national highways

Lower Thames Crossing

6.3 Environmental Statement Appendix 12.3 – Operational Ventilation Noise Assessment: North Portal

APFP Regulation 5(2)(a)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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Lower Thames Crossing

Appendix 12.3 – Operational Ventilation Noise Assessment: North Portal

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1 Introduction

1.1 Project introduction

1.1.1 This Appendix presents the findings of the noise impact assessment completed in relation to the tunnel ventilation system at the North Portal building associated with the proposed 4.25km tunnel section of the Lower Thames Crossing ('the Project'). This Appendix supports Chapter 12 of this Environmental Statement (Application Document 6.1).

1.1.2 The assessment has been undertaken in accordance with the methodology and guidance of BS 4142:2014 (+A1:2019) 'Methods for rating and assessing industrial and commercial sound' (British Standards Institution, 2019).

1.1.3 The assessment is based upon background and ambient noise measurement surveys undertaken near the site between Wednesday 18 and Thursday 19 July 2018, prior to any operational facility at the site.

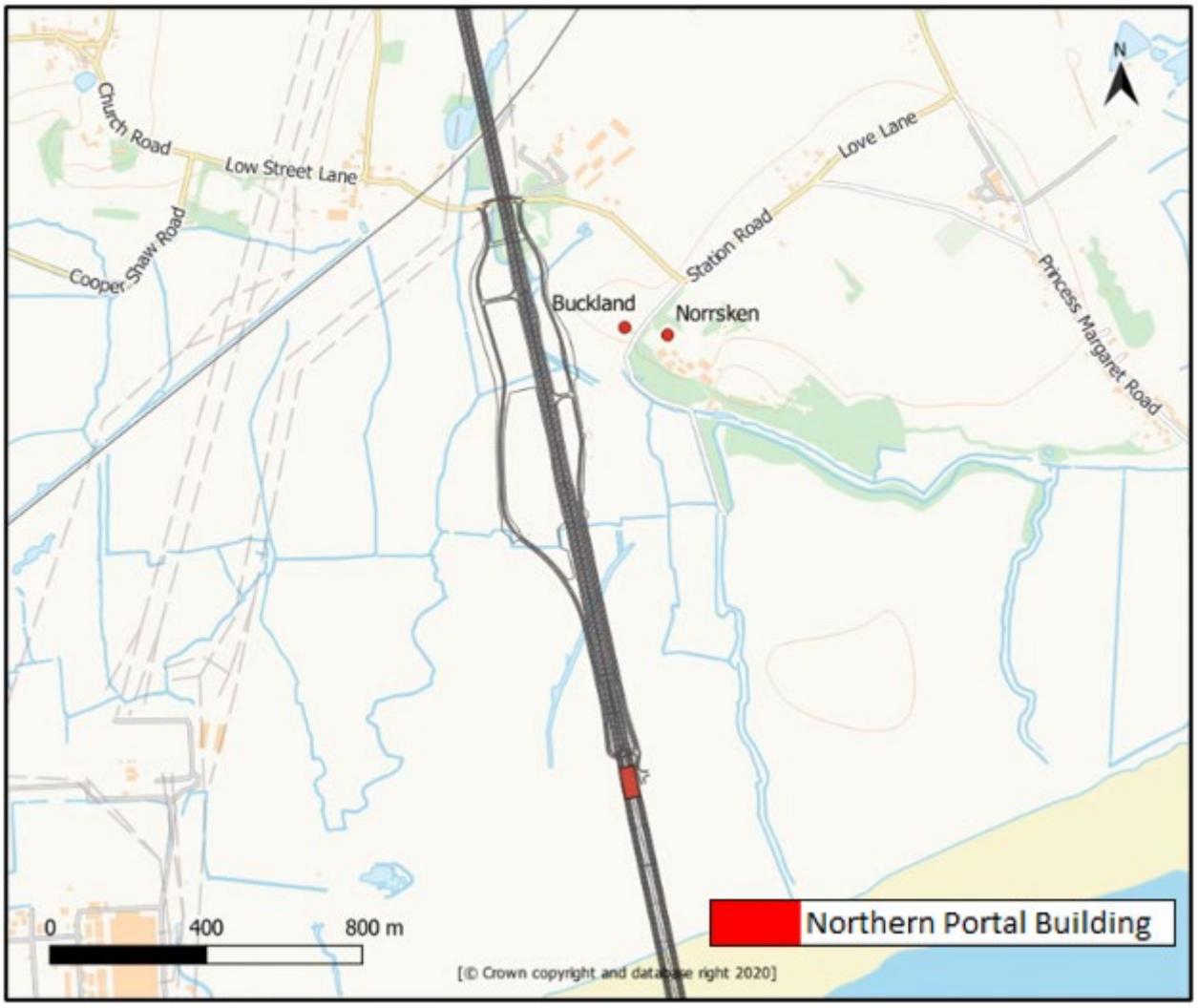
1.1.4 Details regarding the assessment methodology employed, together with the results of the survey undertaken and the subsequent conclusions and recommendations, are presented within this appendix.

