work schedules, requirements for returning work permit(s) and/or access authorisation permits. Process for reporting to authorised personnel incidents in accordance with established procedures. Work completion records, reports/data sheets for completed works.

Qualification and experience of the trainer:

Persons presenting the above training course should have relevant industry experience associated with the NSW Electricity Supply Industry and have as a minimum a 'Workplace Trainer and Assessor Certificate 1V 'and be conversant with all the relevant NSW Acts, Regulations, Codes and Industry Guides associated with work near live overhead power lines.

Overview of assessment:

Registered training organisations should ensure that assessment of the above training course be carried out in accordance with accepted industry and regulatory practice. Evidence for competence should be considered holistically and cover the essential knowledge and associated skills for work that is to be carried out safely near live overhead power lines by a non-electrical worker.

Trainees should be assessed across a representative range of contexts from the Units listed in the model training course including,

- Preparation to work safely near live overhead power lines
- Carry out the work safely near live overhead power lines
- Complete the work safely near live overhead power lines.

Further information on training and assessment for work that is to be carried out safely near live overhead power lines by a non-electrical worker can be found in the Australian National Training Authority document UETTDREL04A – Working safely near live electrical apparatus as a non electrical worker.

APPENDIX 5 – EMERGENCY PROCEDURE FOLLOWING CONTACT WITH LIVE OVERHEAD POWER LINES

Should contact be made with a live overhead power line or a flash-over occurs between a live overhead power line and a crane or an item of mobile plant, the following actions shall be taken:

- An attempt should be made to break the machinery's contact with the live overhead power line by moving the jib or driving the machine clear.
- If it is not possible to break the contact with the live overhead power line, the operator of the crane or mobile plant should remain inside the cabin of the crane or on the plant item. The network operator should be called immediately to isolate power to the live overhead power line. The operator must remain in place until the power has been isolated, and the 'all clear' given by the network operator.

WARNING



When a crane or item of plant inadvertently contacts overhead power lines circuit protective devices may operate to automatically turn the power off. However some protection devices are designed to automatically reclose thereby re-energising the powerlines after a short period of time, typically 1 – 4 seconds.

- If it is essential to leave the cabin or the operator's position due to fire or other life threatening reason, then jump clear of the equipment. Do not touch the equipment and the ground at the same time. When moving away from the equipment, the operator should hop or shuffle away from the plant item (with both feet together) until at least eight metres from the nearest part of the crane or plant. Under no circumstances run or walk from the crane or item of plant as voltage gradients passing through the ground may cause electricity to pass through the body resulting in an electric shock.
- Warn all other personnel and members of the public to keep 8 metres clear from the crane or item of plant. Do not touch or allow persons to touch any part of the crane or plant item and do not allow persons to approach or re-enter the vehicle until the network operator has determined the site safe. Remember electricity flows through the ground, so an electric shock could be received from walking close to the scene. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site made safe before giving assistance.
- Untrained, unequipped persons should not attempt to rescue a person receiving an electric shock. All too often secondary deaths occur because others get electrocuted trying to help earlier victims. If the crane or plant operator is immobilised, ensure the power supply has been isolated and the site has been made safe before giving assistance.

