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AUSTRALIA

OAKDALE WEST ESTATE
LOT 2A OUT OF HOURS CONCRETE WORKS NOISE ASSESSMENT

Report 11.00340R-03

prepared for Richard Crookes Constructions
on 08/03/2022

REPORT PREPARED BY

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BASIS OF REPORT

This report has been prepared by **Acoustics Consultants Australia (ACA)** with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with the Client. Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

REFERENCE	DATE	PREPARED	REVIEWED	AUTHORISED
11.00340R-01 – DRAFT	25/01/2021	SF	MdlM	SF
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1. INTRODUCTION

This report presents the findings of a construction noise assessment conducted by Acoustics Consultants Australia (ACA) in relation to out-of-hours concreting works proposed to be undertaken by Richard Crookes Constructions (RCC) on Lot 2A of the Oakdale West Estate (OWE), located in Kemps Creek.

The currently approved Lot 2A construction hours are:

- Monday to Friday: 7.00am to 6.00pm; and
- Saturday 8.00am to 1.00pm

The out of hours concrete works proposed are for the internal space warehouse slab pours only. These pours would occur entirely within the Lot 2A warehouse footprint and only once the warehouse superstructure is sufficiently developed such that the warehouse structure and cladding would provide effective acoustic shielding.

A maximum of 42 internal slab pours would be undertaken between 31/03/2022 and 02/06/2022, with shifts commencing generally at 3.00am and finishing at 8.00pm Monday to Friday, with no pours proposed on Saturdays or Sundays.

Depending on the pour sequencing, during some weeks pours would occur every day, whilst at other times there would be one or two concrete pours per week.

No external pours outside the Lot 2A warehouse footprint would be undertaken out of hours; all external pours would be undertaken during standard approved construction hours only.

The aims of this assessment are:

- to identify the main sources of noise anticipated from the site and the potential noise exposure of the nearest noise sensitive receivers;
- to conduct an objective noise assessment based on noise modelling of the proposed construction methodologies; and
- where necessary, to identify any practicable and effective noise mitigation measures recommended to control noise from the out-of-hours works to satisfactory levels.

The methodology and standards used to conduct the assessment and numeric assessment results are presented in the following sections.

Acoustic terms used in this report are defined in the Glossary in **Appendix A**.

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2. PROPOSED OUT OF HOURS WORKS

Figure 2.1 shows the location of the Lot 2A warehouse on the OWE.

A maximum of 42 out of hours pours are proposed to complete the Lot 2A internal slab works. The proposed out-of-hours concreting works would be undertaken progressing from east to west whilst the warehouse superstructure is progressively developed.

Figures 2.2 to 2.5 show the four key stages of the warehouse development as provided by RCC.

