14. NOISE AND VIBRATION

14.1 Introduction

14.1.1 This chapter describes and presents the results of the preliminary work undertaken to date to assess the likely Noise and Vibration effects of the Silvertown Tunnel Scheme. It identifies the methodology used to establish existing and future baseline information, receptors potentially affected, environmental design measures and predicted residual effects.

14.1.2 The assessment covers construction noise and vibration impacts as well as operational impacts which considers operational traffic noise, night time noise and traffic vibration.

14.1.3 A full impact assessment of all potential noise and vibration impacts will be provided in the Environmental Statement (ES) that will be submitted with the DCO application.

14.1.4 All drawings referenced within this chapter are presented in Volume 2 of the PEIR and all appendices referenced in this chapter are presented in Volume 3.

14.2 Regulatory and policy framework

14.2.1 The impact assessment has been undertaken in accordance with current international and national legislation, and national, regional and local plans and policies relating to noise and vibration in the context of the Scheme. A summary of the relevant legislation and policies, the requirements of these policies and the Scheme's response to each of them has been provided in Table 14-1.

Table 14-1 Noise and vibration - regulatory and policy framework

Policy/legislation	Summary of requirements	Scheme response
National Road and Rail Networks: National Policy Statement (NN NPS)	Paragraph 5.189 sets out guidance for undertaking the assessment of noise impacts. In addition, paragraph 5.195 states that The Secretary of State should not grant development consent unless satisfied that the proposals will meet the following aims within the context of Government policy on sustainable development: • avoid significant adverse impacts on health and quality of life from noise as a result of the new development; • mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and • contribute to improvements to health and quality of life through the effective management and control of noise, where possible. Due regard must have been given to the relevant sections of the Noise Policy Statement for England, National Planning Policy Framework (NPPF) and the	An explanation of how this assessment complies with assessment principles set out in the NPS is provided in Table 14-33. The noise and vibration assessment has predicted noise levels and implemented mitigation into the Scheme design to avoid significant adverse impacts on health and quality of life. Mitigation measures are presented in Section 14.5. Further explanation on compliance with National policy is provided in section 14.9.

Policy/legislation	Summary of requirements	Scheme response
	Government's associated planning guidance on noise.	
Noise Policy Statement for England' (Defra, 2010)	The Noise Policy Statement for England (NPSE) vision is to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development. To achieve this vision the NPSE sets out the following aims for the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development: • avoid significant adverse impacts on health and quality of life; • mitigate and minimise adverse impacts on health and quality of life; and • where possible, contribute to improvement of health and quality of life.	The noise and vibration assessment has predicted noise levels and implemented mitigation into the Scheme design to avoid significant adverse impacts on health and quality of life. Mitigation measures are presented in Section 14.5. Further explanation of compliance with National policy is provided in section 14.9
National Planning Policy Framework (March 2012)	Paragraph 123 of the NPPF states that: Planning policies and decisions should aim to:	The noise and vibration assessment has predicted noise levels and implemented mitigation into the Scheme design to avoid significant adverse impacts on health and

Policy/legislation	Summary of requirements	Scheme response
	• Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development; • Reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions; • Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and • Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.	quality of life. Mitigation measures are presented in Section 14.5. Further explanation on compliancy with National policy is provided in section 14.9
Planning Practice Guidance - Noise	Decision taking should take account of the acoustic environment and in doing so consider: • Whether or not a significant adverse	The noise and vibration assessment has taken into account whether or not a significant effect would occur throughout the assessment with mitigation measures recommended that would

Policy/legislation	Summary of requirements	Scheme response
	effect is occurring or likely to occur; • Whether or not an adverse effect is occurring or likely to occur; and • Whether or not a good standard of amenity can be achieved. In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.	reduce impacts to a minimum. What would be considered as significant observed effect levels have been defined in section 14.3 and through discussion with the local Environmental Health Departments.
Environmental Protection Act 1990	Under Part III of the Environmental Protection Act 1990 local authorities have a duty to investigate noise complaints from premises (land and buildings) and vehicles, machinery or equipment in the street.	Mitigation measures presented in Section 14.5 are designed to minimise noise complaint.
Control of Pollution Act 1974	Where it appears to a local authority that works to which the Control of Pollution Act 1974 applies are being, or are going to be, carried out on any premises, the local authority may serve a notice imposing requirements as to the way in which the works are to be carried out and may, if it	Mitigation measures presented in Section 14.5 are designed to keep any noise generated by the Scheme to a minimum.