1.2 Site location and setting

1.2.1 The proposed tunnel ventilation system at the North Portal site is to be located to the west of East Tilbury, approximately 500m north of the River Thames and 1.5km south of the Tilbury Loop Railway Line.

1.2.2 The site location plan is presented in Plate 1.1.

Plate 1.1 Site location plan



1.2.3 The surrounding area consists predominantly of open farmland and fields.

1.2.4 There are a number of residential properties and farm buildings within the vicinity of the site, specifically along Station Road to the north. Beyond Station Road are further residential dwellings on Love Lane, Low Street Lane and along Princess Margaret Road; although these are all well removed from the tunnel portal building by approximately 1,500m.

1.2.5 The settlement of East Tilbury is located approximately 1.2km to the north-east.

1.3 Noise study area

1.3.1 Noise impacts from the operation of the tunnel ventilation system have been considered at selected closest identified sensitive receptors. Outside this immediate area, noise emissions from the ventilation plant are not anticipated to give rise to any significant impact.

1.3.2 The receptors considered in the ventilation assessment are presented in Paragraph 6.3.1 and on Plate 6.3, identified as Buckland and Norrsken.

1.4 Description of proposed tunnel portal development

1.4.1 As the operational Project includes a twin bore tunnel under the River Thames, there is a requirement for a permanent ventilation system to maintain airflow through the tunnel. As such, there is a potential for static plant noise emissions to impact upon existing nearby noise-sensitive receptors.

1.4.2 The ventilation plant will be housed within a purpose-built portal building, the location of which is shown in Plate 1.1 and Plate 1.2. The following static plant items will be contained within the portal building:

a. Two chiller units

b. Four pumps

c. Four air handling units

1.4.3 The design of the external building structure will be developed during the detailed design stage. However for the purposes of this assessment the following preliminary design has been assumed:

a. Intensive green roof construction

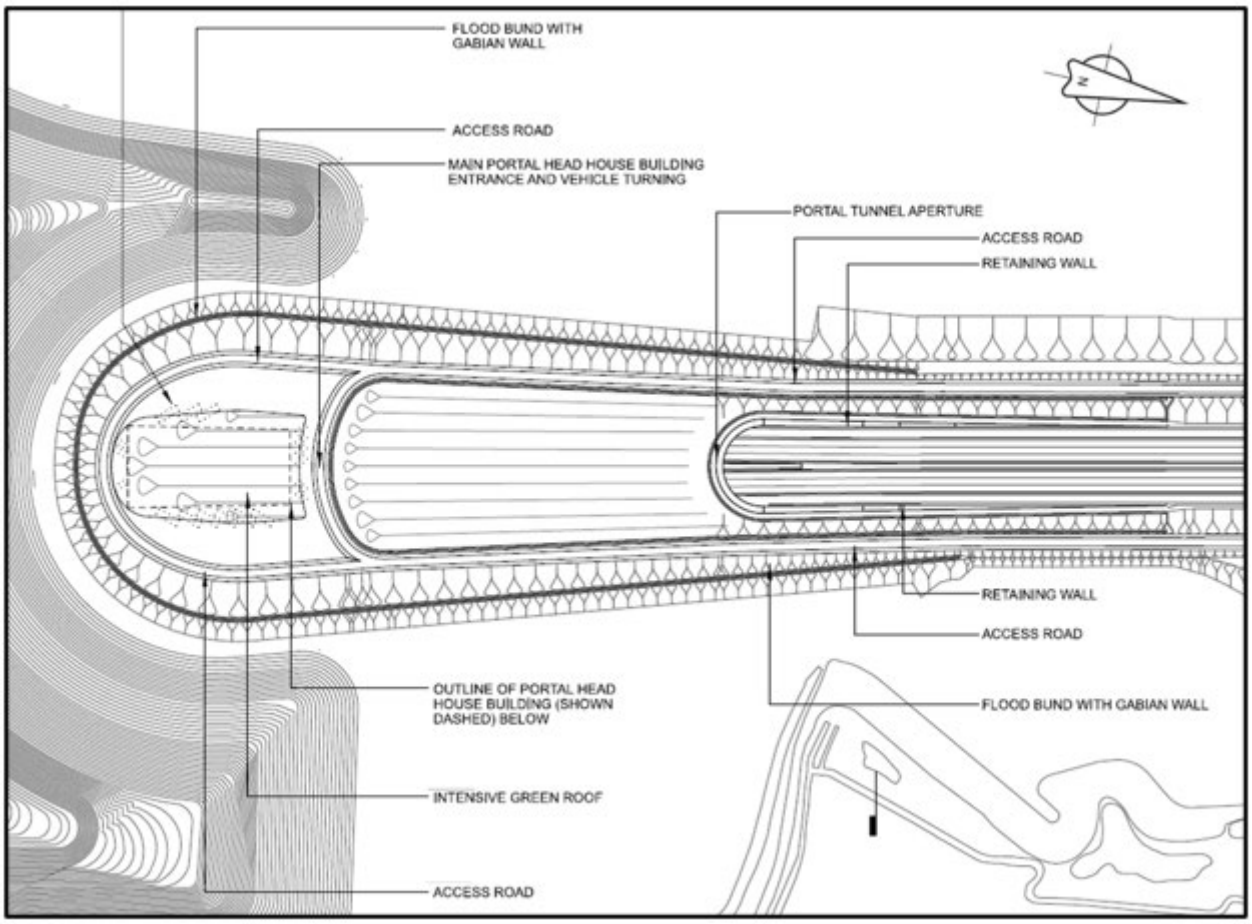
b. Concrete walls or masonry with steel framing

1.4.4 The ventilation plant would be in operation 24 hours a day, seven days a week.

1.4.5 No plant will be located externally to the portal building other than the ventilation fans within the tunnels themselves. The tunnel ventilation fans will be located in banks of two fans over 30 rows, totalling 60 fans per tunnel.