Figure 2.1 Aerial View of Site Showing the Location of the 2A Concrete Works

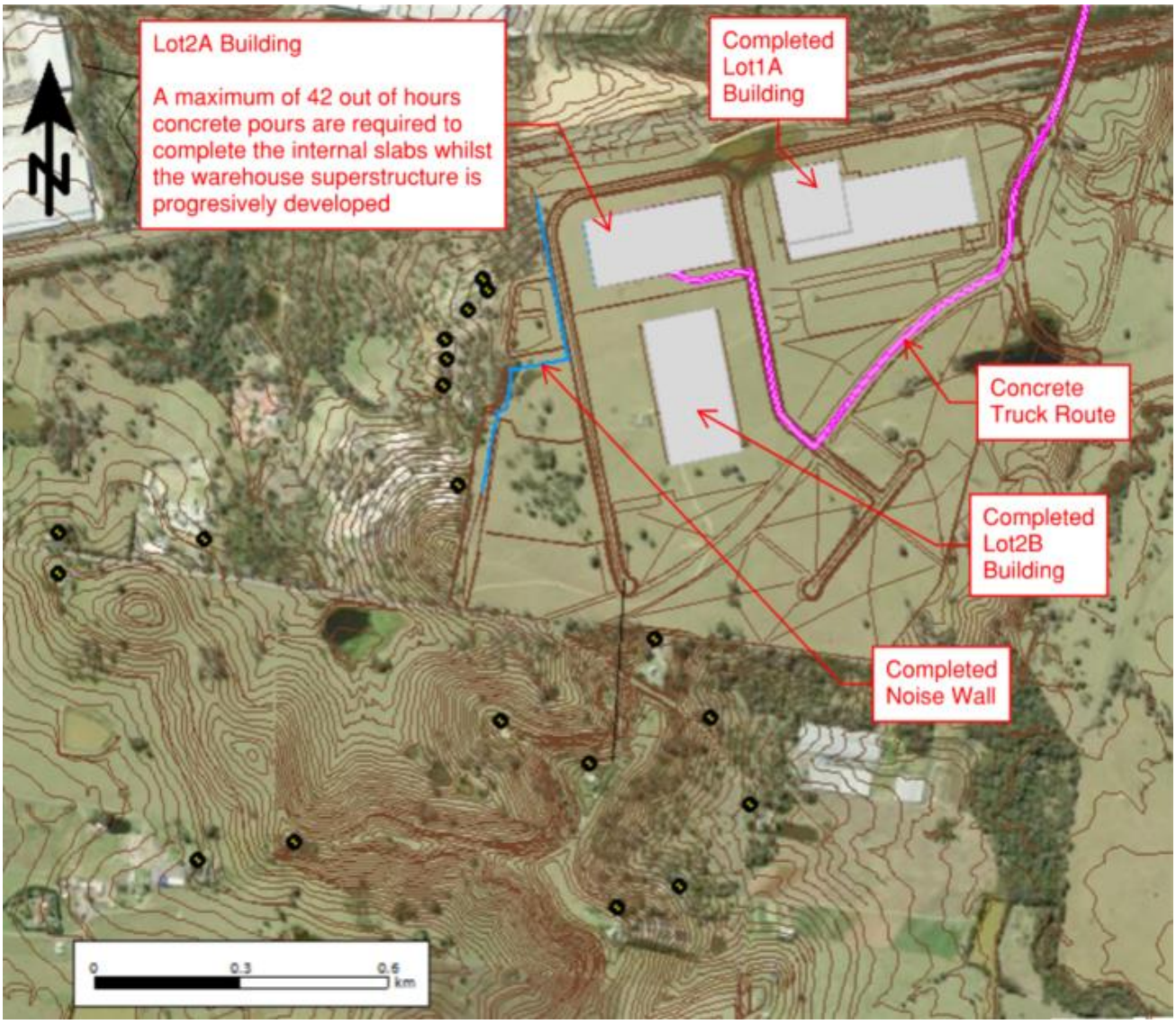

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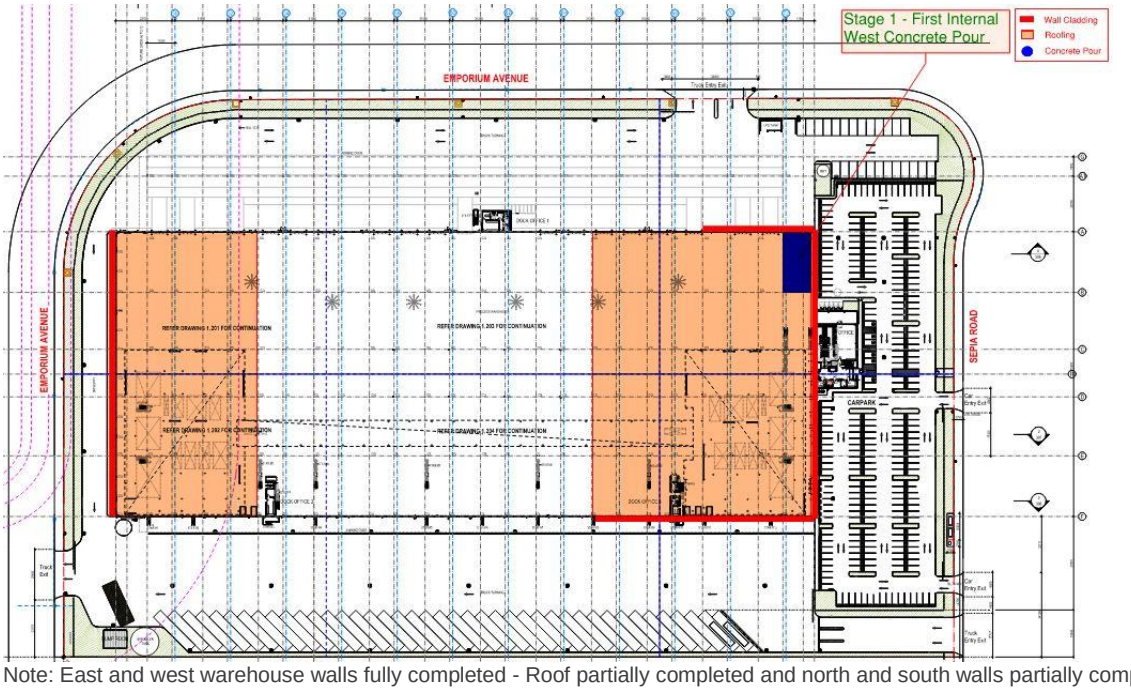
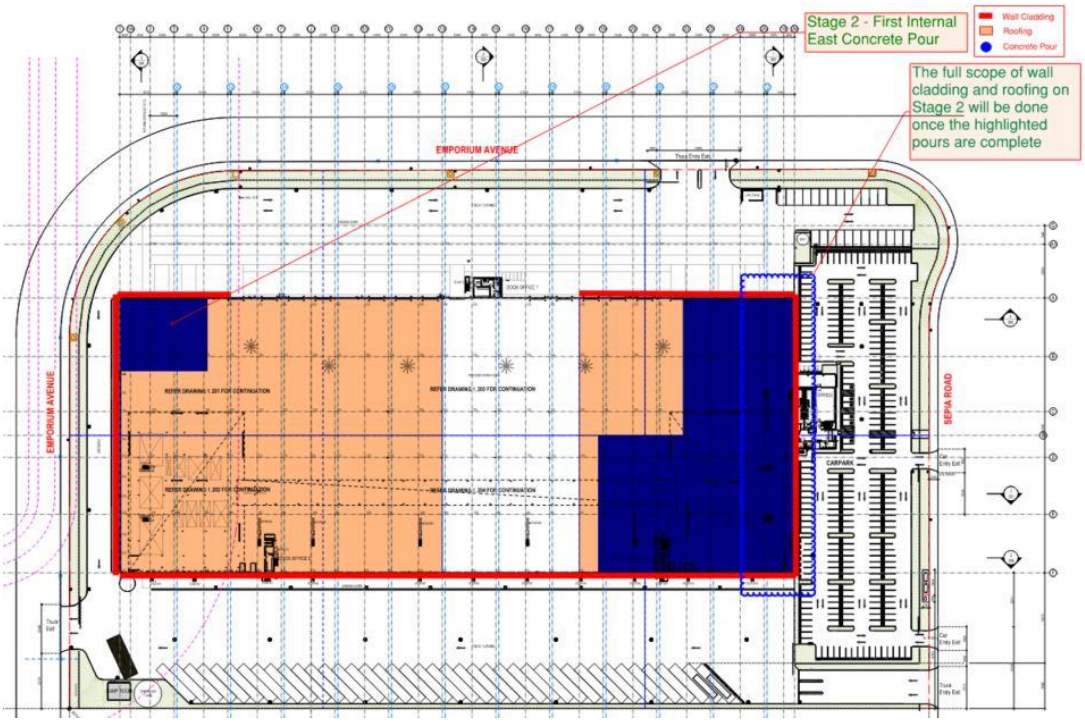
Figure 2.2 Stage 1 Warehouse Development



Note: East and west warehouse walls fully completed - Roof partially completed and north and south walls partially completed

Figure 2.3 Stage 2 Warehouse Development



Note: South warehouse wall will be fully completed by the time the concrete pours are progressed approximately 20m from the eastern side of the warehouse (as indicated by the clouded area in the figure above) - Roof also further completed