Policy/legislation	Summary of requirements	Scheme response
	thinks fit, publish notice of the requirements in such way as appears to the local authority to be appropriate.	
The Environmental Noise (England) Regulations 2006 implement the Assessment and Management of Noise Directive 2002/49/EC (the "Environmental Noise Directive" or "END").	As required by the Directive, the Department for Environment, Food and Rural Affairs ("Defra") produced Noise Action Plans for Major Roads in March 2010. The Noise Action Plans focus on those areas most exposed to noise from major roads. These are defined as 'Important Areas'.	The Noise Action Plans and Important Areas have been considered in the assessment for the Scheme.
Greater London Authority (GLA) /July 2011/Policy 7.15/Reducing Noise and Enhancing Soundscapes	Development proposals should seek to reduce noise by: • minimising the existing and potential adverse impacts of noise on, from, within, or in the vicinity of, development proposals; • separating new noise sensitive development from major noise sources wherever practicable through the use of distance, screening, or internal layout in preference to sole reliance on sound insulation; and • promoting new technologies and improved practices to reduce noise at source.	Mitigation measures presented in Section 14.5 are designed to keep any noise generated by the Scheme to a minimum.

Policy/legislation	Summary of requirements	Scheme response
Tower Hamlets Local Plan/April 2013/Policy DM25/Amenity	Development should seek to protect, and where possible improve, the amenity of surrounding existing and future residents and building occupants, as well as the amenity of the surrounding public realm by not creating unacceptable levels of noise and vibration during the construction and life of the development.	Mitigation measures presented in Section 14.5 are designed to keep any noise generated by the Scheme to a minimum.
Royal Greenwich Local Plan/July 2014/Policy E(a)/Pollution	Planning permission will not normally be granted where a proposed development or change of use would generally have a significant adverse effect on the amenities of adjacent occupiers or uses, and especially where proposals would be likely to result in the unacceptable emission of noise	All identified aspects of the Scheme which could give rise to considerable increases in noise have been assessed and mitigated to a minimum.
Newham Core Strategy Saved Unitary Development Plan Policies/Febuary 2012/Policy EQ47	Where a proposed development is likely to produce a considerable increase in noise relating to its use, the council will require an assessment of noise impact to be carried out by a developer for submission with the planning application.	All identified aspects of the Scheme which could give rise to considerable increases in noise have been assessed and mitigated to a minimum.

14.2.2 Technical guidance which has been used in the assessment on noise and vibration as a result of the Scheme are presented in Table 14-2.

Table 14-2 Noise and vibration – technical guidance

Technical guidance	Scope of guidance
BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise, British Standards Institution, 2014	Part 1 of the Code of Practice for Noise and Vibration Control on construction and Open Sites provides guidance on the methods that can be used to predict and measure noise from construction activities and how to assess the impact on those exposed to it. In particular Annex F sets out the methods of estimating noise from construction sites which take into account distance, ground effects, reflections from surfaces, and screening by obstacles.
BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration, British Standards Institution, 2014	This part of BS 5228 gives recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels, including Industry specific guidance. Guidance is provided concerning methods of measuring vibration and assessing its effects on the environment
BS 4142:2014 Methods for rating and assessing industrial and commercial sound, British Standards Institution, 2014	This British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes sound from fixed installations which comprise mechanical and electrical plant and equipment. The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.
Calculation of Road Traffic Noise (CRTN), Department for Transport and Welsh Office, 1988	CRTN is the standard method for calculating road traffic noise in the UK. It is the Design Manual for Roads and Bridges (DMRB) recommended method for calculating road traffic noise
Design Manual for Roads and Bridges, Volume 11 Section 3 Part 7 (HD213/11) ‘Noise and Vibration’	DMRB provides guidance on the appropriate level of assessment to be used when assessing the noise and vibration impacts arising from all road projects, including new construction,

Technical guidance	Scope of guidance
	improvements and maintenance.
Guideline for Environmental Noise Impact Assessment, Institute of Environmental Management and Assessment, October 2014	These guidelines address the key principles of noise impact assessments and are applicable to all development proposals where noise effects are likely to occur. The guidelines provide specific support on how noise impact assessment fits within the Environmental Impact Assessment (EIA) process. They cover: How to scope a noise assessment, Issues to be considered when defining the baseline noise environment, Prediction of changes in noise levels as a result of implementing development proposals and Definition and evaluation of the significance of the effect of changes in noise levels (for use only where the assessment is undertaken within EIA)

14.3 Methodology

General approach

Construction noise impacts

14.3.1 The method of assessing and calculating construction noise impacts has been undertaken using the guidance contained in British Standard 5228: 2009+A1: 2014 ‘Code of Practice for Noise and Vibration Control on Construction and Open Sites’ Parts 1 (Ref 14-1).

