29 July 2022

610.19360-L01-v1.0 HLP Mod 7.docx

ESR
Level 24, 88 Phillip St
Sydney NSW 2000

Attention: Grace Macdonald

Dear Grace

Horsley Logistics Park
SSD 10436 Mod 7 – Acoustic Statement

SLR Consulting confirms that the 3.0m noise wall to the southern boundary of the western hardstand of Lot 201 shown in Figure 2 of the SSDA report (SLR report 610.19360-R02-v2.1 dated 2 November 2020) was removed during the assessment of Planning Modification 1 (Mod 1) in April 2021.

Noise modelling of the extension of the Lot 201 building footprint and alterations to the western hardstand conducted for Mod 1 (SLR report 610.19360-R06-v0.2 dated 28 April 2021) confirmed that the 3.0 noise wall was no longer required to achieve compliance at the nearest receivers. The noise wall was removed from the Mod 1 report, as well as all subsequent modelling and reports issued for the project to date.

Attached to this letter is a copy of the most recent acoustic report submitted for Lot 202 noise verification (SLR report 610-19360-R11-v1.0 dated 31 March 2022). The report confirms the approved Mod 1 masterplan has been referenced, and the layout in Figure 1 does not include the 3.0m noise wall. Compliance is indicated at the most affected receivers in each noise catchment area.

SLR Consulting confirms that the 3.0m noise wall is not required to achieve compliance for the approved Mod 1 masterplan as the above documents demonstrate.

Yours sincerely

MARK IRISH
Principal Consultant - Acoustics & Vibration

APPENDIX – SSD 10436 Lot 202 Noise Verification Report

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HORSLEY LOGISTICS PARK

SSD 10436
Lot 202 Noise Verification Report

Prepared for:

ESR
Level 29
20 Bond Street
Sydney

SLR Ref: 610.19360-R11
Version No: -v1.0
March 2022

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with ESR (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.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.19360-R11-v1.0	31 March 2022	Mark Irish	Antony Williams	Mark Irish

EXECUTIVE SUMMARY

A Noise Verification Report (NVR) has been prepared for Lot 202 (formerly Lot 204) of the Horsley Logistics Park (HLP) as required by SSD 10436 Consent Condition B13. The NVR includes updated noise source information to the SSDA approved layout of Lot 202 to reflect the needs of future operators of the site, including changes to vehicle numbers and external plant.

The SSDA approved development was assessed in SLR report 610.19360-R02-v2.1 dated 2 November 2020.

The MOD1 modification was originally assessed in SLR report 610.19360-R06-v0.2 dated 28 April 2021.

Lot 202 Operational Noise Impacts

An analysis of the prevailing weather conditions for the HLP indicated that noise-enhancing weather is a feature of the area only during the night-time period.

The operational noise modelling of the Lot 202 NVR design found no exceedances of the noise limits at any sensitive receivers under both neutral (day, evening and night periods) and noise-enhancing (night period) weather conditions.

The Lot 202 noise mitigation measures (super canopy infill wall and Warehouse C rooftop plant screening) have been re-evaluated and confirmed to be required to ensure compliance with the Operational Noise Limits during all time periods.

It is noted that the rooftop smoke spill fans (SSF) for Warehouse A, B and C are only permitted to operate during the daytime period to ensure no exceedances of the Operational Noise Limits during the night-time period.

The L_{AMax} noise emissions from Lot 202 sources are predicted to comply with the sleep disturbance screening level at all identified receivers under both neutral and noise-enhancing weather conditions during the applicable periods.

As such, with consideration of the above, operational noise emissions from the Lot 202 NVR design are considered to be compliant with the Operational Noise Limits.

Comparison with Approved Development

Compared to the approved development, operational noise impacts at the identified residential receivers are generally predicted to be consistent for the Lot 202 NVR design.

The change in road traffic noise levels on the main access route to the development site compared to the approved development would be negligible.

Overall, the predicted operational noise impacts of the Lot 202 NVR design are considered to be consistent with those of the approved MOD1 development.

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APPENDICES

Appendix A Acoustic Terminology

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by ESR to prepare a Noise Verification Report (NVR) for Lot 202 (formerly identified as Lot 204 in Development Consent SSD 10436) at the Horsley Logistics Park (HLP). This assessment is required to satisfy Condition B13 of the Development Consent SSD 10436.

The SSDA approved development was assessed in SLR report 610.19360-R02-v2.1 dated 2 November 2020.