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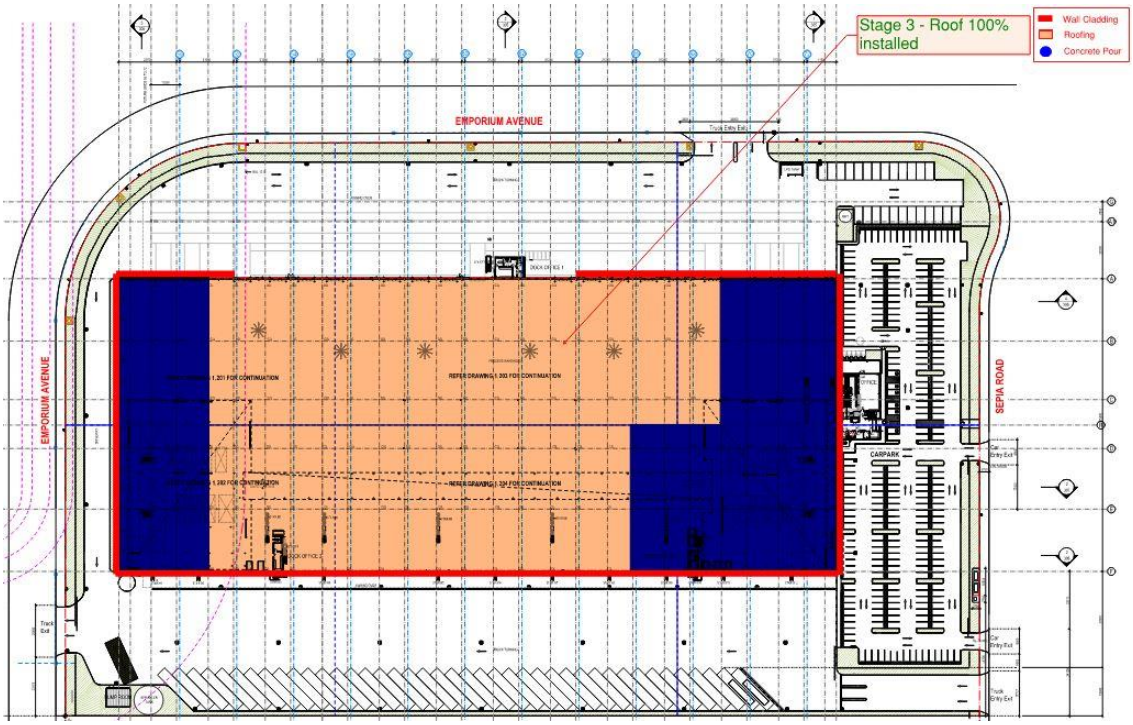
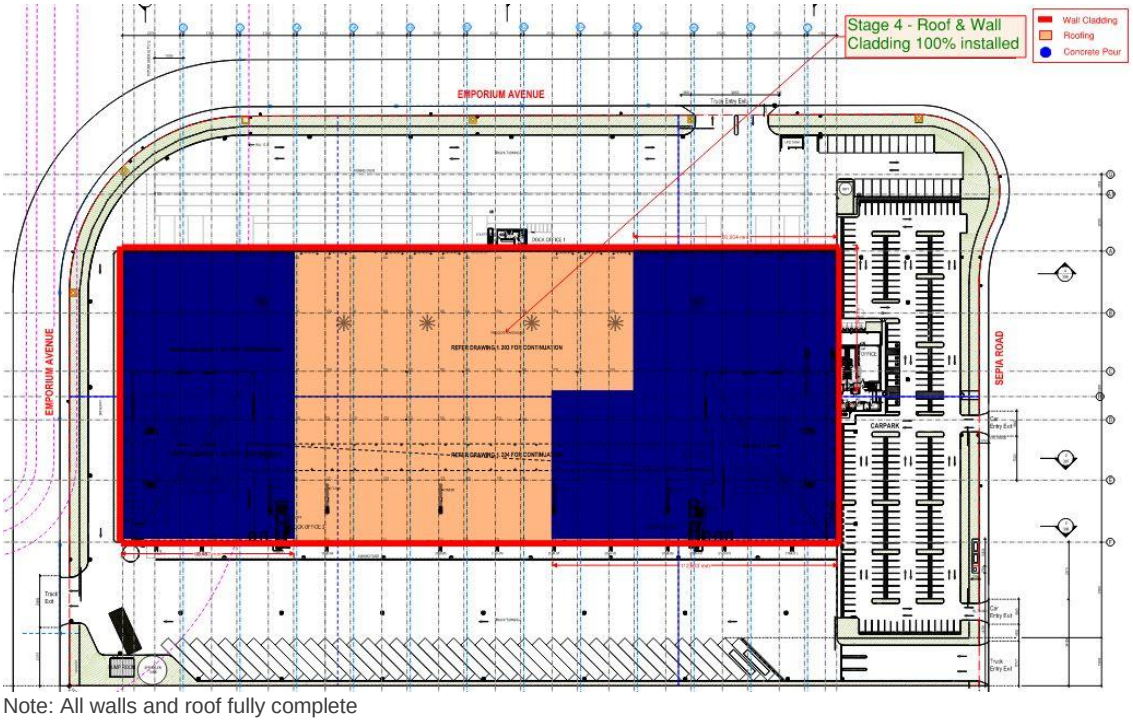
Figure 2.4 Stage 3 Warehouse Development



Note: Roof fully complete - North wall remains partially complete

Figure 2.5 Stage 4 Warehouse Development



Note: All walls and roof fully complete

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As indicated in **Figures 2.2** to **2.5** at the commencement of the pours the east and west warehouse walls would be completed, whist the roof and the north and south walls would be partially completed.

By the time the concrete pours are progressed by approximately 20 m from the eastern side of the warehouse (as indicated by the clouded area in the **Figure 2.3**), the south warehouse wall would be fully completed and the roof would be further progressed.

By Stage 3, the roof would be complete and only the north warehouse wall would remain partially open and by Stage 4, the warehouse superstructure would be entirely complete.

The warehouse would be constructed with lower walls up to a height of 2.4 m comprising 150 mm precast concrete panels with upper walls formed from profiled steel cladding internally lined with sarking. The roof of the warehouse would be formed from profiled steel cladding internally lined 75mm Anticon roof insulation.

The north and south warehouse facades include numerous loading dock openings. These will be fitted with roller doors as the warehouse walls are completed, per **Figures 2.2** to **2.5**. The roller doors within the southern façade include penetrations (in their upper portions) whilst the within the northern façade rollers doors are unperforated.

The acoustic shielding that would be achieved by the Lot2A warehouse at the various stages of its development has been accounted for in the noise modelling undertaken, as discussed further in **Section 6**.

The internal slab pours would be undertaken between 31/03/2022 and 02/06/2022, with shifts commencing generally at 3.00am and finishing at 8.00pm Monday to Friday.

All vehicle movements including concrete agitator truck movements onto Lot 2A during pours will be from the south east corner of Lot 2A and into the warehouse superstructure from the south east of the warehouse. This will be the case during all concrete pouring stages.

All vehicle movements will strictly follow the access and departure routes shown in **Figure 2.6**.

The identified vehicle routes have been considered in the noise modelling undertaken.