14.3.2 Construction activities generate noise which can be experienced by nearby sensitive receptors, such as the occupants of residential properties. The noise levels experienced depend upon a number of variables, the most significant of which are:

- the noise generated by plant or equipment used on site, generally expressed as a sound power level (Lw);
- the periods of operation of the plant on the site, known as its ‘on-time’;
- the distance between the noise source and the receptor; and
- operational times.

14.3.3 Predictions of the construction noise impacts from the Scheme have been undertaken for areas up to 300m from the Limits of Land to be Acquired or

Used (LLAU), utilising the calculation methods contained within BS5228. All predicted noise levels have been presented as a façade level at representative receptors.

14.3.4 The calculations of predicted noise impacts undertaken within the study area for this assessment have been conducted using a computer based prediction program IMMI (produced by Wölfel Meßsysteme). The software package follows the procedures given in BS 5228 and is widely used to predict noise impacts for various types of environmental noise assessments.

14.3.5 The construction noise assessment has been based upon an indicative construction schedule and construction plant itinerary. A copy of the construction schedule and plant itinerary is presented in Appendix 14.A.

14.3.6 Where construction plant does not have a reference sound power level provided in BS 5228, reasonable worst-case assumptions based on similar plant or manufacturer's data have been used.

14.3.7 A calculation of groundborne noise levels from the operation of the Tunnel Boring Machine (TBM) has been undertaken by Rupert Thornley Taylor FIOA using proprietary software known as FINDWAVE. The output of the modelling is an indication of likely ground vibration and associated groundborne noise at various depths and geological situations, as well as a prediction of the decay of vibration with distance.

Construction vibration impacts

14.3.8 There are currently no British Standards that provide a methodology to predict levels of vibration from construction activities, other than that contained within BS5228-2:2009+A1:2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites, Vibration (Ref 14-2), which relates to percussive or vibratory piling only.

14.3.9 Research into levels of vibration from various construction activities were reported by The Transport and Road Research Laboratory (now the Transport Research Laboratory (TRL)) in Supplementary Report 328 'Ground vibrations caused by road construction activities' (Ref 14-3).

14.3.10 The report concluded:

> *'that at distances greater than 20m, the vibration levels measured were below the level of human perception because of attenuation in the ground and that it is unlikely that people would be disturbed*

by vibration from general construction activities at distances of 20 m or more.'

14.3.11 Given the research undertaken by TRL it is not anticipated that there would be any vibration impacts from general construction activities on sensitive receptors. The vibration impacts from piling activities have been considered using prediction formulae contained within BS 5228-2 Annex E.

14.3.12 Calculations of construction vibration levels from the operation of the TBM have been undertaken by Rupert Thornley Taylor FIOA using proprietary software known as FINDWAVE. The output of the modelling is an indication of likely ground vibration and associated groundborne noise at various depths and geological situations, as well as a prediction of the decay of vibration with distance.

Operational road traffic noise impacts

14.3.13 The procedure for predicting the noise level from a road is described in the Department for Transport and Welsh Office technical memorandum Calculation of Road Traffic Noise (CRTN) (Ref 14-4). The prediction method takes into account factors such as the traffic flow, composition and speed, the alignment and distance of the road relative to receiving property, the road surface type, the nature of the intervening ground cover between the road and reflections from building facades in order to calculate the dB LA10 18 hour noise level.

14.3.14 Traffic and the level of noise it generates fluctuate in intensity hourly, daily and seasonally and so the impact of traffic noise is assessed in terms of a time-averaged indicator.

14.3.15 In the UK, traffic noise is normally assessed using dB LA10 18 hour index, defined as the arithmetic mean of the dB(A) noise levels exceeded for 10% of the time in each of the 18, one-hour periods between 06:00 and 00:00 on a typical weekday. This takes account of the diurnal variation in traffic noise. Annual average weekday traffic (AAWT) flows, speeds and percentage of heavy vehicles is used to allow for seasonal variations.

14.3.16 The calculations undertaken within the 'calculation area' of this assessment have been conducted using a computer based prediction program IMMI (produced by Wölfel Meßsysteme). The software package follows the procedures given in CRTN.