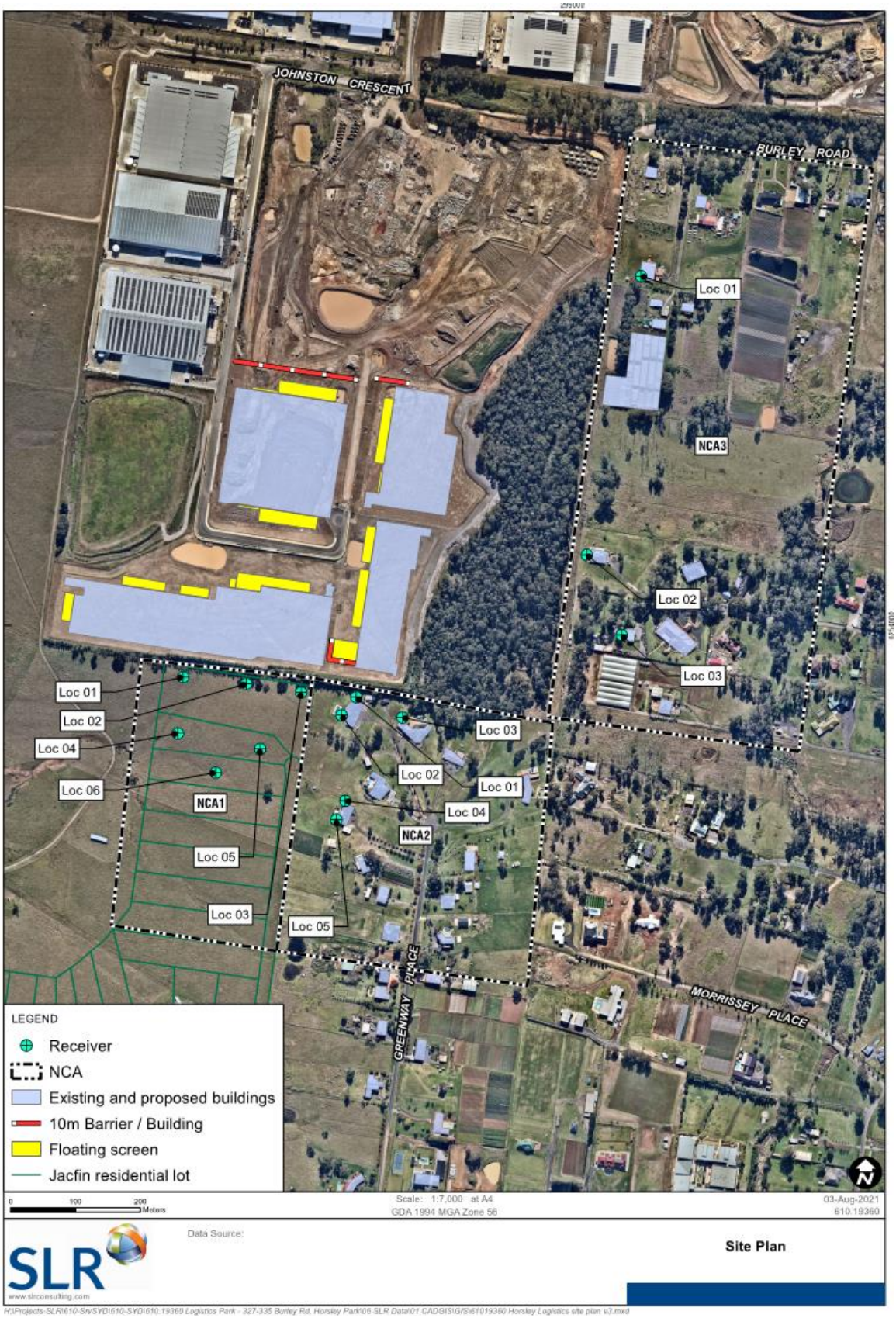
The MOD1 modification was originally assessed in SLR report 610.19360-R06-v0.2 dated 28 April 2021.

This assessment uses specific acoustic terminology. An explanation of common terms is included as **Appendix A**.

2 MOD1 Approved Development

Approval for development of the HLP was granted under the site Development Consent SSD 10436-Mod-1. The location of the development and surrounding receivers are shown in **Figure 1**.