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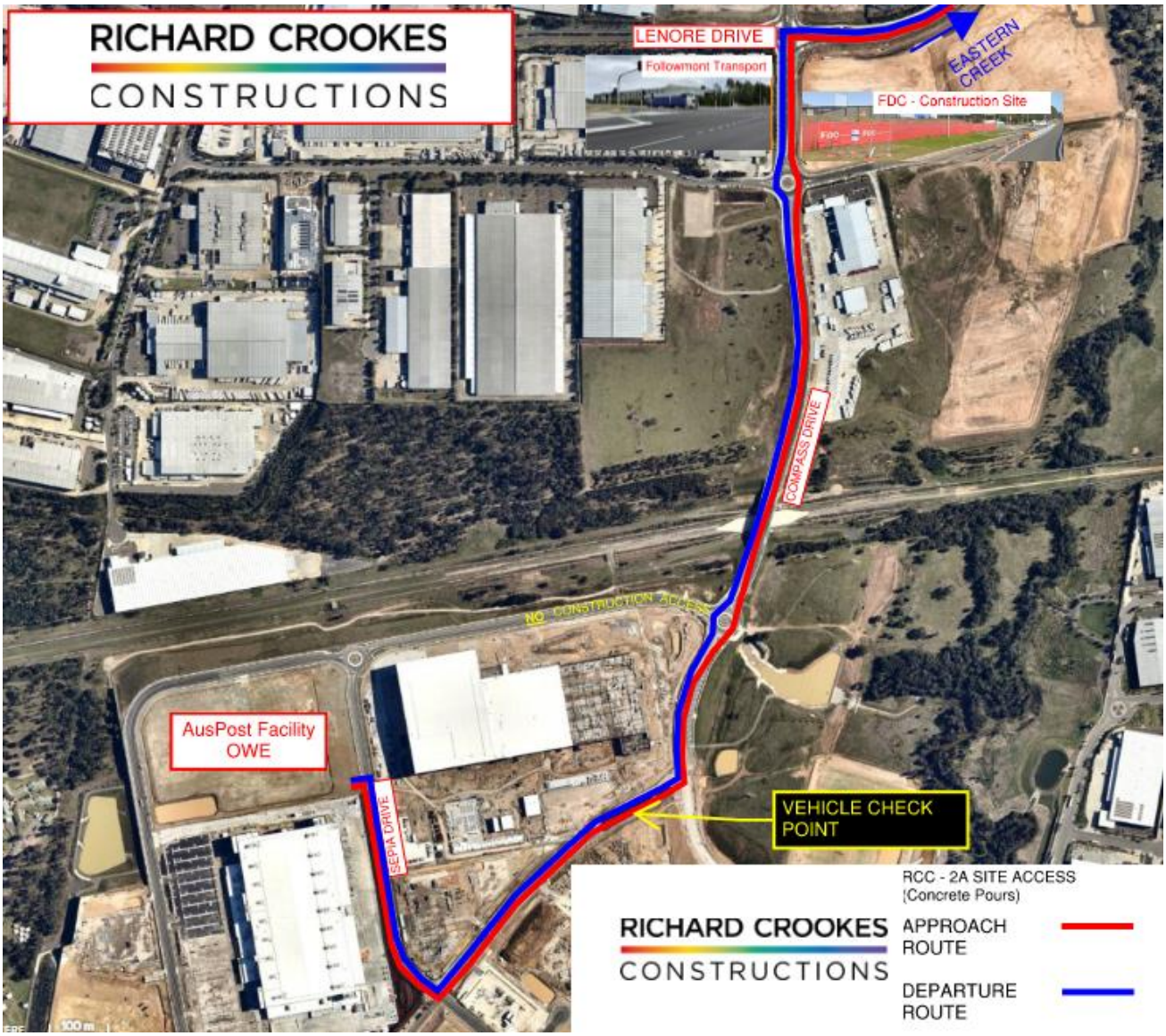
Figure 2.6 Vehicle Access and Departure Routes



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The requirement to undertake the internal concrete works outside approved hours has been identified by RCC, as follows:

- *Starting a concrete pour at 7:00am will lead to increased traffic on the roads from the concrete batching plant to site (Mulgoa Road Penrith, M4 and Mamre Road). If concrete trucks are sitting in traffic, this may lead to longer periods between concrete placement which will likely introduce cold joints into the slabs. Cold joints create weak points in the slab and delamination which will affect the overall integrity of the slab;*

- *Traffic congestion means longer concrete pours i.e. concrete trucks entering site more frequently;*

- *The workability of concrete will be affected if concrete sits in the truck for extended periods, meaning water will need to be added to the mix on site. This is generally not accepted by the engineers as it increases the concrete slump and will affect the strength of the concrete;*

- *Delayed arrival of concrete trucks to site leads to the workforce working for longer periods. Worker fatigue becomes an issue as they are on site for 12-15 hours and this becomes a potential WHS and union issue;*

- *Commencing the pours during the cooler times of the day is preferred as this leads to better curing and slab integrity outcomes.*

All earthworks, in ground services, footings, external concrete pours and warehouse superstructure works would be undertaken during approved standard construction hours only.

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3. CONCRETING WORKS METHODOLOGY

As discussed in **Section 2**, the works would be undertaken progressing from east to west whilst the warehouse superstructure is progressively developed.

Up to eight to ten concrete agitator trucks per hour would deliver concrete to the site between approximately 3.00am to 5.00pm. The trucks would access the site from the north, via Compass Drive. The identified route is shown in **Figure 2.1**.

At Lot 2A the concrete would be pumped into place with a Mitsubishi FS500 concrete pump and manipulated with a hand held concrete vibrator and Somero Laser mechanical screeder.

During the pours the concrete pump would be located inside the warehouse and located to optimise the acoustic shielding that the warehouse superstructure would provide. The agitator trucks would access the warehouse in a controlled manner and would discharge only once inside the building. The completed warehouse structures would therefore provide a high degree of acoustic shielding from the internal concreting works to the off-site receivers.

The poured concrete would be left to cure for a number of hours. Once sufficiently cured, two ride-on power trowels would be used to finish the slabs and then crack control joints would be formed with dowel joints. With the proposed dowel joint method there would be no requirements to use concrete saws to form the joints.

RCC has advised it is generally required to commence the concreting work shift at 3.00 am (outside standard construction hours). This is to ensure the concrete has enough time to adequately cure before dowel joints are formed.

Each pour is estimated to take between six to eight hours to complete (depending on size of the pour). It then takes a further four hours (approx) for curing before the slab can be walked on.

The principal construction noise emissions from the site would be expected to be from:

- on-site concrete truck movements;
- the operation of a concrete pump and agitator trucks within the Lot 2A warehouse;
- the operation of a mechanical screeder and hand held concrete vibrator within the warehouse;
- the operation of two power trowels within the warehouse; and
- on-site light vehicle movements.