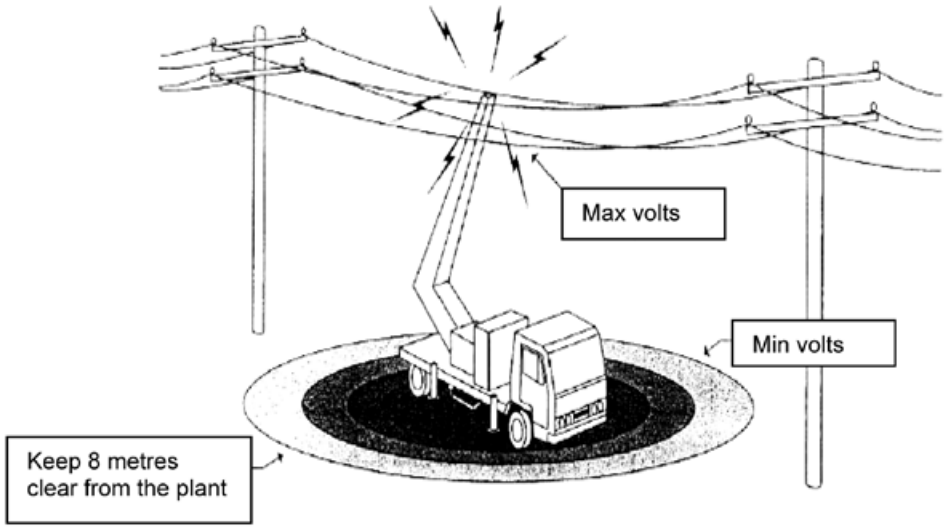


Figure 17: Affected area surrounding mobile plant when in contact with a live overhead power line

Post – incident inspection by a competent person

When a crane or item of mobile plant has been in contact with a live overhead power line, it should checked by a competent person for any damage to the components of the crane or mobile plant. Any actions recommended by the competent person are to be completed before the crane or mobile plant is returned to service.

Tyres on cranes and mobile plant that have been in contact with overhead power lines where electrical flash-over and current flow occurs through the rubber tyres should be considered as a potential hazard. These rubber tyres may catch fire, with the obvious potential for them to explode. Additionally, a lesser known danger may occur, which results when combustion takes place within the tyre, with no apparent external signs. When excessive heat is developed in or applied to a tyre as in the case from contact with overhead power lines, it can initiate a process known as pyrolysis, which is the decomposition of a substance by heat. This can generate a build up of flammable gases and pressure within the tyre, which may ultimately rupture or explode.

Vast amounts of energy can be released by a tyre explosion, often leading to significant equipment damage, serious injures or fatalities. Pyrolysis related explosions are very unpredictable, and have been known to occur immediately or up to 24 hours after initiation. An explosion can occur where no fire is visible and the danger area can be up to 300 metres from the tyre.

Any rubber tyred crane or plant item involved in an incident where contact is made with overhead power lines which results in discharges or flash-over of electrical current through the tyres should be considered as a potential hazard. If any personnel suspect there is a danger of a tyre explosion, as in the case of the mobile crane contacting overhead power lines, then the procedure should include:

- parking the crane in an isolation zone, with a minimum 300 metre radius,
- removing all personnel from the area, and not allowing access to isolation zone for 24 hours, and
- alerting fire fighting services

APPENDIX 6 – CASE STUDIES OF OVERHEAD POWER LINE INCIDENTS

CASE 1

Incident – Mobile Crane Operation

A mobile crane came into contact with 132,000 volt overhead power lines that were located adjacent to a worksite. At the time of the incident the crane driver had slewed the boom of the crane towards the overhead power lines, which resulted in the lifting chains swinging outwards, making contact with the power line.

Luckily no persons were injured, however the crane sustained extensive damage to the tyres, lifting rope and electrical system on the crane.

Contributing factors and relevant sections

Failure to:

- maintain relevant approach distance to the power lines and take outcome of the possibility of the lifting chains swinging towards the overhead power lines when the crane was operated. – Section 3.3
- carry out an adequate risk assessment of the worksite – Section 4.3
- implement appropriate control measures for the work – Section 4.4
- use a safety observer to observe the crane operations near the power lines – Section 4.7

CASE 2

Incident – Scaffolding Work

A worker died and three apprentice roof plumbers were injured when attempting to move an 8.9 metre high aluminium scaffold at a construction site. At the time of the incident the workers were moving the mobile scaffold over soft sand when the castor wheels located at the base of the scaffold sunk into the sand causing it to fall and make contact with 33,000 volt overhead power lines that were located adjacent to the construction site.

As a result of this incident the construction firm and roofing contractor were fined a total of $224,000 by the NSW Industrial Relations Commission.