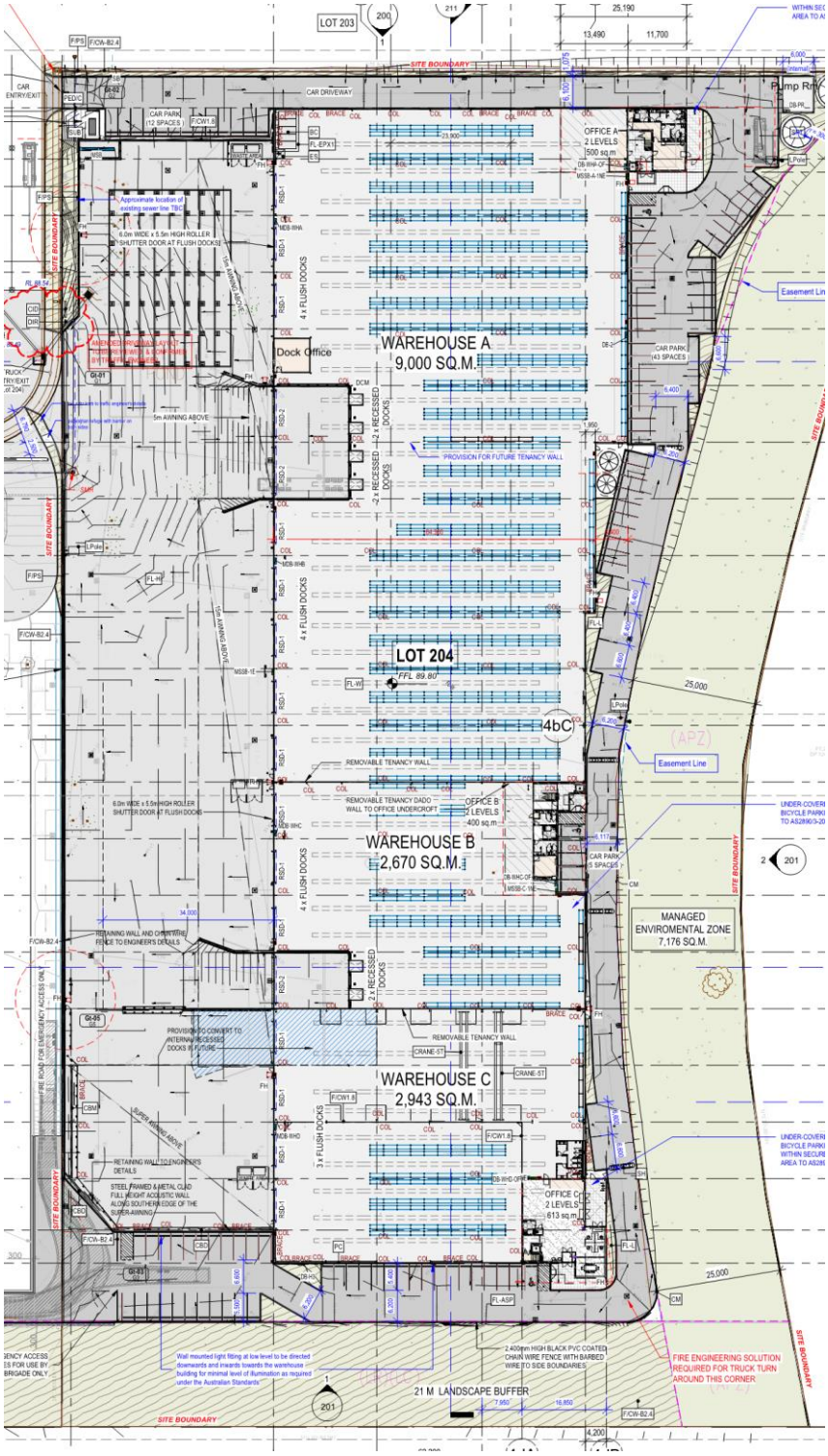
Figure 1 MOD1 Masterplan



3 Lot 202 NVR

The NVR is required to assess the operation of the HLP Lot 202 Site and Facility plan HLA-AR-200227-001 Rev 12 dated 31.1.22, shown in the plan detail in **Figure 2** (formerly identified as Lot 204).

Figure 2 Lot 202 Site and Facility Plan



The update to the approved Lot 202 facility includes noise source alterations to reflect the needs of the tenants of the site and broadly entails:

- Amending the external mechanical plant to reflect the needs of individual operators
- Adjustment of day and night-time vehicle movements based on updated operator information.

4 Operational Noise Limits

The operational noise limits applicable to the HLP are defined in Condition B11 of the Development Consent SSD 10436. The operational noise limits for each receiver Noise Catchment Area (NCA) are reproduced in **Table 1**.

Table 1 Operational Noise Limits

Location	Day $L_{Aeq(15minute)}$ (dBA)	Evening $L_{Aeq(15minute)}$ (dBA)	Night $L_{Aeq(15minute)}$ (dBA)	Night L_{AFmax} (dBA)
NCA1	44	43	38	52
NCA2	40	40	38	52
NCA3	44	43	38	52

5 Noise Verification Report Requirements

Development Consent Conditions B13 and B14 are reproduced below. It should be noted that reference to Lot 204 in the Consent should be read as Lot 202 (the new identification of this Lot).

