Grand Union Canal Transfer

Appendix 19-PD-3: Noise and Vibration Calculation Methodology

Table of Contents

Appendix 19-PD-3: Noise and Vibration Calculation Methodology

1. Introduction

1.1.1 This appendix of the Preliminary Environmental Information (PEI) Report presents the methodology for calculating noise and vibration.

2. Noise Methodology

2.1 Construction Phase

2.1.1 For the purposes of assessing noise from construction activities, sound power level (Lw) data for representative plant to be used have been sourced from BS 5228-1:2009+A1:2014 Noise predictions of construction activities (BS 5228-1) (Ref. 1) have been undertaken using Cadna-A noise modelling software.

2.1.2 Cadna-A applies methodologies within BS 5228-1 to predict construction noise.

2.1.3 The calculation methodology is based on the number and type of equipment operating, their associated Sound Power Level, and the distance to sensitive receptors.

2.1.4 Sound power data for representative construction plant for each type of activity that have been applied in noise prediction are presented in **Appendix 19-P1A-1**, **Appendix 19-P1B-1**, **Appendix 19-P2-1**, **Appendix 19-P3-1**, **Appendix 19-P4A-1** and **Appendix 19-P4B-1** in PEI Report **Volume 4**.

Acoustic model settings

2.1.5 Model settings are as follows:

a. Maximum search radius of 2,000 metres (m);

b. Maximum number of reflections: 1;

c. Noise predictions carried out at 1.5 m and 4 m above ground to represent ground and first floor levels respectively. The highest predicted level across either floor is presented in the results; and

d. Ground absorption has been set to G=060 (corresponding to a mix of hard and soft ground).

2.2 Operational

Prediction Methodology

2.2.1 Modelling of sound levels from the development was undertaken using CadnaA acoustic modelling software. This software implements the sound propagation calculation methodology set out in ISO 9613-2 (Ref. 2).

Acoustic model settings

2.2.2 Model settings will be determined on receipt of input data but are likely to be similar to the following:

a. Maximum search radius of 1,000 m;

b. Maximum number of reflections: 1;

c. Noise predictions carried out at 1.5 m and 4 m above ground to represent ground and first floor levels respectively; and

d. Ground absorption has been set to G=0.0 (corresponding to 100% hard ground) to represent reflective surfaces such as roads and hardstanding within the proposed site boundary. For the remaining areas ground absorption has been set to G=1 acoustically soft ground.

2.3 BS 4142 Assessment Methodology

2.3.1 BS 4142:2014+A1:2019 'Method for Rating and Assessing Industrial and Commercial Sound' (BS 4142) (Ref. 3) describes methods for rating and assessing sound of an industrial and/or commercial nature. The method compares the rating level of the sound source under consideration with the background sound level in the vicinity of residential locations. The relevant parameters are as follows:

a. Ambient sound level, L_a, $L_{Aeq,T}$ decibels (dB) – ambient sound is defined in BS 4142 as the *"…totally encompassing sound in a given situation at a given time, usually from many sources near and far*". The ambient sound comprises the residual sound and the specific sound when present;

b. Residual sound level, *Lr*, $L_{Aeq,T}$ dB – residual sound is defined in BS 4142 as the *"…ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound"*;

c. Specific sound level, *Ls*, $L_{Aeq,Tr}$ dB – the specific sound source is defined in BS 4142 as the *"…sound source being assessed', with the specific sound level being specified at the assessment location over a given reference time interval, Tr,"*;

d. Background sound level, $L_{A90,T}$ dB – defined in BS 4142 as the *"A-weighted sound pressure level that is exceeded by the residual sound for 90% of a given time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels"*;

e. Rating level, $L_{Ar,Tr}$ dB – defined in BS 4142 as the *"…specific sound level plus any adjustment made for the characteristic features of the sound"*:

   i. Up to six dB for tonal characteristics. Subjectively, this can be converted to a penalty of two dB for a tone which is just perceptible at the noise receptor, four dB where it is clearly perceptible, and six dB where it is highly perceptible;

   ii. Up to nine dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of three dB for impulsivity which is just perceptible at the noise receptor, six dB where it is clearly perceptible, and nine dB where it is highly perceptible;

   iii. If intermittency is readily distinctive against the residual acoustic environment, a penalty of three dB can be applied; and

   iv. Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of three dB can be applied.

2.3.2 When comparing the background noise level and the rating level at a noise sensitive receptor, the standard states that:

a. *"Typically, the greater the difference, the greater the magnitude of impact.*

b. *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending upon the context.*

c. *A difference of around +5 dB is likely to be an indication of an adverse impact, depending upon the context.*

d. *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 upon the context."*

2.3.3 Importantly, as indicated above, BS 4142 requires that the rating level of the noise source under assessment be considered in the context of the environment when defining the overall significance of the impact. The standard suggests that in assessing the context, all pertinent factors should be taken into consideration, including the following:

a. *"The absolute level of sound;*

b. *The character and level of the residual sound compared to the character and level of the specific sound; and*

c. *The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions."*

3. Vibration Methodology

3.1 Construction Phase

3.1.1 The vibration levels from the vibratory sheet piling have been calculated using the prediction method described in BS 5228-2:2009+A1:2014 'Code of Practice for Noise and Vibration Control of Construction and Open Sites - Part 2: Vibration' (BS 5228-2) (Ref. 4). The method in BS 5228-2 is based on empirical data for vibratory piling and includes a formula for predicting the peak particle velocity (PPV) from the vibratory piling works using the distance from the works.

3.1.2 The formula used is shown in the excerpt below.

Vibratory piling	$v_{res} = \frac{k_v}{x^\delta}$	k_v = 60 (50%) k_v = 126 (33.3%) k_v = 266 (5%)	$1 \leqslant x \leqslant 100$ m $1.2 \leqslant W \leqslant 10.7$ kJ δ = 1.3 (all operations) δ = 1.2 (start up and run down) δ = 1.4 (steady state operation)

3.1.3 The formula includes a scaling factor that allows for the probability of the predicted value being exceeded. A media scaling factor of k_v = 126 has been used. A delta value of δ = 1.3, corresponding to 'all operations' has also been used.

3.1.4 Based on the above calculations were undertaken to establish the spatial extent over which minor (Lowest Observed Adverse Effect Level [LOAEL] exceedance) and moderate or above (Significant Observed Adverse Effect Level [SOAEL] exceedance) may occur. These distances were calculated to be 100 m and 40 m respectively. These distances were then used to calculate the LOAEL and SOAEL buffers shown in **Figure 19-PD-3** in PEI Report **Volume 3**.

3.2 Operational Phase

3.2.1 The most appropriate approach to the assessment of operational phase vibration emissions will be determined for the Environmental Statement (ES), based on design details with are to be confirmed at the time of writing this PEI Report.

4. References

Ref. 1 BSI (2009) BS 5228-1:2009+A1:2014 Code of Practice for Noise and Vibration Control of Construction and Open Sites – Part 1: Noise.

Ref. 2 ISO 9613-2:2024 Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors.

Ref. 3 BSI (2019) BS 4142:2014+A1:2019 Method for Rating and Assessing Industrial and Commercial Sound.

Ref. 4 BSI (2009) BS 5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control of Construction and Open Sites - Part 2: Vibration.