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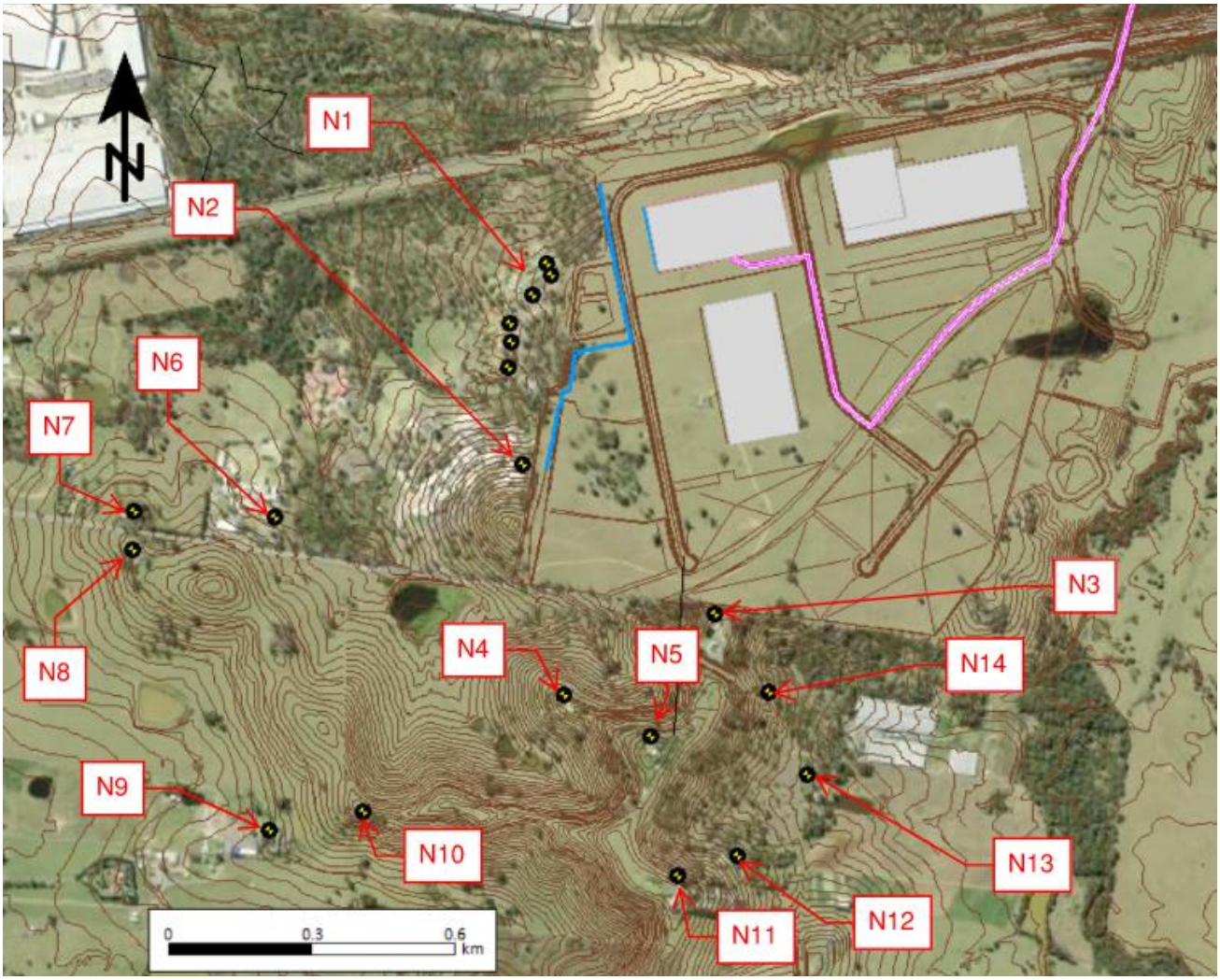
4. SENSITIVE RECEIVERS

Based on details provided by RCC, ACA has undertaken a detailed assessment of potential construction noise impacts. The locations of the sensitive receivers considered by this assessment are shown in **Figure 4.1**.

Figure 4.1 Sensitive Receivers Considered



The sensitive receiver of principal interest is the Emmaus Village aged care facility located to the west of the OWE (Receiver N1) as the potential for disturbance is greatest at this location.

The Emmaus College located to the west of the OWE (Receiver N2) would not be occupied during the proposed out of hours works, and therefore no impacts on this receiver are anticipated.

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Construction noise levels have been predicted at the Receivers N3, N4 and N5. However, as fully executed noise agreements are in place with the N3, N4, N5 landowners there is no requirement to consider noise impacts on these receivers.

Additionally, construction noise levels have been predicted at the further receivers N6-N14. Receivers N6-N13 are located within the IN1 General Industrial zone under the State Environmental Planning Policy (Western Sydney Employment Area) 2009 [SEPP WSEA].

Receiver N6 is Mamre Anglican College – the school would not be occupied during the proposed out of hours works and therefore no impacts on this receiver are anticipated.

Receivers N7-N13 are residences and residential criteria have been considered for these receivers.

Receiver N14 is a residence located within the Environmental Conservation zone under the SEPP WSEA. Residential criteria have been considered for this receiver.

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5. OUT OF HOURS CONSTRUCTION NOISE CRITERIA

This assessment establishes out-of-hours Construction Noise Management Levels (CNMLs) determined in general accordance with the provisions of the *NSW Interim Construction Noise Guideline* (ICNG).

For this purpose, the Rating Background Noise Levels (RBLs) determined by the most recent Oakdale West Estate (OWE) modification noise assessment have been considered (ref Modification 7 – Noise Assessment prepared by RWDI Report No. 2102730A).

Based on analysis of data obtained between 1 May 2021 and 29 June 2021 from the existing Sentinex real-time noise and weather monitoring stations located at the western and southern OWE site boundaries, the MOD 7 assessment determined the RBLs set out in **Table 5.1**.

The locations of the Sentinex real-time noise & weather monitoring systems are indicated in **Figure 5.1**.

Figure 5.1 Sentinex Real-Time Noise & Weather Monitoring Station Location

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Table 5.1 Rating Background Noise Levels (1 May 2021 and 29 June 2021)

Location	RBL[1] L_{A90} (dBA)		
	Day	Evening	Night
South OWE Boundary	42	37	37
West OWE Boundary	39	38	37

Note 1: RBLs consistent with OWE Modification 7 Noise Assessment (RWDI Report No. 2102730A)
Note 2: Day 7.00am–6.00pm; Evening 6.00pm–10.00pm; Night 10.00pm-7.00am.

The western boundary monitoring station RBLs have been used to determine CNMLs for the Emmaus Village and the southern boundary monitoring station RBLs have been used to determine CNMLs for the residential receivers to the south.

The resultant CNMLs determined in general accordance with the provisions of the *NSW Interim Construction Noise Guideline* (ICNG) are set out in **Tables 5.2** and **5.3**. Additionally, the sleep disturbance trigger levels recognised by the *NPfI* are shown.

Table 5.2 Out of Hours Construction Noise Management Levels – South Receivers

Time	Measured Noise Levels	Construction Noise Criteria	
	RBL[1] L_{A90} (dBA)	ICNG Construction Noise Criteria[2] $L_{Aeq,15min}$ (dBA)	Sleep Disturbance Noise Level[3] $L_{Amax,15min}$ (dBA)
Standard Hours	42	n/a	n/a
Out-of-Hours - Day	42	47	n/a
Out-of-Hours - Evening	37	42	n/a
Out-of-Hours - Night	37	42	52

Note 1: RBL = Rating Background Level.
Note 2: The ICNG considers standard hours as Monday to Friday 7.00am to 6.00pm and Saturday 8.00am to 1.00pm (with no work on Sundays or public holidays). Works undertaken outside these timeframes are considered 'out-of-hours works'.
Note 3: With consideration to the proposed work timeframes, the following out-of-hours periods apply. Out-of-Hours - Day: Saturday 1.00pm to 6.00pm; OOH Evening: Monday to Saturday 6.00pm to 8.00pm; OOH Night: Monday to Friday 3.00am to 7.00am.
Note 4: ICNG criteria for out of hours works are based on the RBL + 5 dB.
Note 5: Sleep disturbance criteria are based on the guidance provided by the *NSW Noise Policy for Industry* (NPfI). The NPfI requires a detailed maximum noise level event assessment to be undertaken where the development's night-time noise levels at a residential location exceed L_{AFmax} 52dBA or the prevailing RBL plus 15 dB (whichever is the greater).