B13. A Noise Verification Report must be prepared by a suitably qualified and experienced acoustic consultant and submitted to the satisfaction of the Planning Secretary at the following stages of the development:

(a) prior to issue of a Construction Certificate for the Lot 201 warehouse and Occupation Certificate for the Lot 204 warehouse to confirm the required noise mitigation measures;

(b) within three months of the commencement of operation of each warehouse; and

(c) within three months of the occupation of the warehouses by any new tenants for the life of the development.

B14. The Noise Verification Reports required by condition B13 must include:

(a) an analysis of compliance with noise limits undertaken in accordance with the NSW Noise Policy for Industry (EPA, 2017) and Australian Standard AS 1055:2018 Acoustics – Description and measurement of environmental noise (Australian Standard 2018);

(b) a detailed maximum noise level event assessment undertaken in accordance with the NSW Noise Policy for Industry (EPA, 2017);

(c) an assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, re-assessment of mitigation measures identified; and

(d) identification of additional noise control measures, excluding at-receiver controls, to be implemented to address any exceedances of the limits specified in condition B12 and when these measures are to be implemented and how their effectiveness is to be measured and reported to the Planning Secretary.

The items in Condition B14 have been addressed in the following sections of this report:

Condition B14	Relevant Section of Report
(a) an analysis of compliance with noise limits undertaken in accordance with the NSW Noise Policy for Industry and Australian Standard AS 1055:2018	**Section 6** **Section 7.1** **Section 7.2**
(b) a detailed maximum noise level event assessment undertaken in accordance with the NSW Noise Policy for Industry	**Section 7.2.2**
(c) an assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, re-assessment of mitigation measures identified	**Section 7.3**
(d) identification of additional noise control measures, excluding at-receiver controls, to be implemented to address any exceedances of the limits specified in condition B12	**Section 7.4**

6 Prevailing Weather Conditions

Certain meteorological/weather conditions can increase noise levels and are required to be considered in accordance with the NSW *Noise Policy for Industry* (NPfI) where they occur regularly. This can occur during temperature inversions (where temperatures increase with height above ground level), or where there is a wind gradient (where wind speed increases with height).

In order to determine the prevailing weather conditions for the development area, 12 months of weather data (January 2016 to December 2016) was obtained from the Bureau of Meteorology automatic weather station at Horsley Park, which is approximately 6 km to the east of the development. This data was analysed to determine the frequency of noise-enhancing wind and temperature inversion conditions which may affect noise levels at the site.

The analysis indicated that during the daytime and evening periods, winds of up to 3 m/s did not exceed the 30% threshold during any season. However, the 30% threshold was exceeded during the night-time period in autumn, in both the SW and WSW directions.

The analysis also indicated that temperature inversions of Class F or Class G are likely to occur for more than 30% of the night-time period during all four seasons. Therefore, noise-enhancing temperature inversions are required to be included in the assessment of noise impacts during the night-time period.

On this basis, assessment of noise-enhancing weather during the daytime and evening periods is not required. Noise-enhancing conditions (wind and temperature inversion) are required to be considered for night-time operations.

7 Operational Noise Impact Assessment

7.1 Operational Noise Modelling

Noise modelling of the development site was undertaken using the CONCAWE noise prediction algorithms in SoundPLAN modelling software.

A 3D digital noise model was constructed from a combination of aerial photography, existing ground topography, design ground topography, receiver buildings / structures and design plans for the development. Warehouse buildings and office buildings within the HLP have been modelled based on the design plans. The modelled MOD1 site layout is included in **Figure 1**.

In order to assess the operational noise impacts from the HLP, worst-case peak light and heavy vehicle movements have been modelled across the development. Light vehicles have been modelled on the estate roads and in the car parking areas. Heavy vehicles have been modelled on the estate roads and manoeuvring in the hardstand areas.

Supplied heavy and light vehicle volumes for Lot 202 Warehouse A, B and C are provided in **Table 2** and **Table 3**. All other Lots have been modelled with identical vehicle movements to the approved MOD1 development.

Table 2 Lot 202 Daytime Vehicle Movements – Tenant Specific

Warehouse	Vehicle Type	Number of Vehicles (two way)
A - Holman	B-Double	2
	Semi	2
	Light vehicle	20
B - Tennant	B-Double	1
	Semi	2
	Rigid truck	5
	Light vehicle	30
C - Rhomberg	Semi	1
	Rigid truck	4
	Light vehicle	120

Table 3 Lot 202 Night-time Vehicle Movements – Tenant Specific

Warehouse	Vehicle Type	Number of Vehicles (two way)
A - Holman	Semi	1 (up to 2 per month)
	Light vehicle	30
B - Tennant	Heavy vehicle	0
	Light vehicle	30
C - Rhomberg	Heavy vehicle	0
	Light vehicle	30

The modelling inputs and source Sound Power Levels (SWL) for each component of the vehicle access road, manoeuvring and loading are summarised below.