14.3.17 Traffic data from the River Crossings Highway Assignment Model (RXHAM) has been provided for the Scheme opening year of 2021 and future assessment year (assumed to be 15 years after opening) of 2036.

14.3.18 Other model inputs include mapping data, height contours, Scheme design drawings and address point data. The mapping product that has been used is the OS Master Map product, which has been used to allow the spatial position of features such as buildings, road kerb-lines, areas of different ground types to be identified. Height contours of the calculation area allow for the vertical heights of both the Do Minimum and Do Something situations to be modelled, with the Scheme drawings used to inform the vertical alignment of the Scheme in the Do Something situation. In addition, address point data has been used to identify residential dwellings, and Other Sensitive Receptors, within the study area.

14.3.19 Details of the existing road surface have been obtained which have indicated that the existing road surfaces within the study area are typically of hot rolled asphalt. This surface has been assumed in Do minimum opening year (2021).

14.3.20 It is assumed that the new roads within the Scheme will be surfaced with a thin surfacing system (or a material with similar characteristics from a noise emissions perspective) in the Do Something Opening year (2021). ‘Thin surface’ is a generic term covering proprietary surface course materials that are laid at a thickness less than 50 mm. These surfaces are recognised as being significantly quieter than conventional surfacings such as hot rolled asphalt and brushed concrete.

14.3.21 Transport for London (TfL) policy is that road surface maintenance would replace the road surfaces with a thin surfacing system (or a material with similar characteristics from a noise emissions perspective) over time. Therefore a thin surfacing system has been assumed on all roads within the LLAU in both the Do Something and Do Minimum future assessment year (2036).

14.3.22 Where a thin surfacing system has been presumed a correction of -1dB has been applied where the mean traffic speed is less than 75km/hr. This correction has been applied in accordance with guidance provided in DMRB.

14.3.23 Although it is likely that thin surfacing systems will provide more acoustic benefit than specified above at lower speeds, until further research is

carried out, the advice contained within DMRB of applying a conservative correction has been applied.

14.3.24 A DMRB 'detailed' assessment has been undertaken. In accordance with DMRB HD213/11 (2011) the following comparisons have been made with the calculated road traffic noise levels:

- Do Minimum scenario in the opening year against Do Minimum scenario in the future assessment year (long term);
- Do Minimum scenario in the opening year against Do Something scenario in the opening year (short term); and
- Do Minimum scenario in the opening year against Do Something scenario in the future assessment year (long term).

Operational road traffic vibration impacts

14.3.25 Airborne vibration from traffic can be produced by the engines or exhausts of road vehicles with dominant frequencies in the 50-100Hz range. Traffic-induced vibrations from low frequency sound emitted by vehicle engines and exhausts can be a source of annoyance to nearby residents and can occur to some extent along any type of road. Such sound may result in detectable vibrations in building elements e.g. windows and doors.

14.3.26 Ground borne vibration is typically found to be in the 8-20Hz range and is produced by the interaction between rolling wheels and the road surface. Research undertaken by TRL in report RR246 'Traffic induced vibration in buildings' (Ref 14-5) found no evidence that traffic induced vibration is a source of significant damage to buildings. The report concluded that:

> *'peak particle velocities in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and typically are below 1mm/s. Normal use of a building such as closing doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic.'*

14.3.27 Traffic generated vibrations mostly arise where road surfaces are uneven, e.g. on older roads that are damaged or require re-surfacing, and where they carry a significant proportion of Heavy Goods Vehicles (HGVs) (the high axle loading passing over a break in the road surface imparts vibrational energy into the ground).

14.3.28 The assessment of vibration impacts has been undertaken following guidance given within HD213/11. For all dwellings within 40m of a proposed new road the dB LA10 18 hour has been calculated for the Do Minimum and Do Something situations. The percentage of people bothered 'very much' or 'quite a lot' by noise exposure has been calculated for each dwelling using graphs given within the DMRB, and the percentage of people bothered 'very much' or 'quite a lot' by vibration is considered to be 10% lower than for noise exposure. For those dwellings at noise exposure levels below 58dB LA10,18 hour, a zero percent change in those bothered by vibration has been assumed.

Operational road traffic night-time noise impacts

14.3.29 The assessment of night-time noise impacts identifies those dwellings and Other Sensitive Receptors in the study area that meet the following night-time noise criteria over the long term:

- where the introduction of the project results in a sensitive receptor being exposed to night-time noise levels in excess of 55dB Lnight, outside, where it is currently below that level; and
- where a receptor is exposed to pre-existing Lnight, outside, in excess of 55dB and this is predicted to increase.