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Table 5.3 Out of Hours Construction Noise Management Levels - Emmaus Village

Time	Measured Noise Levels	Construction Noise Criteria	
	RBL[1] L_{A90} (dBA)	ICNG Construction Noise Criteria[2] $L_{Aeq,15min}$ (dBA)	Sleep Disturbance Noise Level[3] $L_{Amax,15min}$ (dBA)
Standard Hours	39	n/a	n/a
Out-of-Hours - Day	39	44	n/a
Out-of-Hours - Evening	38	43	n/a
Out-of-Hours - Night	37	42	52

Note 1: RBL = Rating Background Level.

Note 2: The ICNG considers standard hours as Monday to Friday 7.00am to 6.00pm and Saturday 8.00am to 1.00pm (with no work on Sundays or public holidays). Works undertaken outside these timeframes are considered 'out-of-hours works'.

Note 3: With consideration to the proposed work timeframes, the following out-of-hours periods apply. Out-of-Hours - Day: Saturday 1.00pm to 6.00pm; OOH Evening: Monday to Saturday 6.00pm to 8.00pm; OOH Night: Monday to Friday 3.00am to 7.00am.

Note 4: ICNG criteria for out of hours works are based on the RBL + 5 dB.

Note 5: Sleep disturbance criteria are based on the guidance provided by the *NSW Noise Policy for Industry* (NPfI). The NPfI requires a detailed maximum noise level event assessment to be undertaken where the development's night-time noise levels at a residential location exceed L_{AFmax} 52dBA or the prevailing RBL plus 15 dB (whichever is the greater).

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6. OUT OF HOURS CONCRETING NOISE PREDICTIONS

For the identified out of hours construction timeframes, this assessment considers the construction equipment and sound power levels set out in **Tables 6.1** and **6.2** and the estimated on-site peak hourly vehicle movements provided by RCC as shown in **Table 6.3**.

The sound power levels are consistent with previous OWE construction noise assessments and have been verified against ACA's internal noise source database.

Table 6.1 $L_{Aeq,15min}$ Sound Power Levels (SWLs) for Construction Equipment

Construction Activity	Equipment	Type/ Manufacturer/ Capacity	Number of Equipment Items	$L_{Aeq,15min}$ Sound Power Level (dBA)	
				Item	Activity
Lot 2A Slab Concreting Works	Concrete Pump	Mitsubishi FS500	1	109	113
	Concrete Truck / Agitator	Western Suburbs Concrete 7 to 9 m^3 agitators	1	109	
	Concrete Vibrator	Hand Held	1	102	
	Mechanical Screeder	Somero Laser	1	104	
	Power Trowel	Hoppt Ride-On	2	107	
	Light Vehicle	-	1	96	

Note 1: The $L_{Aeq,15min}$ activity sound power level conservatively assumes the coinciding operation of the concrete pump, agitator truck, concrete vibrator and mechanical screeder. The power trowels would not operate at the same time as the other plant, so are not included in the activity SWL.

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Table 6.2 $L_{Amax,15min}$ Sound Power Levels (SWLs) for Construction Equipment

Construction Activity	Equipment	Type/ Manufacturer/ Capacity	$L_{Amax,15min}$ Sound Power Level (dBA)
Lot 2A Slab Concreting Works	Concrete Truck / Agitator During Discharge within Lot2A	Western Suburbs Concrete 7 to 9 m^3 agitators	118
	Concrete Truck / Manoeuvring on Site Access Road	Western Suburbs Concrete 7 to 9 m^3 agitators	115

Note 1: The $L_{Amax,15min}$ sound power levels conservatively represent the maximum nose levels that may be expected from an occasional impact noise from an agitator truck during discharge within Lot2A and from the unlikely event of an engine/air brake event during travel on the site access road.

Table 6.3 Estimated Peak On-Site Vehicle Movements per Hour

Out of Hours Periods	Estimated Number of Vehicle Movements per Hour	
	Concrete Trucks	Light Vehicles
Evening (6.00pm-8.00pm)	-	100
Night (3.00am-7.00am)	10	100

Construction noise emissions from the site have been predicted using a model created with the SoundPLAN (Ver 8.2) environmental noise prediction software, implementing the Concawe calculation algorithm. This program is used and recognised internationally as a preferred computer noise model.

Factors that are addressed in the noise modelling are:

- Equipment noise level emissions and locations
- Shielding/reflection effects from structures
- Receiver locations
- Ground topography
- Noise attenuation due to geometric spreading

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- Ground absorption
- Atmospheric absorption and
- Influence of meteorology, per Concawe methodologies.

Predictions of construction noise emissions from the site have been undertaken for the key stages identified, in each case considering the locations of the pours with respect to the development of the warehouse.

The predictions assume the concrete pump is located within the Lot 2A building and that the agitator trucks are discharged only once within the Lot 2A building footprint. Noise from these sources would be attenuated by the warehouse structure. RCC has confirmed that the plant would be located to optimise the shielding provided by the warehouse structures, particularly during the early stages, prior to the full completion of the warehouse.

Additionally, the predictions include the attenuation effects of the completed western site boundary noise wall and the shielding and reflection effects from the completed Lot 1A and Lot 2B buildings, as shown in **Figure 2-1**.

Predicted $L_{Aeq,15min}$ night construction noise levels at the identified receivers are set out in **Tables 6.4** and predicted $L_{Amax,15min}$ night maximum construction noise levels are set out in **Table 6.5**.

Evening noise levels would be no higher than those shown in **Table 6.4**.

The noise predictions undertaken are considered reasonably representative of ‘typical worst case’ scenarios and it is expected that actual noise levels would typically be less than the identified levels.