7.1.1 Lot 202 Vehicle Numbers

The modelled line sources for all Lots were subdivided into the following sections:

- Access road movements at 25 km/h, 20% accelerating driving condition
- Loading and hardstand areas at 5 km/h.

The updated vehicle numbers for Lot 202 are included in **Table 4.**

Table 4 Lot 202 Daytime Vehicle Movements - Modelled

Source	Source SWL, dBA	Number of Vehicles (two way)
202 (1) HV Day Loading	105	1
202 (1) HV Day Road	105 (80%) 111 (20%)	1
202 (2) HV Day Loading	105	2
202 (2) HV Day Road	105 (80%) 111 (20%)	2
202 (3) HV Day Loading	105	1
202 (3) HV Day Road	105 (80%) 111 (20%)	1
202 (1) LV Day Carpark	96	20
202 (1) LV Day Road	96	20
202 (2) LV Day Carpark	96	15
202 (2) LV Day Road	96	15
202 (3) LV Day Carpark	96	30
202 (3) LV Day Road	96	30

Table 5 Lot 202 Night-time Vehicle Movements - Modelled

Source	Source SWL, dBA	Number of Vehicles (two way)
202 (1) HV Day Loading	105	1
202 (1) HV Day Road	105 (80%) 111 (20%)	1
202 (2) HV Day Loading	105	0
202 (2) HV Day Road	105 (80%) 111 (20%)	0
202 (3) HV Day Loading	105	0
202 (3) HV Day Road	105 (80%) 111 (20%)	0
202 (1) LV Day Carpark	96	10
202 (1) LV Day Road	96	10
202 (2) LV Day Carpark	96	10
202 (2) LV Day Road	96	10
202 (3) LV Day Carpark	96	10

Source	Source SWL, dBA	Number of Vehicles (two way)
202 (3) LV Day Road	96	10

7.1.2 Area Sources

Table 6 L_{Aeq} Sound Power Levels – Area Sources

Noise Source	Source SWL, dBA	Duration of Use in Peak 15-minute Period, s	Comment
Truck Reversing Alarm	107[1]	60	Applicable to 50% of two way truck movements
Forklift Reversing Alarm	102[1]	90	-
Gas Forklift	93	900	-

Note 1. LAeq sound power level 3 dBA lower than the maximum sound power level

7.1.3 Point Sources

Rooftop smoke exhaust fan locations for Lot 202 are shown in **Figure 3.**

Fan sound power levels are detailed in **Table 7**.

Table 7 Rooftop Plant Sound Power Levels

Location	Noise Source	Outlet SWL, dBA
Warehouse A (SSF-1 to SSF-4)	Pacific Ventilation VD10JA35A-4HFF	91
Warehouse B SSF-1 Warehouse C SSF-1	Pacific Ventilation VD10JF37A-4KFF	95

Maximum noise level events are modelled to occur anywhere within the area sources at each hardstand with the SWLs shown in **Table 8**.

Table 8 L_{Amax} Sound Power Levels – Hardstand, Loading Areas and Car Parks

Noise Source	Source SWL, dBA
Air brake	118
Truck Reversing Alarm	110
Forklift Reversing Alarm	105
Car Peak Events	100

It is anticipated that the L_{Aeq} noise contribution from occasional impact sounds due to loading activities would not be significant compared to the dominant sources included in **Table 6**.

The maximum SWL of occasional impact sounds is also considered unlikely to exceed the air brake SWL 118 dB in **Table 8** for the sleep disturbance screening assessment.

Figure 3 Lot 202 Rooftop Plant Locations



7.1.4

7.1.4 Nearest Sensitive Receivers

The area surrounding the development has been divided into three Noise Catchment Areas (NCAs). The NCAs and sensitive receivers in the area around the development are shown in **Figure 1**. NCA1 includes nominal locations of future receivers to the south of the development. NCA2 and NCA3 includes existing receivers to the south and east of the development respectively.

In accordance with the procedures in the NPfI for individual residential dwellings, compliance with the operational noise limits and maximum noise levels have been assessed at the most-affected point at each residential property and at a height of between 1.2–1.5 m above ground level, as indicated in **Figure 1**.

7.2 Predicted Operational Noise Impacts

7.2.1 Compliance with Operational Noise limits

Operational noise levels for the HLP were predicted for the MOD1 Masterplan design. The indicative 10m barriers/buildings representing future Stage 3 development were included in the noise model as indicated in **Figure 1** (also included in the approved SSDA).

The predicted operational noise levels at the most affected receiver in each catchment for the Lot 202 NVR design are summarised in **Table 9**.