1.4.6 The proposed layout of the tunnel portal is detailed within Plate 1.2.

Plate 1.2 Proposed North Portal site layout



1.5 Scope of work

1.5.1 In order to assess the potential impacts from the proposed facility at the North Portal site, a number of elements of work have been completed. These are detailed below:

a. Quantification of prevailing background and ambient noise levels at the nearest noise-sensitive receptors to the site

b. Noise modelling using SoundPLAN 8.0 software to calculate specific noise levels at the nearest receptors

c. Consideration of additional mitigation provision where necessary, and above that inherent within the design of the facility, to ensure appropriate limits are met at identified sensitive receptors

2 Planning policy and guidance

2.1.1 The assessment of noise impacts associated with the North Portal tunnel building ventilation system has been undertaken in accordance with the following guidance methodology:

a. BS 4142:2014 (+A1:2019) Methods for rating and assessing industrial and commercial sound (British Standards Institution, 2019)

2.1.2 The assessment methodology used to determine potential noise impacts associated with the ventilation system plant is primarily based upon the guidance of BS 4142:2014 (+A1:2019). Further details relating to the guidance provided within this document are included below.

BS 4142:2014 (+A1:2019) Methods for rating and assessing industrial and commercial sound

2.1.3 BS 4142:2014 (+A1:2019) provides methods for rating and assessing sound of an industrial and/or commercial basis. The methods use outdoor sound levels to assess the likely effects of sound on people who might reside within a dwelling or other premises used for residential purposes upon which sound is incident.

2.1.4 BS 4142 is based around the premise that the significance of the impact of an industrial/commercial facility can be derived from the numerical subtraction of the background noise climate level (not necessarily the lowest background level measured, but the typical background of the receptor) from the measured or calculated rating level of the specific sound under consideration. This comparison enables the impact of said sound to be concluded because typically, the greater this difference, the greater the magnitude of the impact. This difference is then considered as follows:

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

b. A difference of around +5dB and greater is likely to be an indication of an adverse impact, depending on context

c. Below +5dB 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 or significant adverse impact.

2.1.5 BS 4142 further states that '*where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact'*, again depending upon the specific context of the site. BS 4142 further qualifies the assessment protocol by outlining conditions to the comparative assessment and stating that '*not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact'*, implying that all sites should be assessed on their own merits and specifics.

2.1.6 BS 4142 quantifies the typical reference periods (for the purpose of the standard) to be used in the assessment of noise:

Typical daytime	07:00 – 23:00	1hr assessment period
Typical night-time	23:00 – 07:00	15 min assessment period

2.1.7 BS 4142 also outlines a number of methods for defining appropriate '*character corrections*' within the rating level to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency. These are the subjective method; the objective methods for tonality; and the reference method. It is noted that where multiple features are present, the corrections should be added in a linear fashion to the specific level.

2.1.8 The subjective method, which as a result of the current level of design detail of these facilities has been applied within the scope of this study, is based on the following corrections shown in Table 2.1.

Table 2.1 Subjective method rating corrections

Level of perceptibility	Tonal correction	Impulsivity correction	Correction for 'other sound characteristics'	Intermittency correction
No perceptibility	+0dB	+0dB	Where neither tonal nor impulsive but clearly identifiable +3dB	If intermittency is readily identifiable +3dB
Just perceptible	+2dB	+3dB		
Clearly perceptible	+4dB	+6dB		
Highly perceptible	+6dB	+9dB		

2.1.9 BS 4142 further qualifies that the assessment methodology provided is not intended for the derivation of internal noise levels arising from sound levels outside or '*where background sound levels and rating levels are low'*, however, no definition of 'low' is provided. Where these situations prevail, it may be appropriate to reference the absolute guidance levels provided in British Standard BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (British Standards Institution, 2014) and Guidelines for Community Noise (World Health Organisation, 1999).

3 Noise monitoring survey

3.1 Introduction

3.1.1 This section describes the specifics of the background and ambient noise surveys undertaken within the scope of the assessment. It should be noted that the baseline noise surveys could only be undertaken with the existing situation (i.e. without the Project). The ventilation system would only operate with the Project, where the baseline would be different. This situation is insoluble, but it is considered that using baseline data before the opening of the Project would be worst case as noise levels would be lower than with the Project open.

3.2 Survey details

3.2.1 The noise monitoring surveys were undertaken between Wednesday 18 July and Thursday 19 July 2018 at the locations detailed within Plate 3.1.