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Table 6.4 Predicted $L_{Aeq,15min}$ Night Construction Noise Levels (3.00am to 7.00am)

Receiver	ICNG Criteria	Predicted $L_{Aeq,15min}$ Noise Level (dBA)							
		Concreting Works at Lot 2A		Concrete Trucks on Access Road		Light Vehicles on Access Road		Concreting Works + Access Road	
		Neutral Met	Noise Enhancing Met	Neutral Met	Noise Enhancing Met	Neutral Met	Noise Enhancing Met	Neutral Met	Noise Enhancing Met
N1	42	28 - 41	32 - 41	<25 - <25	27 - 27	<25 - <25	<25 - <25	28 - 41	33 - 41
N2	n/a	25 - 35	27 -38	<25 - <25	<25 - <25	<25 - <25	<25 - <25	25 - 35	28 -38
N3	n/a	<25 - 29	<25 - 32	29 - 29	34 - 34	<25 - <25	<25 - <25	27 - 32	31 -36
N4	n/a	<25 - 26	<25 - 31	<25 - <25	29 - 29	<25 - <25	<25 - <25	<25 - 29	29 -33
N5	n/a	<25 - 25	<25 - 29	25 - 25	30 - 30	<25 - <25	<25 - <25	26 - 28	30 - 33
N6	n/a	<25 - 30	<25 - 35	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - 30	<25 - 35
N7	42	<25 - 27	<25 - 33	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - 28	<25 - 33
N8	42	<25 - 26	<25 - 32	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - 27	<25 -32
N9	42	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - <25
N10	42	<25 - 26	<25 - 31	<25 - <25	<25 - <25	<25 - <25	<25 - <25	<25 - 27	<25 -32
N11	42	<25 - <25	<25 - 28	<25 - <25	27 -27	<25 - <25	<25 - <25	<25 - 26	28 - 31
N12	42	<25 - <25	<25 - 29	<25 - <25	29 -29	<25 - <25	<25 - <25	<25 - 27	29 -32
N13	42	<25 - 25	<25 - 30	27 - 27	31 -31	<25 - <25	<25 - <25	27 - 29	32 - 34
N14	42	<25 - 27	<25 - 32	29 -29	33 - 33	<25 - <25	<25 - <25	29 - 31	34 - 36

- Receiver N2 (Emmaus College) would not be occupied during the proposed out of hours works, and therefore no impacts on this receiver are anticipated.
- Fully executed noise agreements are in place with the N3, N4, N5 landowners and as such there is no requirement to consider noise impacts on these receivers.
- Receiver N6 (Mamre Anglican College) would not be occupied during the proposed out of hours works, and therefore no impacts on this receiver are anticipated.
- Receivers N7-N13 are residences located within the IN1 General Industrial zone under the State Environmental Planning Policy (Western Sydney Employment Area) 2009 [SEPP WSEA]. Residential criteria have been considered for these receivers.
- Receiver N14 is a residential receiver located within the Environmental Conservation zone under the SEPP WSEA. Residential criteria have been considered for this receiver.
- Predictions are provided for neutral meteorological conditions and noise enhancing meteorological conditions (moderate strength F-Class temperature inversion).

Table 6.5 Predicted $L_{Amax,15min}$ Maximum Construction Noise Levels (3.00am to 7.00am)

Receiver	Sleep Disturbance Noise Level $L_{Amax,15min}$ (dBA)	Predicted $L_{A1,1min}$ Noise Level (dBA)			
		Concreting Works at Lot 2A		Concrete Trucks on Access Road	
		Neutral Met	Noise Enhancing Met	Neutral Met	Noise Enhancing Met
N1	52	46	46	40	44
N2	n/a	40	43	27	31
N3	n/a	34	37	43	47
N4	n/a	31	36	37	41
N5	n/a	30	34	37	42
N6	n/a	35	40	33	38
N7	52	32	38	31	35
N8	52	31	37	30	35
N9	52	< 25	< 25	< 25	< 25
N10	52	31	36	30	35
N11	52	28	33	34	39
N12	52	29	34	35	40
N13	52	30	35	38	42
N14	52	32	37	41	45

Notes:

- Sleep disturbance criteria are based on the guidance provided by the NSW Noise Policy for Industry (NPfI).
- Predictions are provided for neutral meteorological conditions and noise enhancing meteorological conditions (moderate strength F-Class temperature inversion).

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7. DISCUSSION OF RESULTS

The predictions indicate that the ICNG CNMLs would be expected to be met at all surrounding receivers including N1 (Emmaus Village aged care facility) throughout the Lot 2A out-of-hours concreting works undertaken between 3.00am to 7.00am and between 6.00pm to 8.00pm.

Additionally, maximum construction noise levels would not be expected to trigger the sleep disturbance trigger levels recognised by the NPfI at any receiver.

N2 (Emmaus College) and N6 (Mamre Anglican College) would not be occupied during the proposed out of hours works, and therefore no impacts on these receivers are anticipated.

As fully executed noise agreements are in place with the N3, N4, N5 landowners there is no requirement to consider noise impacts on these receivers. Nevertheless, the predictions indicate that the ICNG CNMLs and the identified sleep disturbance criterion would be expected to be met at these receivers.

It should be noted that the noise levels set out in **Tables 6.4** to **6.5** are those predicted to arise externally to the dwellings. Inside the dwellings the internal levels may be expected to be some 10 dB lower assuming partially open windows, or some >20-25 dB lower with windows closed. On this basis, the anticipated internal noise levels from the construction works would not be expected to be a cause of disturbance for most people.

The noise mitigation measures identified by the OWE Construction Noise Management Plan (CNMP) would be applied throughout the works.

Additionally, **Section 8** of this report recommends a number of specific measures that can be applied to manage noise emissions from the site as much as reasonably possible and maintain noise within acceptable levels.

8. RECOMMENDATIONS

Whilst it is predicted that compliance with the ICNG criteria can be achieved, RCC proposes to implement specific measures to mitigate noise emissions during the extended construction hours.

RCC proposes to closely manage the extended construction hours works and proactively manage noise emissions. This would be achieved by undertaking the following:

- Goodman will inform the Emmaus Village aged care facility Management prior to RCC undertaking the extended construction hours works by way of their approved community consultation procedures.

- Prior to the works Goodman will meet with the Emmaus Village aged care facility Management to discuss the works and will provide contact details of site representatives that may be contacted in the case of any concerns during the works. Additionally, Goodman will periodically check in with the Emmaus Village Management during the works to ensure the works are not generating concerns or impacts to the residents of the aged care facility. In the event if any raised concerns, Goodman and RCC will work with the Emmaus Village Management to reduce any further impacts as far as practicable.

- Goodman and RCC site representatives will be provided access to the real-time noise monitoring data collected by the Sentinex noise monitoring stations located at the western and southern OWE site boundaries. Noise levels will be proactively and continuously monitored by RCC on-site representatives throughout the extended construction hours. RCC will closely monitor the Sentinex real-time data for any approaches or exceedances of the noise criteria identified in **Table 5.2** during the works. In the case of an exceedance of the identified criteria, the reason for exceedance would be immediately investigated by RCC. If it is found that the exceedance is attributable to RCC works, the works are to be immediately reviewed and work practices are to be amended and/or remedial measures will be put in place where necessary.

- Remedial measures may include the use of additional acoustic screening in the form of local noise barriers formed by noise blankets around noise generating plant items; ensuing existing acoustic shielding is being optimised and ensuring plant items are located accordingly; review of noise emissions from plant / activities / works locations and implementation of restrictions where necessary.

- All RCC staff and contracted concrete truck drivers that access the site are to be briefed on appropriate truck routes, discharge locations, compliance with on-site speed limits, the requirements for good driving behaviours and the minimisation of noise including the use of horns, reversing alarms and air brakes.