14.3.30 The prediction of Lnight, outside uses guidance provided in the TRL report 'Converting the UK traffic noise index dB LA10 18 hour to EU noise indices for noise mapping' (Ref 14-6). This report provides three methods for the prediction of Lnight, depending on the traffic data that is available.

14.3.31 Method 1 can be used where traffic data for each separate hour over the 24-hour period is available for each road link. Values of LA10,1-hour are calculated and then converted to LAeq, 1hour values, and subsequently Lden values, using the relationships provided in the report.

14.3.32 Method 2 can be used where detailed hourly traffic data is not available but traffic data is known for the relevant Lden time periods. The value of LA10,18 hour is calculated using CRTN, and converted to Lden time periods using the relationships provided.

14.3.33 Method 3 is used where detailed hourly traffic data is not available. An 'end-correction' is applied to the CRTN calculated levels of LA10,18 hour to convert to Lday, Levening and Lnight as required.

14.3.34 For this assessment method 2 has been used, based on the available traffic data.

Operational tunnel ventilation noise impacts

14.3.35 The method for assessing noise impacts from the tunnel ventilation system has been undertaken in accordance with BS 4142:2014 ‘Methods for Rating and Assessing Industrial and Commercial Sound’ (Ref 14-7). The guidance provided within BS 4142 provides a method whereby the likelihood of a significant impact due to noise from industrial sources can be assessed.

14.3.36 BS 4142 advises that the existing background noise levels outside noise sensitive premises are compared with the rating noise levels from any nearby industrial/mechanical noise sources.

14.3.37 Noise predictions have been carried out using International Standard ISO 9613, ‘Acoustics – Attenuation of Sound during Propagation Outdoors’ (Ref 14-8). The propagation model described in Part 2 of this standard provides for the prediction of sound pressure levels based on either short-term downwind (i.e. worst case) conditions or long-term overall averages. Only the downwind condition has been considered in this assessment, that is, for wind blowing from the application site towards the nearby residential properties. When the wind is blowing in the opposite direction noise levels may be significantly lower, especially if there is any shielding between the application site and the houses.

14.3.38 This assessment uses published values of ‘α’ (atmospheric absorption) from ISO 9613 Part 1 corresponding to a temperature of 10ºC and a relative humidity of 70% which give relatively low levels of atmospheric attenuation, and subsequently worst case noise predictions.

14.3.39 The calculations undertaken within this assessment have been conducted using a computer based prediction program IMMI (produced by Wölfel Meßsysteme). The software package follows the procedures given in ISO 9613.

Consultation

14.3.40 As part of the noise and vibration assessment, consultation with the local environmental health departments of Royal Borough of Greenwich, London Borough of Tower Hamlets and London Borough of Newham has been undertaken. Details of the consultation are provided in Table 14-3.

Table 14-3 Noise and Vibration assessment consultation

Consultee	Date of consultation	Summary of consultation
Robin Whitehouse Principal Environmental Health Officer, Pollution Unit, Environment Directorate, London Borough of Newham	12 May 2015 (e-mail) 28 July 2015 (email)	Consultation/agreement on noise survey locations. Consultation on additional noise survey locations to be undertaken as part of the ES.
Jen Taylor Team Leader - Pollution Team, London Borough of Tower Hamlets	11 May 2015 (e-mail)	Consultation/agreement on noise survey locations.
Nick Marks Team Manager Environmental Protection, Community Safety and Environment, Royal Borough of Greenwich	12 May 2015 (e-mail)	Consultation/agreement on noise survey locations.
Nick Marks Team Manager Environmental Protection, Community Safety and Environment, Royal Borough of Greenwich Harriet Peacock, EIA officer, London Borough of Tower Hamlets	9 July 2015 (meeting)	Consultation/agreement on methodologies, study areas and significance to be used for noise and vibration assessment.