3.2.2 The monitoring locations are considered to represent the noise climate at the closest residential receptors to the ventilation building and were described as:

a. ST-NML 3 – 1 Gravel Pit Cottages, Station Road, East Tilbury, RM18 8QR. Grid Reference: TQ 676 773, approximately 1,400m from the tunnel building. Microphone positioned at an approximate height of 1.5m above local ground level on the driveway adjacent to south-western façade of the residential cottages. This location was considered to be representative of Buckland.

b. A-NML 10 – Norrsken property, Station Road, East Tilbury, RM18 8QR. Grid Reference: TQ 675 772, approximately 1,000m from the tunnel building. Microphone positioned at an approximate height of 1.5m above local ground level at the rear of the property within the garden area.

3.2.3 Plate 3.1 shows the approximate positions of the monitoring locations.

Plate 3.1 Noise monitoring locations

3.2.4 The noise monitoring comprised both attended and unattended surveys:

a. ST-NML 3 consisted of a 24-hour unattended survey

b. A-NML 10 consisted of a three-hour attended survey

3.2.5 The specific survey durations and timeframes are presented in Table 3.1.

Table 3.1 Monitoring survey details

Monitoring location	ST-NML 3 (24 hour)	A-NML 10 (three hour)
Start time	Wednesday 18 July 2018 11:00 hrs	Wednesday 18 July 2018 13:40 hrs
End time	Thursday 19 July 2018 10:45 hrs	Wednesday 18 July 2018 16:40 hrs

3.3 Weather

3.3.1 The weather conditions during the survey periods were deemed to be acceptable for the measurement of environmental noise in accordance with the requirements of BS 7445:1-2003 Description and measurement of environmental noise, Part 1 Guide to quantities and procedures (British Standards Institution, 2003), and are as follows:

a. The weather during 18 and 19 July 2018 daytime survey period was noted to be warm with an ambient temperature around 19-22°C. Cloud cover was consistent, noted to be around 50%. There was noted to be a wind of <5m/s during the survey period.

b. The weather during the night-time survey period was noted to be mild with an ambient temperature of around 12°C. Cloud cover was noted to be around 70%, with a windspeed of <5m/s.

c. Ground conditions and road surfaces were noted to be dry for the duration of the survey, with no precipitation falling immediately prior to or during the survey period.

3.4 Monitoring equipment

3.4.1 The sound level meters were programmed to measure 0.1 second L_{Aeq} values, which were then used to process the dataset into the assessment periods necessary. The equipment used was set to record the following parameters:

a. L_{Aeq} in dB

b. L_{A10} in dB

c. L_{A90} in dB

3.4.2 The monitoring equipment used complies with the performance specifications for Class 1 devices in accordance with BS EN 61672-1:2013 Electroacoustics: Sound level meters – Specifications (British Standards Institution, 2013). Table 3.2 provides information regarding the monitoring equipment.

Table 3.2 Noise monitoring equipment

Equipment	Manufacturer	Type	Serial number	Calibration due date
Sound level meter	01dB	CUBE	10695	03/07/2020
Sound level meter	01dB	FUSION	11036	09/02/2020
Calibrator	RION	NC-74	35183003	16/11/2020

3.4.3 The following set-up parameters were used on the sound level meters during all of the measurements undertaken:

a. Time weighting: fast

b. Frequency weighting: “A”

3.4.4 The sound level meters were locally calibrated using an electronic calibrator prior to commencement and upon completion of each survey; no significant drift in calibration was observed. The external laboratory calibration documentation for the equipment used can be provided upon request.

4 Noise survey results

4.1 Noise monitoring survey results

4.1.1 This section of the report summarises the results of the noise monitoring survey undertaken within the scope of this assessment. The full noise surveys results are presented within Appendix 12.5 (Application Document 6.3).

4.1.2 Table 4.1 summarises the noise levels monitored; with respect to the 24-hour survey at ST-NML 3, the data collected has been reported in terms of daytime and night-time hourly average levels, as based upon the reference time periods detailed within BS 4142:2014 (+A1:2019).

Table 4.1 ST-NML 3 – 24-hour measured noise level data

Time period	$L_{A90, T}$	$L_{Aeq, T}$	$L_{A10, T}$
Weekday (07:00 – 23:00)	36.7	51.8	52.7
Night (23:00 – 07:00)	35.3	45.3	42.6

4.1.3 The data in Table 4.2 presents the daytime levels recorded at A-NML 10 presented as hourly averages.

Table 4.2 A-NML 10 – three-hour measured noise level data

Time period	$L_{A90, T}$	$L_{Aeq, T}$	$L_{A10, T}$
13:40 – 14:40	36.5	47.7	48.0
14:40 – 15:40	34.1	48.0	47.3
15:40 – 16:40	34.5	43.3	43.6

4.1.4 The subjective notes accompanying the survey indicated that at both survey locations the dominant noise source was identified as road traffic noise from nearby roads. In addition, there were other minor sources that contributed to the background noise levels which included the following:

a. Birdsong and other natural noises including vegetation rustle

b. Overhead aircraft

5 Predictive noise modelling

5.1 Overview

5.1.1 As the tunnel building ventilation plant is not currently installed, it is necessary to undertake the prediction of noise associated with the new sources of noise.