Contributing factors and relevant sections

Failure to:

- carry out an adequate risk assessment of the worksite that took account of the ground conditions at the worksite – Section 4.3
- implement appropriate control measures for the work – Section 4.4.

CASE 3

Incident – Work on a rural property

The victim, a 17 year old rural worker, received a fatal electric shock due to a flashover when a steel flagpole came into close proximity with an 11kV overhead power line that was located above the entrance to a rural property. At the time of the incident the worker was attempting to erect the 5.2m flag pole at the main entrance gate to the property.

Contributing factors and relevant sections

Failure to

- identify the hazard of the overhead power lines – Section 7.2
- carry out a risk assessment of the worksite and implement appropriate risk controls – Sections 7.3 and 7.4.

CASE 4

Incident – Tipper truck operation

A tipper truck contacted an 11,000 volt overhead power line causing it to break and fall to the ground striking a worker who was at the worksite. At the time of the incident the tip truck was delivering a load of granulated bitumen to the worksite when the tip tray of the truck was raised upwards into the overhead power lines.

As a result of this incident the NSW Chief Industrial Magistrates Court fined the construction firm a total of $15,000.

Contributing factors and relevant sections

Failure to:

- plan the work and identify the hazard of the overhead power lines – Section 2.5 and 4.2
- maintain the relevant approach distance to the overhead power lines and take account of the height of the raised tray when the load was dumped at the worksite. Sections 3.3
- carry out a risk assessment of the worksite – Sections 3.7 and 4.3
- implement appropriate control measures for the work – Section 4.4
- use a safety observer to observe the truck operations near the power lines – Section 4.7.

APPENDIX 7 – USEFUL PUBLICATIONS

WORKCOVER NSW APPROVED INDUSTRY CODES OF PRACTICE

- *Code of Practice: Occupational Health and Safety Consultation*
- *Code of Practice: Risk assessment*
- *Code of Practice: Occupational Health and Safety induction training for construction work*
- *Code of Practice: Moving plant on Construction Sites*
- *Code of Practice: Amenity Tree Industry*
- *Code of practice: Technical Guidance*

Note: The Australian Standards listed below are also WorkCover approved industry codes of practice.

WORKCOVER GUIDES

- *Identification Tool for Electrical Hazards on-site*
- *Subby Pack – OHS contractor management tool*
- *Dangers of Power Lines when Pumping Concrete*
- *WorkCover Safety Alert – Tiger Tails*

Standards and Codes offer practical guidance on health and safety for work. However, these are subject to change from time to time. For further information contact the WorkCover Assistance Service on: **13 10 50**.

For information about the wide range of other codes of practice, certification guides and publications on OHS, rehabilitation and workers compensation, contact the Publications Order line: 1300 797 003.

Information on the latest laws can be checked at www.legislation.nsw.gov.au or contact (02) 9238 0950 or 1800 463 955 (NSW country only).

AUSTRALIAN STANDARDS

Australian Standards can be purchased from SAI Global by contacting the Customer Service Centre on 131 242 or over the net at http://www.saiglobal.com/shop

AS 2550.1 Crane, hoist and winches – Safe use Part 1: General requirements

AS 2550.1 Crane, hoist and winches – Safe use Part 5: Mobile and vehicle loading cranes

AS/NZS 4576 Guidelines for Scaffolding

NATIONAL ELECTRICITY NETWORK SAFETY GUIDELINES

National Guidelines can be purchased from the Electricity Supply Association of Australia by phoning 03 9670 0188 or over the net at http://www.esaa.com.au

- NENS 04-2003 *National guidelines for safe approach distances to electrical apparatus*

NETWORK OPERATORS – CONTACT NUMBERS

- Energy Australia: 13 15 25
- Integral Energy: 13 10 81
- Country Energy: 13 23 56
- Rail Corp: (02) 9379 4911
- Transgrid is divided into three regional areas:
    - Central Region – 1800 625 108
    - Northern Region – 1800 998 049
    - Southern Region – 1800 654 195.