The study area

Construction noise and vibration impacts

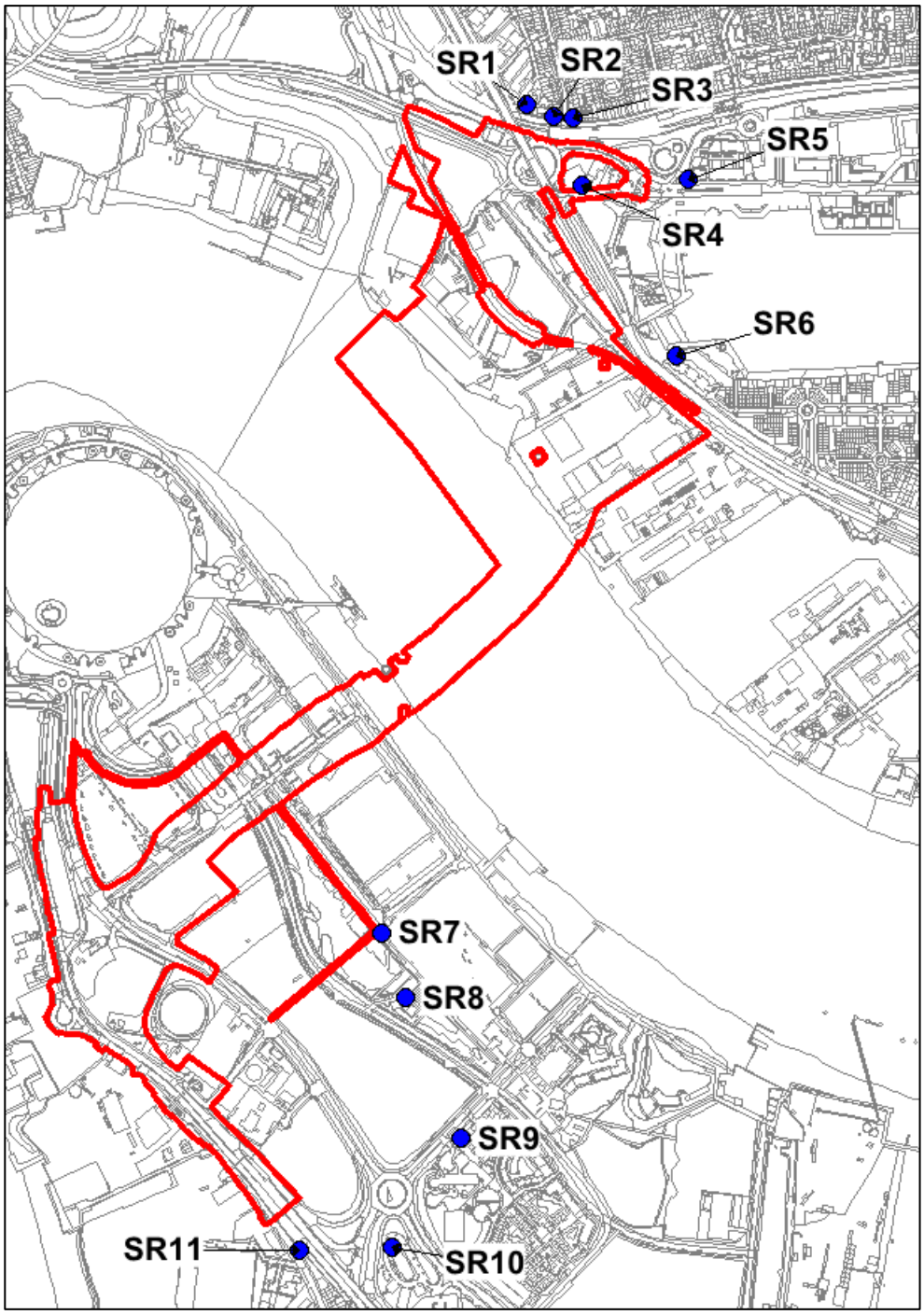
14.3.41 The study area for the construction noise assessment comprises an area up to 300m from the Limits of Land to be Acquired or Used (LLAU). This was determined in accordance with guidance provided in BS5228:2009+A1:2014 ‘Code of Practice for Noise and Vibration Control on Construction and Open Sites’ Parts 1 and 2 (BS5228) and using professional judgement. At distances over 300m noise predictions have to be treated with caution because of the increasing importance of meteorological effects. The predicted noise levels when undertaken in accordance with BS5228 may be incorrect at distance greater than 300m.

14.3.42 Noise impacts from the construction of the Scheme have been considered at selected worst case identified sensitive receptors. These receptors are presented in Table 14-4 and indicated on Figure 14-1.