5.1.2 As such a 3D noise model has been constructed using the proprietary SoundPLAN 8.0 noise modelling software package to predict the noise generated by the new plant installations and how this will propagate into the surrounding environment.

5.1.3 This section of the report details the calculation methodologies used, along with the assumptions embodied within the noise modelling.

5.2 Noise modelling protocols

5.2.1 Within the scope of this modelling exercise, acoustic propagation has been calculated in accordance with the following standard:

a. ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors: Part 2: General method of calculation (International Organisation for Standardisation, 1996).

5.2.2 The noise modelling was completed using the following information and assumptions:

a. Site layout and terrain information:

   i. Drawing no. HE540039-CJV-SAR-S05_PTN0000001-M2-AX-06210 and HE540039-CJV-SAR-S07_PTN0000001-M2-AX-06210

   ii. Ordnance Survey Commercial and Project-specific Digital Terrain Model data

b. Noise levels associated with the ventilation plant installations have been based upon the guideline values provided by the design team as listed below:

   i. Pumps and chillers: 75dBA @ 3m per unit

   ii. Air handling units: 107dBA @ source (0m) per unit

   iii. Tunnel ventilation fans designed to have a *maximum permissible level of NR85 at any point in a plane 1.5m above the road surface* as defined in paragraph 5.85.1 of DMRB CD 352 ‘Design of road tunnels’ (National Highways, 2020)

c. The source height associated with the ventilation plant has been taken as 2m above the local surface

d. The ground cover in the area has been assumed to be a mixture of hard ground (e.g. road surfaces, pavements) and grassed areas

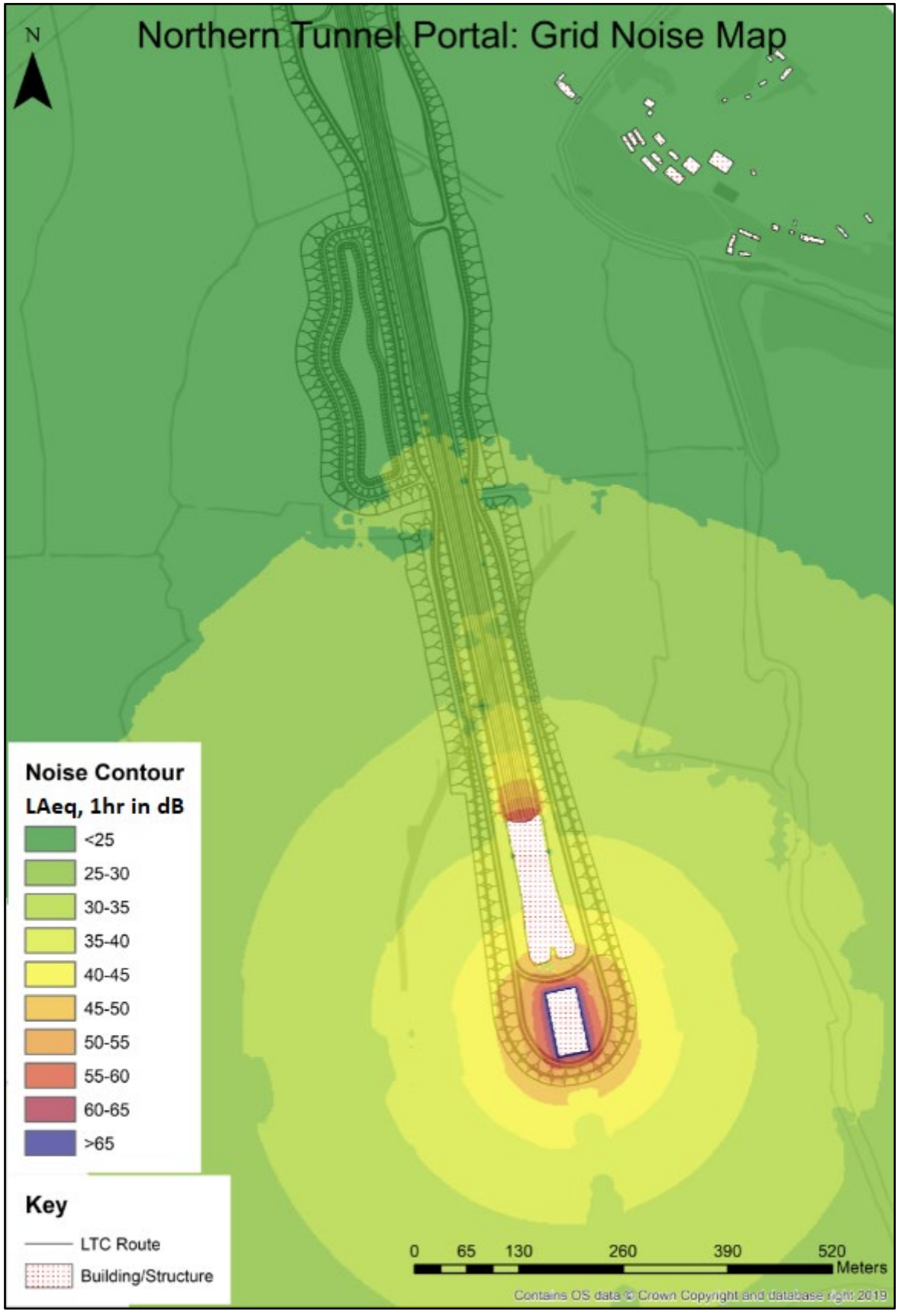
e. The portal building consists of a masonry build-up with substantial green roof. Façade openings associated with plant air intakes/exhausts and ventilators have been accounted for within the model. Within the modelling the conservative assumption of a façade attenuation of Rw (Lab Tested Sound Reduction Index) 25dB has been made on all façade elements (including the roof).