Table 9 Lot 202 NVR Operational Scenario with Indicative 10 m Building/Barrier to Stage 3 Boundary

NCA	Period (weather)	$L_{Aeq(15\ minutes)}$ Noise Level (dBA)			L_{Amax} Noise Level (dBA)		
		Operational Noise Limit	Predicted	Compliance	Sleep Disturbance Screening Noise Level	Predicted	Compliance
NCA1	Daytime (neutral)	44	38	Yes	n/a[2]	n/a[2]	n/a[2]
	Evening (neutral)	43	38	Yes	n/a[2]	n/a[2]	n/a[2]
	Night-time (noise-enhancing)	38	38	Yes	52	46	Yes
NCA2	Daytime (neutral)	40	40	Yes	n/a[2]	n/a[2]	n/a[2]
	Evening (neutral)	40	40	Yes	n/a[2]	n/a[2]	n/a[2]
	Night-time (noise-enhancing)	38	38	Yes	52	48	Yes
NCA3	Daytime (neutral)	44	39	Yes	n/a[2]	n/a[2]	n/a[2]
	Evening (neutral)	43	39	Yes	n/a[2]	n/a[2]	n/a[2]
	Night-time (noise-enhancing)	38	38	Yes	52	52	Yes

Note 1: **Bold** text indicates an exceedance of the operational noise limit.

Note 2: L_{Amax} criteria are not applicable during this time period.

7.2.2 Lot 202 Maximum Noise Level Event Assessment

The maximum noise level contributions for the Lot 202 noise sources included in **Table 8** were predicted at the nearest receivers in NCA1, NCA2 and NCA3 as required by Consent Condition B14 item (b). The location of each receiver is indicated in **Figure 1**.

The results for night-time (noise enhancing) conditions are summarised in the following tables. Due to the limited amount of night-time activity at Lot 202, the most significant maximum noise events for other Lots are also included for context below.

Table 10 NCA1 Location 3 – Maximum Noise Source Contributions

Noise Source	Maximum Source Noise Level L_{Amax} (dBA)
Loading 202 (Warehouse A)	46 (air brake)
Loading 203 (Warehouse B)	40 (air brake)
Loading 204	38 (air brake)
Loading 201 (Warehouse 3)	35 (air brake)
202 LV Night Carpark (Warehouse C)	32 (car)
Highest Receiver Maximum Noise Level (Lot 202 Sources)	**46**
Sleep Disturbance Screening Criterion	**52**

Table 11 NCA2 Location 1 – Maximum Noise Source Contributions

Noise Source	Maximum Source Noise Level L_{Amax} (dBA)
Loading 202 (Warehouse A)	46 (air brake)
Loading 203 (Warehouse B)	40 (air brake)
202 LV Night Carpark (Warehouse C)	38 (car)
Loading 204	37 (air brake)
Loading 201 (Warehouse 3)	32 (air brake)
Highest Receiver Maximum Noise Level (Lot 202 Sources)	**46**
Sleep Disturbance Screening Criterion	**52**

Table 12 NCA2 Location 2 – Maximum Noise Source Contributions

Noise Source	Maximum Source Noise Level L_{Amax} (dBA)
Loading 202 (Warehouse A)	48 (air brake)
Loading 203 (Warehouse B)	40 (air brake)
202 LV Night Carpark (Warehouse C)	32 (car)
Loading 204	36 (air brake)
Loading 201 (Warehouse 3)	35 (air brake)

Noise Source	Maximum Source Noise Level L_{Amax} (dBA)
Highest Receiver Maximum Noise Level (Lot 202 Sources)	**48**
Sleep Disturbance Screening Criterion	**52**

Table 13 NCA3 Location 1 – Maximum Noise Source Contributions

Noise Source	Maximum Source Noise Level LAmax (dBA)
Loading 203 (Warehouse A)	52 (air brake)
Loading 201 (Warehouse 3)	47 (air brake)
Loading 201 (Warehouse 2b)	47 (air brake)
Loading 201 (Warehouse 2a)	43 (air brake)
203 LV Night Carpark	35 (car)
Highest Receiver Maximum Noise Level (Lot 203 Sources)	**52**
Sleep Disturbance Screening Criterion	**52**

Table 14 NCA3 Location 2 – Maximum Noise Source Contributions

Noise Source	Maximum Source Noise Level LAmax (dBA)
202 LV Night Carpark (Warehouse C)	38 (car)
202 LV Night Carpark (Warehouse A)	38 (car)
203 LV Night Carpark	37 (car)
Loading 201 (Warehouse 1)	34 (air brake)
Loading 203 (Warehouse B)	32 (air brake)
Highest Receiver Maximum Noise Level (Lot 202 Sources)	**38**
Sleep Disturbance Screening Criterion	**52**

The noise predictions in **Table 10** to **Table 14** confirm that compliance with the night-time Operational Noise Limits and sleep disturbance screening criterion is predicted at the nearest receiver locations in all catchments.