Table 14-4 Construction noise and vibration sensitive receptors

Sensitive receptor (Refer to Drawing 14-1)	Receptor ID	OS coordinates
Ardennes House	SR1	539840, 180867
120 Victoria Dock Road	SR2	539885, 180848
Foster Court	SR3	539917, 180845
Hoola Development	SR4	539932, 180736
Alaska Apartments	SR5	540107, 180744
Western Beach Apartments	SR6	540086, 180453
Proposed New Developments with Residential Elements (Planning Applications 12/1708, 12/2819, 12/2841, 13/2823, 13/2822/F, 12/2840, 13/2874 AND 13/2865/F)	SR7	539602, 179503
River Way	SR8	539640, 179395
Holly Court	SR9	539730, 179164
Holiday Inn Express	SR10	539618, 178985
Proposed New Hotel (Planning Application Number 09/2796/F)	SR11	539466, 178980

Figure 14-1 Construction noise and vibration sensitive receptors



Operational road traffic noise and vibration impacts

14.3.43 The study area has been derived in accordance with the requirements of DMRB Volume 11 Section 3 Part 7 HD213/11 'Noise and Vibration' Detailed Assessment methodology (HD213/11) (Ref 14-9).

14.3.44 The study area in accordance with HD213/11 is defined by the following process presented in Table 14-5.

Table 14-5 Determining operational road traffic noise study area in accordance with DMRB (Ref 14-9)

A	Identify the start and end points of the physical works associated with the road project.
B	Identify the existing routes that are being bypassed or improved, and any proposed new routes, between the start and end points.
C	Define a boundary one kilometre from the carriageway edge of the routes identified in (B) above.
D	Define a boundary 600m from the carriageway edge around each of the routes identified in (B) above and also 600m from any other affected routes within the boundary defined in (C) above. The total area within these 600m boundaries is termed the 'calculation area'. An affected route is one where there is the possibility of a change of 1dB(A) or more between the Do Minimum and Do Something scenarios in the short-term or 3dB(A) or more in the long term.
E	Identify any affected routes beyond the boundary defined in (C) above.
F	Define a boundary 50m from the carriageway edge of the routes identified in (E) above.

14.3.45 For the purpose of the operational road traffic noise assessment it has been decided to omit stage D in Table 14-5 and to undertake detailed calculations in the larger 1km area detailed in stage C to allow for a like for like comparison of different user charging scenarios.