Modelling outputs

5.2.3 Plate 5.1 summarises the modelling outputs used to inform the noise assessment. The image illustrates the predicted noise levels resulting from the proposed ventilation plant installations and how this propagates into the surrounding area.

5.2.4 The propagation model used in the assessment provides for the prediction of sound pressure levels based on worst-case downwind conditions, with a relative humidity of 70%, an ambient temperature of 10°C and propagation over mixed ground.

Plate 5.1 Noise contour for North Portal



6 Noise impact assessment

6.1 Baseline noise climate analysis

6.1.1 The measured baseline noise climate has been used as the basis of the assessment. With regard to this, reference has been made to the guidance of BS 4142:2014 (+A1:2019) which states that:

'In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods.

Among other considerations, diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night time period for sleep purposes.'

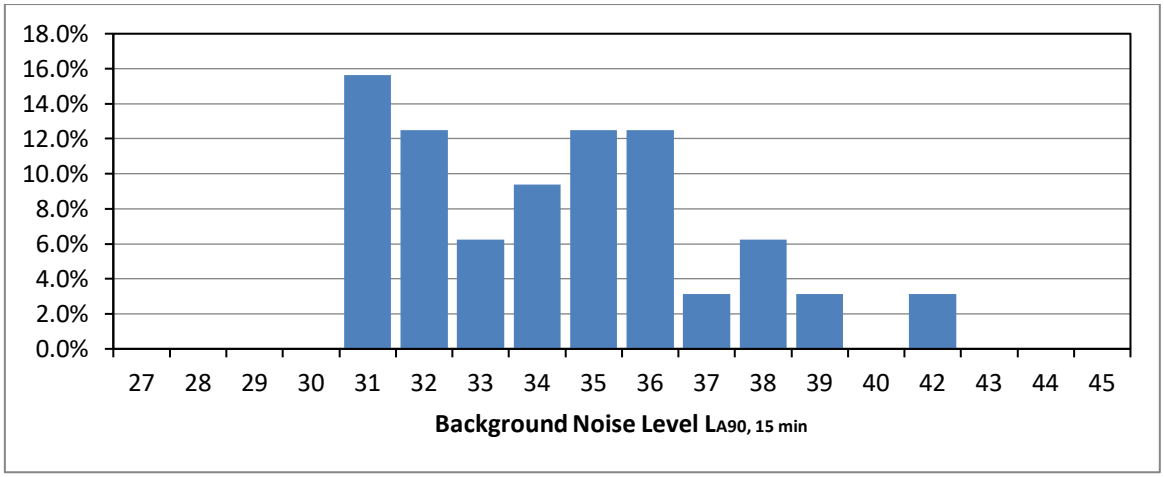
6.1.2 The assessment of the ventilation plant operational noise has been undertaken based upon the measured modal values of the existing background (L_{A90}) noise climate. This ensures that the typical noise climate at the receptor location is accounted for.

6.1.3 The background (L_{A90}) data collected during the site noise survey has been analysed to determine the modal value recorded at each of the following monitoring locations where sufficient data has been amassed. This has been done separately for the data monitored at ST-NML 3 and A-NML 10 and is presented below.

Noise monitoring location ST-NML 3

6.1.4 The statistical analysis of the night-time background (L_{A90}) noise data at ST-NML 3 is presented in Plate 6.1.

Plate 6.1 Modal analysis night-time periods (23:00 – 07:00)



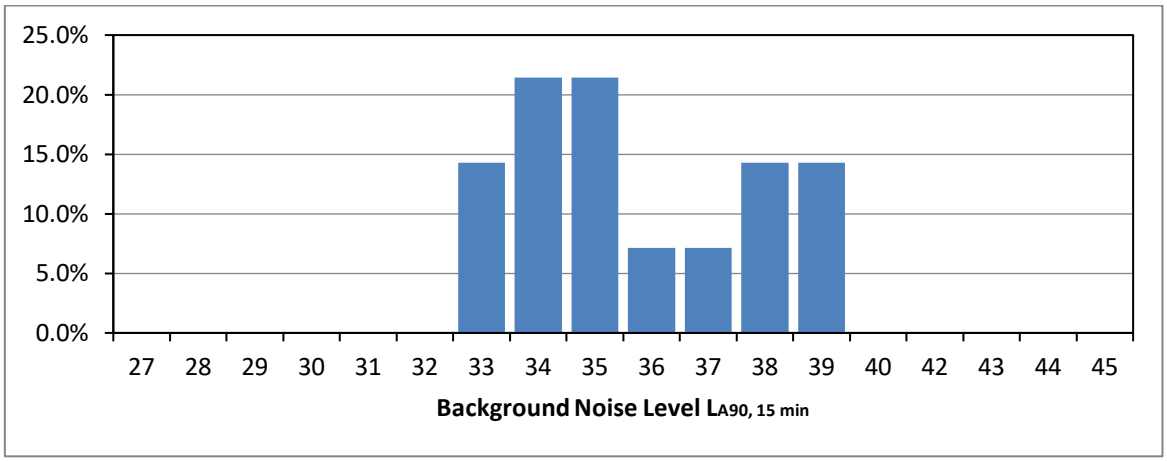
6.1.5 The analysis of the L_{A90} data indicates that the minimum L_{A90} for the night-time period (23:00 – 07:00) is 31dB. In this case the modal L_{A90} value for the period is also 31dB with 15.6% of the rounded dataset reporting this value.

