## Appendix 12.5 Operational Sound Prediction & Assessment Methodology

This appendix includes detailed information on both the methods of prediction and assessment of operational sound.

## Predictions of Operational Sound

Regarding the prediction of operational sound from HGV activity, a 3D model of the surrounding area including topography and site bunding has been constructed using the software package IMMI. Predictions of sound arising from HGV activities in service yards have been modelled within IMMI as point sources, using the propagation methodology described in ISO 9613-2:1996. Predictions of the noise levels from HGVs travelling along the access roads within the red line boundary have been modelled in IMMI using the haul road method from BS 5228-1:2009+A1:2014.

Octave frequency band source levels for the HGV service yard activities have been taken from Vanguardia's measurement library and are presented in Table 1 below.

HGV Activity	Sound Power Level (L <sub>w</sub> dB in each Octave Band)								Lwa (dB)
	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz	
HGV Reverse	101	94	94	91	94	95	84	79	99
HGV Start-up & Pull away	107	101	98	97	97	94	87	78	101
HGV Load	90	89	90	89	86	83	79	73	91
Cab picking up trailer (Lmax)	113	106	107	108	108	107	102	92	113

Table 1 Source levels for predictions of HGV service yard activity noise

The primary standard for the assessment of operational sound from the Development is BS 4142:2014+A1:2019, which indicates that the operational sound at the receptor locations should be evaluated over reference interval of 1-hour during the day (07:00 - 23:00 hours) and 15-minutes during the night (23:00 - 07:00 hours). Therefore, the model considers the likely number of manoeuvres (i.e., a HGV reversing into the loading or parking bay and pulling away) and loading/unloading activities taking place over these periods. The number of manoeuvres has been based on the hourly HGV profile for the warehousing provided by the Applicant's transport consultant, which is based on the proposed maximum floor area of the Development.

Where the activity takes place for less than the duration of the assessment period, the levels have been corrected to take account of their duration or 'on-time'. For the 1-hour daytime assessment period, it has generally been assumed that manoeuvres (reversing and pull away) take 1 minute to complete and loading/unloading takes 30 minutes. For the 15-minute night-time assessment period, the same assumptions apply to manoeuvres, but no on-time correction is applied to loading/unloading as this may occur for the full duration of the assessment period. These assumptions are based on Vanguardia's experience of undertaking these assessments for a range of occupiers and the duration of the measurements in our library measurement data (as presented in Table 1 above). The number of activities that have been assumed for each assessment period (which also inform the predictions of noise from HGV movements on the access roads within the red line boundary) and the corresponding source levels are summarised in Table 2.

	HGV Activity	1-hou	Daytime Ir Assessment I	Period	Night-time 15-minute Assessment Period			
Plot		No. during hour	On-time correction (dB)	Corrected Sound power level (dBA)	No. during 15 minutes	On-time correction (dB)	Corrected Sound power level (dBA)	
1	Reverse	26	-18	81	5	-12	87	
	Pull-away	20	-18	83	5	-12	89	
	Loading	23	-3	88	10	0	91	
2	Reverse	19	-18	81	4	-12	87	
	Pull-away	15	-3	83	3	0	89	
	Loading	17	-18	88	7	-12	91	
3	Reverse	41	-18	81	8	-12	87	
	Pull-away	31	-3	83	7	0	89	
	Loading	36	-18	88	15	-12	91	
4	Reverse	14	-18	81	3	-12	87	
	Pull-away	11	-3	83	3	0	89	
	Loading	13	-18	88	5	-12	91	

Table 2 Details of HGV service yard activities during peak hour of the day and peak 15 minutesat night

As mentioned in Chapter 12 of the ES, individual noise events from night-time HGV activity are also assessed, which use the "Cab picking up trailer (Lmax)" source level from Table 1 above.

## **Assessment of Operational Sound**

The assessment of the potential effects arising from operational sound associated with the Proposed Development is based on the principles of BS 4142:2014+A1:2019. This methodology provides an initial estimate of impact based on the difference between the sound from the source being assessed (the specific level) and the existing background sound level at the measurement location.

Regarding the background sound level, the standard states that the value used should be representative of what occurs at the receptor locations during the assessment periods and that the objective is not simply to identify the lowest level. Typical background sound levels are usually identified using statistical analysis; see the Baseline Conditions section of the ES Noise Chapter and Appendix 12.2 for further information.

The standard also states that certain characteristics, if perceptible at the receptor location, can increase the extent of the impact over that expected from a simple difference in noise levels. These characteristics include tonality, impulsivity and intermittency as well as "other sound characteristics" which is used when the sound might be readily distinctive against the residual acoustic environment but is not considered to have any of the other three features. The standard describes various options for taking any such features into account and for determining what is described in the standard as a 'rating level'.

To derive the rating level for this assessment, a 3 dB correction has been added to the predicted operational sound level if it exceeds the typical background sound level on the basis that some characteristics of the sound may be readily distinctive against the residual acoustic environment at this point.

The standard states that the extent of the impact can be determined by subtracting the typical background sound level from the rating level:

- 'Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around + 10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around + 5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it
  is that the specific sound source will have an adverse impact or a significant adverse impact.
  Where the rating level does not exceed the background sound level, this is an indication of the
  specific sound source having a low impact, depending on the context.'

The standard indicates that while the difference between the rating level and the background sound level provides an initial estimate of impact, other factors should be considered in terms of context, such as the absolute noise levels and how the character and level of the source relates to the existing sound environment. Regarding the absolute noise levels, relevant guideline values are presented in below.

Location (activity)	Time period	Desirable Sound Level not to be exceeded			
Inside bedrooms and living rooms (resting)	Day (07:00-23:00)	$35 - 40 \text{ dB } L_{Aeq,T}$			
Inside bedrooms (sleeping)	Night (23:00-07:00)	30 – 35 dB L <sub>Aeq,T</sub>			
Inside Dining Room/area (dining)	Day (07:00 – 23:00)	40 – 45 dB L <sub>Aeq,T</sub>			
External Amenity Space	Day (07:00-23:00)*	50 – 55 dB L <sub>Aeq,T</sub>			
*Time period not defined but assumed to be day.					

Table 3 Summary of Guideline Values from BS 8233:2014

The lower values presented in the table are generally regarded as the LOAEL for steady external sound, i.e., no adverse effect due to the impact of the sound would be expected. If the sound has certain characteristics at the receptor location, it could be appropriate to consider a lower value as the LOAEL. Alternatively, a correction for those characteristics could be applied to the predicted levels. The latter is the approach followed in this assessment, with the rating levels (including any appropriate corrections for the acoustic character of the noise present at the receptor location) being used as the basis of the assessment of the absolute noise levels.

The World Health Organisation's Guidelines for Community Noise has been used to consider the potential impact from any maximum short-term noise levels from operational sound during the night-time period. The guidelines state that, for good sleep, indoor sound pressure levels should not exceed around 45 dB L<sub>AFmax</sub> more than 10-15 times per night. This is equated to a level at the outside façade of 60 dB L<sub>AFmax</sub> with a partially open window.

The Institute of Environmental Management and Assessment (IEMA) published their Guidelines for Environmental Noise Impact Assessment in 2014. The document describes a process for undertaking such assessments. It notes that the extent of the effects of noise impact can rarely be determined solely by the difference between current and future noise levels, and that there are other factors to consider when determining potential effects. This principle has been followed in the assessment.