7.2.3 Screening Test for Annoying Characteristics

As defined in Fact Sheet C of the NPfI, non-tonal reversing alarms may be considered intermittent during the night-time period, in the event that noise from this source is sufficiently dominant above the ambient noise level to result in a 5 dB change in level at the receiver.

To assess the potential for individual reversing alarms to be perceived as intermittent at the nearest receivers in the absence of other significant activity occurring on site, an intermittency screening test has been conducted by comparing the maximum noise level of a non-tonal truck reversing alarm (SWL 110 dB) at any point within the Lot 202 hardstand/loading area to the established Rating Background Level (RBL) for the receiver. This enables a prediction of the emergence of an individual reversing alarm noise level that would be measured at the receiver location compared to the prevailing night-time background noise level.

The Lot 202 reversing alarm maximum noise level intermittency screening test is provided for the nearest receiver in each noise catchment NCA1 (in **Table 15**) and NCA2 (in **Table 16**), with weather enhancing conditions. Rating Background Levels for each noise catchment are taken from the NVIA report (SLR report 610-19360-R02-v2.1 dated 2 November 2020).

Table 15 NCA1 Location 3 – Lot 202 Reversing Alarm Intermittency Screening Test

Scenario	Receiver Maximum Noise level LAmax	Rating Background Level (RBL) dBA	Emergence above RBL dBA	Perceived Intermittency Likely at Receiver?
Loading 202 (Warehouse A)	38	38	0	No

Table 16 NCA2 Location 1 – Lot 202 Reversing Alarm Intermittency Screening Test

Scenario	Receiver Maximum Noise level LAmax	Rating Background Level (RBL) dBA	Emergence above RBL dBA	Perceived Intermittency Likely at Receiver?
Loading 202 (Warehouse A)	38	35	+3	No

The screening test for the most affected receiver in each noise catchment indicates that the maximum Lot 202 reversing alarm noise level would not be considered intermittent at the nearest receivers.

7.3 Effectiveness of Noise Mitigation Measures

As indicated in **Figure 1** and **Figure 3**, there are specific noise mitigation measures associated with verification of the Lot 202 design, summarised below:

- Infill noise wall to Southern and Western eave height of Lot 202 super canopy (shown in **Figure 1)**
- Two-sided solid screening to one smoke spill fan, minimum height 1.0m above top of unit height (Warehouse C-SSF-1 only, location shown in **Figure 3**) to permit daytime use of all of the smoke spill fans (Warehouse A, B and C).

The operational noise levels in **Table 9** confirm that the above mitigation measures are required in order to comply with the Operational Noise Limits during all time periods.

7.4 Discussion of Noise Impacts

The results in **Table 9** indicate that operational noise levels for Lot 202 are predicted to comply with the residential noise limits at all identified residential receivers under both neutral and noise-enhancing weather conditions during the applicable periods.

The L_{Amax} noise emissions from Lot 202 sources are predicted to comply with the sleep disturbance screening level at all identified receivers under both neutral and noise-enhancing conditions during the applicable periods as indicated in **Table 10** to **Table 14**.

As such, with consideration of the above, operational noise emissions from Lot 202 are considered to be compliant with the mitigation measures included in **Section 7.3**.

7.5 Comparison with Approved Development Impacts

Compared to the approved MOD1 development, operational noise impacts at the identified residential receivers are generally predicted to be consistent with the updated Lot 202 sources.

8 Conclusion

An operational noise verification assessment has been conducted for Lot 202 (formerly Lot 204) at Horsley Logistics Park (HLP). The SSDA approved development was assessed in SLR report 610.19360-R02-v2.1 dated 2 November 2020. The MOD1 modification was originally assessed in SLR report 610.19360-R06-v0.2 dated 28 April 2021.

The operational noise modelling of the MOD1 Masterplan design found no exceedances of the noise limits at any sensitive receivers under both neutral (day, evening and night periods) and noise-enhancing (night period) weather conditions.

The L_{AMax} noise emissions from Lot 202 sources are predicted to comply with the sleep disturbance screening level at all identified receivers under both neutral and noise-enhancing weather conditions during the applicable periods.

The Lot 202 noise mitigation measures (super canopy infill wall and Warehouse C rooftop plant screening) have been re-evaluated and confirmed to be required to ensure compliance with the Operational Noise Limits during all time periods.

Overall, the predicted operational noise impacts of Lot 202 are considered to be consistent with those of the approved MOD1 development.