Noise monitoring location A-NML 10

6.1.6 The statistical analysis of the daytime background (L_{A90}) noise data at A-NML 10 is presented in Plate 6.2.

6.1.7 The data has been used from A-NML 10 as this presented a more representative survey position to the assessment locations than ST-NML 3.

Plate 6.2 Modal analysis daytime period (07:00 – 23:00)



6.1.8 The analysis of the L_{A90} data indicates that the minimum L_{A90} for the daytime period is 33dB, however the modal L_{A90} value is 34/35dB with 42.8% of the rounded dataset reporting these values.

6.1.9 Table 6.1 presents a summary of the modal background noise levels at the two monitoring locations. These values will be used as the basis of the assessment.

Table 6.1 Summary of background noise Levels at ST-NML 3 and A-NML 10

Time period	Modal $L_{A90,T}$ (dB)	Range $L_{A90,T}$ (dB)
Daytime (07:00 – 23:00)	34	33 - 39
Night-time (23:00 – 07:00)	31	31 - 42

6.2 Character corrections

6.2.1 Within the methodology of BS 4142:2014 (+A1:2019) it is necessary to calculate a specific external sound level at the sensitive receptor location from the operations under consideration. This specific sound level then requires converting to a 'Rating' level in order to take account of tonal or noticeable characteristics of the specific sound source.

6.2.2 Table 6.2 presents the character corrections for the operational ventilation plant noise emissions, as based on the subjective assessment methodology described within Section 9.2 of BS 4142:2014 (+A1:2019), implemented as a result of the current detail of the plant and equipment proposed in the ventilation strategy.

Table 6.2 BS 4142 character corrections, operational ventilation plant

Characteristic	Subjective perception	Justification	BS 4142 correction
Tonality	Potentially	Whilst specific product selections have not yet been made, due to the type of plant under consideration, there is the potential for low level of tonality. A correction of +2dB which relates to tonality being 'just perceptible' is considered appropriate due to the separation distances involved.	+2dB
Impulsivity	None	No correction is proposed for this type of characteristic as there is no impulsivity associated with the operation of the ventilation plant.	0dB
Other characteristics	None	No 'other' noise characteristics have been identified with the operation of the ventilation plant.	0dB
Intermittency	None	The plant is expected to operate continuously and hence a correction for intermittency is not considered necessary.	0dB
Total character correction			+2dB