- RCC will proactively manage concrete truck movements on site. All vehicle movements including concrete agitator truck movements onto Lot 2A during pours will be from the south east corner of Lot 2A and into the warehouse superstructure from the south east of the warehouse. This will be the case during all concrete pouring stages.

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- All vehicle movements will strictly follow the access and departure routes shown in **Figure 2.6**. Only one agitator truck at a time is to access the Lot 2A warehouse. The acoustic shielding from the Lot 2B and Lot 1A warehouse structures are to be exploited by any other agitator trucks waiting to access Lot 2A (with respect to the Emmaus Village aged care facility).

Table 8.1 outlines the considerations of various noise mitigation options to reduce impact on residents from operations at the site. The table is divided in 3 sections:

- Treating the source: This refers to ways of reducing emissions directly at the source of sound generation (i.e. vehicles).
- Treating the path: This refers to treatment to the medium that is physically in between the source and the receivers (i.e. air paths, buildings, reflective surfaces, supporting structures).
- Management: This refers to measures that will be required by the site management to minimise noise from operations.

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Table 8.1 Noise Mitigation Options

Item #	Recommendation
Treating the Source	
1	Maintain good driving behaviour and practices on the access road and within the site. Horns not be used, unless in safety critical situations. Quacker reversing alarms to be used in lieu of beepers on-site. Air brakes not be used, unless in safety critical situations.
2	Trucks to access site in controlled manner and not exceed speeds of 25 km/hour when on site. Only one agitator truck at a time is to access the Lot 2A warehouse.
3	Ensure vehicles accessing the site and equipment items used on site are generally well maintained and serviced to minimise their noise emissions.
4	Ensure the access road is generally well maintained to avoid noise arising from potholes etc.
Treating the Path	
5	The concrete pump and discharging concrete truck to be located within the warehouse at all times and acoustic shielding from the Lot 2A warehouse to be exploited at all times.
6	The acoustic shielding from the Lot 2B and Lot 1A warehouse structures are to be exploited to reduce noise levels from any agitator trucks waiting to access Lot 2A (with respect to the Emmaus Village aged care facility).
6	Effective acoustic screening will be provided by the existing western boundary noise wall.
Management	
7	Maintain good management practices on site at all times and review procedures periodically.
8	RCC to proactively monitor real time noise levels from the Sentinex system located at the western and southern boundaries and in the case of any encroachment on the identified CNMLs, modify work practices accordingly.
9	Goodman to undertake consultation with the Emmaus Village aged care facility Management prior to undertaking the extended construction hours works and to make regular follow ups during the works to alleviate and/or address any concerns.
9	Continue ongoing adherence with the measures set out in the OWE CNMP.

It is expected that with the implementation of the identified noise control measures, noise levels at sensitive receivers would generally comply with the *ICNG* stipulations and not generate undue disturbance to the surrounding receivers.

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APPENDIX A: Glossary of Acoustic Terms

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1 Sound Level (or Noise Level)

Sound may be defined as any pressure variation that the human ear can detect. The human ear responds to a wide range of changes in sound pressure. As the greatest sound pressures to which the human ear responds are 10,000,000 times greater than the lowest, the decibel (dB) scale, by the use of logarithms is used to express sound pressure levels more conveniently.

The standard reference sound pressure used to define a Sound Pressure Level is 2×10^{-5} Pascals (Pa).

The decibel is defined as ten times the logarithmic ratio of two pressures. The smallest perceptible change is approximately 1 dB.

Sound Pressure Level is typically abbreviated as SPL, L_P, or L.

2 "A" Weighted Sound Pressure Level

The most common frequency rating is 'A-Weighting'. The A-weighting frequency response curve is designed to approximate the sensitivity of the human ear. The symbol L_A represents A-weighted Sound Pressure Level - The overall broadband level of a sound/noise is typically expressed as a dB(A) level.

Human hearing is most sensitive mid frequencies sounds (500 Hz to 4000 Hz), and less sensitive at higher and lower frequencies. Therefore, the level expressed in dB(A) correlates strongly with the perceived loudness of the sound/noise.

A change in sound pressure level of 1-2 dB is barely noticeable to most people, whilst a 3-5 dB change is perceived as a small but noticeable change in loudness. A 10 dB change is perceived as an approximate doubling or halving in loudness. The table below present the sound pressure levels of some common sources.

Sound Pressure Level (dB)	Sound Source	Typical Subjective Description
140	Propeller aircraft; artillery fire, gunner's position	Intolerable
120	Riveter; rock concert, close to speakers; ship's engine room	
110	Grinding; sawing	
100	Punch press and wood planers, at operator's position; pneumatic hammer or drilling (at 2 m)	Very noisy
80	Kerbside of busy highway; shouting; Loud radio or TV	Noisy
70	Kerbside of busy traffic	
60	Department store, restaurant, conversational speech	
50	General office	Moderate to quiet
40	Private office; Quiet residential area	Quiet
30	Theatre; quiet bedroom at night	
20	Unoccupied recording studio; Leaves rustling	Very quiet
10	Hearing threshold, good ears at frequency of maximum sensitivity	
0	Hearing threshold, excellent ears at frequency maximum response	

In addition to A-weighting, other less commonly applied frequency weightings include B, C and D weightings. Unweighted or Linear levels are sound levels measured without any weighting. These are expressed as simply dB, or dB(lin) or dB(Z).

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3 Sound Power Level

The rate at which a noise source emits acoustic energy is defined by its Sound Power Level. Sound Power Levels are also expressed in decibel units (dB or dB(A)). Sound Power is typically identified as SWL or LW. The standard reference sound power used to define a Sound Power Level is 1×10^{-12} Watts (W).

4 Statistical Noise Levels

Environmental noise levels from various sources in the environment will vary in level over time. Statistical exceedance levels are typically expressed as L_{AN} levels (i.e. the A-weighted sound pressure level exceeded for N% of a specific measurement period.

The most commonly used statistical noise levels are as follows:

L_{Amax} Maximum noise level over a sample period (typically measured on fast time-weighting response).

L_{A1} Noise level exceeded for 1% of a sample period (typically 15-minute interval).

L_{A10} Noise level exceeded for 10% of a sample period (typically 15-minute interval).

L_{A90} Noise level exceeded for 90% of a sample period. This noise level is commonly used to describe the background noise level (in the absence of the source under investigation).

L_{Aeq} A-weighted equivalent noise level. This is equivalent to the steady sound level containing the same amount of acoustical energy as the time-varying sound. Often referred to as the average noise level.

ABL Assessment Background Level. This is the single figure background level representing each assessment period (day, evening and night) for each day. It is determined by calculating the lowest 10th percentile background noise level (L_{A90}) for each period.

RBL Rating Background Level. This is the median value of the ABL values for each period (day, evening, night), determined over several days of measurements.

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