APPENDIX A

Acoustic Terminology

1. Sound Level or Noise Level

The terms 'sound' and 'noise' are almost interchangeable, except that 'noise' often refers to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure. The human ear responds to changes in sound pressure over a very wide range with the loudest sound pressure to which the human ear can respond being ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2. 'A' Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an 'A-weighting' filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4,000 Hz), and less sensitive at lower and higher frequencies. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect, whilst a 3 dB to 5 dB change corresponds to a small but noticeable change in loudness. A 10 dB change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels.

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120	Heavy rock concert	Extremely noisy
110	Grinding on steel	
100	Loud car horn at 3 m	Very noisy
90	Construction site with pneumatic hammering	
80	Kerbside of busy street	Loud
70	Loud radio or television	
60	Department store	Moderate to quiet
50	General Office	
40	Inside private office	Quiet to very quiet
30	Inside bedroom	
20	Recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as 'linear', and the units are expressed as dB(lin) or dB.

3. Sound Power Level

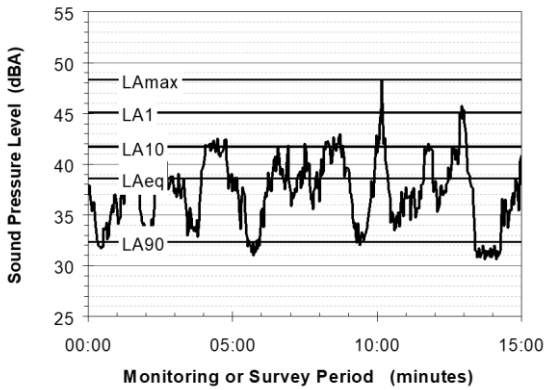
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure is similar to the effect of an electric radiator, which is characterised by a power rating but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4. Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceeded for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq The A-weighted equivalent noise level (basically, the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

5. Frequency Analysis

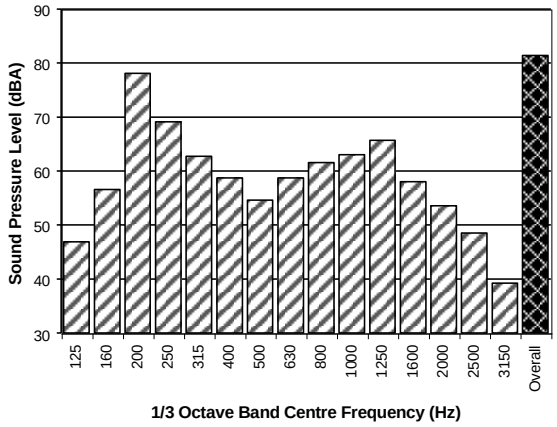
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (three bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



6. Annoying Noise (Special Audible Characteristics)

A louder noise will generally be more annoying to nearby receivers than a quieter one. However, noise is often also found to be more annoying and result in larger impacts where the following characteristics are apparent:

- **Tonality** - tonal noise contains one or more prominent tones (ie differences in distinct frequency components between adjoining octave or 1/3 octave bands), and is normally regarded as more annoying than 'broad band' noise.
- **Impulsiveness** - an impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.
- **Intermittency** - intermittent noise varies in level with the change in level being clearly audible. An example would include mechanical plant cycling on and off.
- **Low Frequency Noise** - low frequency noise contains significant energy in the lower frequency bands, which are typically taken to be in the 10 to 160 Hz region.

7. Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of 'peak' velocity or 'rms' velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as 'peak particle velocity', or PPV. The latter incorporates 'root mean squared' averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements (ie vertical, longitudinal and transverse).

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used.

8. Human Perception of Vibration

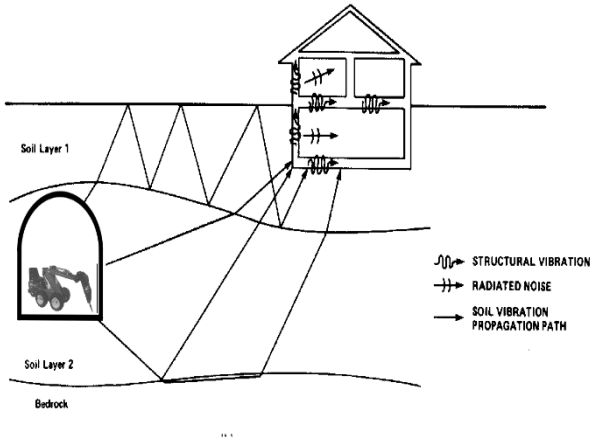
People are able to 'feel' vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as 'normal' in a car, bus or train is considerably higher than what is perceived as 'normal' in a shop, office or dwelling.

9. Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed 'structure-borne noise', 'ground-borne noise' or 'regenerated noise'. This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents an example of the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term 'regenerated noise' is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

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