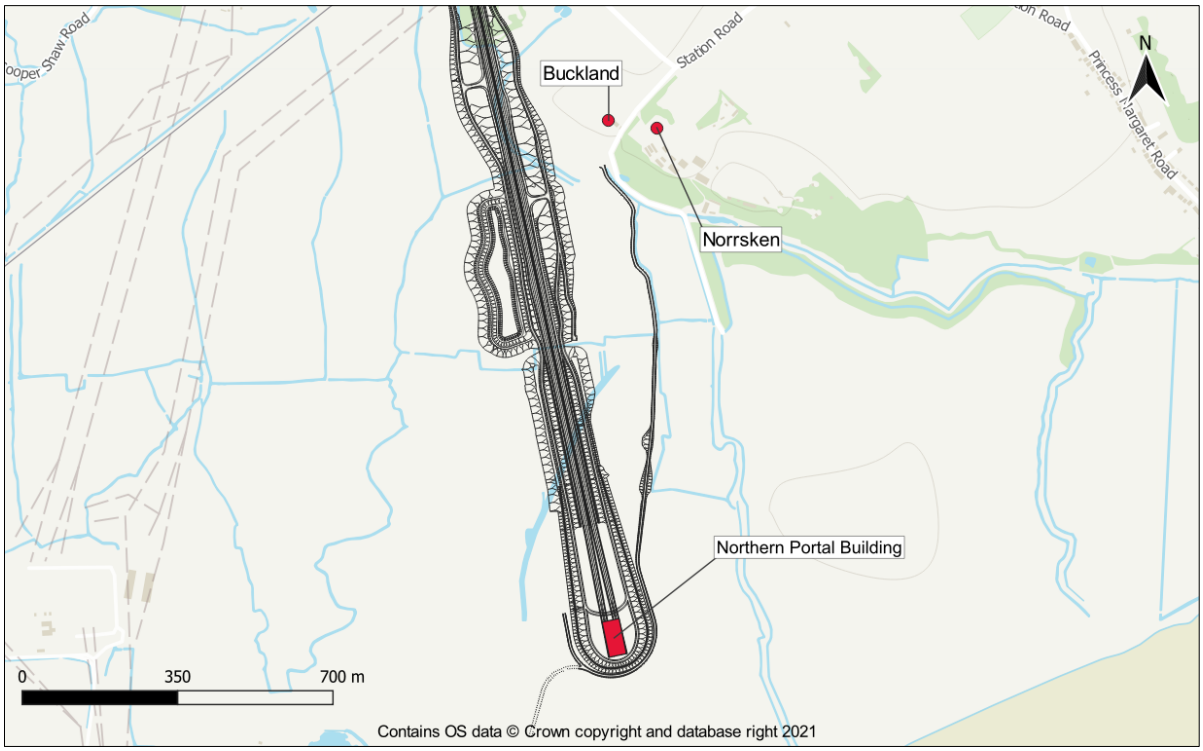
6.3 Assessment locations

6.3.1 Assessment of the potential noise impact from the ventilation plant has been undertaken at the nearest existing sensitive receptor locations as detailed below and identified on Plate 6.3:

a. 1 Gravel Pit Cottages (representative of Buckland), Station Road, East Tilbury, RM18 8QR, Grid Reference: TQ 674 772

b. Norrsken property, Station Road, East Tilbury, RM18 8QR, Grid Reference: TQ 675 772

Plate 6.3 Assessment locations



6.4 Assessment results

6.4.1 The assessment results presented are based on the operational assumptions described earlier with this assessment, and utilising the modal values of the measured background (L_{A90}) noise levels presented in Table 6.1.

6.4.2 The results of the assessment are presented within Table 6.3 and allow for 'total' predicted noise levels. These levels assume noise generation from all ventilation plant units operating simultaneously, with 100% on-time.

6.4.3 There are no additional mitigation measures included within the scope of this assessment beyond those already inherent within the design, relating to façade attenuation measures, plant selection and earth works screening. As such the noise levels presented in Table 6.3 are representative of the highest noise levels predicted from the ventilation plant.

Table 6.3 Assessment, summary of noise levels

Location and time period	Modal measured $L_{90,T}$, 'background' noise level (dB)	Predicted BS 4142 specific noise level (dB)	Corrected BS 4142 rating level (dB)	Difference (dB)	Likelihood of complaints
Daytime period (0700 – 2300)					
Norrsken	34	23	25	-9	Indication of the specific sound source having a low impact
Buckland		25	27	-7	
Night-time period (2300 – 0700)					

Location and time period	Modal measured $L_{90,T}$, 'background' noise level (dB)	Predicted BS 4142 specific noise level (dB)	Corrected BS 4142 rating level (dB)	Difference (dB)	Likelihood of complaints
Norrsken	31	23	25	-6	Indication of the specific sound source having a low impact
Buckland		25	27	-4	

6.4.4 It can be seen from the table above that predicted noise levels arising from the operation of the ventilation plant would be rated by BS 4142:2014 (+A1:2019) as follows:

a. Between -7dBA and -9dBA below the existing daytime background noise climate

b. Between -4dBA and -6dBA below the existing night-time background noise climate

6.4.5 Under BS 4142:2014 (+A1:2019) assessment protocol, where the rating level does not exceed the background sound level, then this is a positive indication that the specific sound source would have a low noise impact.

7 Conclusions

7.1.1 An assessment has been undertaken to consider the potential noise impacts related to the ventilation plant located at the Northern Tunnel Portal building associated with the Lower Thames Crossing Project.

7.1.2 Within the scope of the Chapter 12 Noise and Vibration (Application Document 6.1), baseline noise levels have been quantified within the vicinity of the Northern Tunnel Portal site.

7.1.3 Noise levels generated by the ventilation plant have been assessed in line with appropriate guidance of British Standard BS 4142:2014 (+A1:2019) Methods for rating and assessing industrial and commercial sound.

7.1.4 Consideration in line with the defined BS 4142:2014 (+A1:2019) criteria indicates that the predicted rating noise levels generated by the ventilation plant would have a low impact.

7.1.5 Therefore, the assessment concludes a negligible impact at the closest noise sensitive receptors.

References

British Standards Institution (2019). BS 4142:2014 (+A1:2019) Methods for rating and assessing industrial and commercial sound

British Standards Institution (2014). BS 8233:2014 Sound insulation and noise reduction for buildings

British Standards Institution (2003). BS 7445:1-2003 Description and measurement of environmental noise: Part 1 Guide to quantities and procedures

British Standards Institution (2013): BS EN 61672-1:2013 Electroacoustics: Sound level meters - Specifications

National Highways (2020). Design Manual for Roads and Bridges. CD 352 Design of Road tunnels

International Organisation for Standardisation (1996). ISO 9613-2: Acoustics – Attenuation of sound during propagation outdoors: Part 2: General method of calculation

World Health Organisation (1999): Guidelines for Community Noise

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