14.3.46 Important Areas within the study area, have also been identified and considered and are shown on Drawing 14.4.

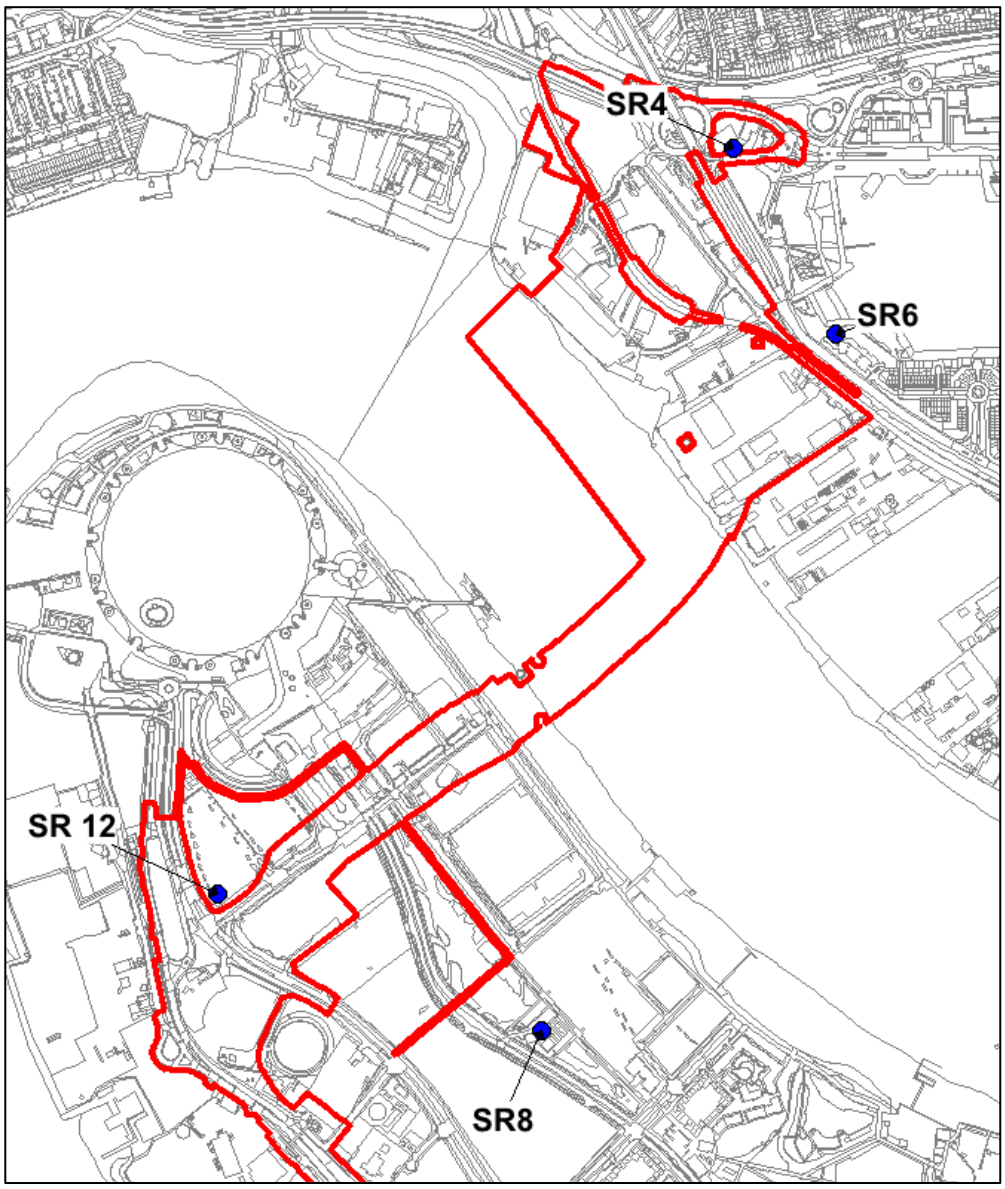
Operational ventilation noise impacts

14.3.47 Noise impacts from the operation of the tunnel ventilation system have been considered at selected worst case identified sensitive receptors. These receptors are presented in Table 14-6 and indicated on Drawing 14.2.

Table 14-6 Operational ventilation noise sensitive receptors

Sensitive receptor (Refer to Drawing 14-2)	Receptor ID	OS coordinates
Hoola Development	SR4	539932, 180736
Western Beach Apartments	SR6	540086, 180453
River Way	SR8	539640, 179395
Nearest residential element within the proposed Greenwich Peninsula Masterplan	SR12	539150, 179591

Figure 14-2 Operational ventilation noise sensitive receptors



Methodology for establishing baseline conditions

Noise monitoring

14.3.48 As part of the noise and vibration assessment for the Scheme, a schedule of noise surveys within 1km of the application boundary has been undertaken to understand existing ambient noise levels within the study area in order to identify areas of existing high or low noise levels and their source (traffic, plane, rail etc.).

14.3.49 The locations of the noise surveys have been agreed with the London Borough (LB) of Newham, LB Tower Hamlets and Royal Borough of Greenwich and are presented in Drawing 14.3.

14.3.50 The noise monitoring equipment used corresponded to that specified in BS-EN 61672-1 Electro-acoustics, Sound Level Meters, Specifications (2013). The equipment was calibrated in accordance with the manufacturers' specifications within the previous 2 years. Appendix 14.B provides details of the monitoring locations and time history of the surveys.

14.3.51 The calibration level was checked prior to and following all measurements to ensure no significant drift has occurred.

14.3.52 The sound level meters were installed no closer than 3m from any façade and logged LAeq, LA90, LA10, LA01, LAmax and LAmin parameters at 10 minute time intervals.

14.3.53 An attended survey was undertaken due to lack of secure locations, and also allowed for the surveyor to identify any extraneous noise event (planes overhead, car horns etc.) while carrying out the survey.

14.3.54 For the daytime noise surveys, the shortened measurement procedure described in the CRTN was undertaken, where measurements are made over any three consecutive hours between 10:00 and 17:00 hours on a weekday.

14.3.55 Night time measurements were undertaken for 3 hours during the night time between 23:00 and 02:00 on a weekday.

Defining the importance/sensitivity of resource

14.3.56 In terms of noise and vibration, a methodology has not yet been developed to assign the importance/sensitivity of a resource. The

sensitivity of a resource is based upon professional judgement and the guidance notes of NPSE.

14.3.57 NPSE defines 3 basic concepts derived from toxicology which are described below:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise;
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected; and
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life could occur.

14.3.58 NPSE states:

> *'It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.'*

14.3.59 For the purposes of this assessment, daytime noise levels of SOAEL have been based upon World Health Organization (WHO) Guidelines for Community Noise Levels (Ref 14–10) and WHO Night Noise Guidelines for Europe (NNG) (Ref 14-11). The definitions of SOAEL are presented in Table 14-7.

Table 14-7 Levels of LOAEL and SOAEL assumed for road traffic noise

Time period	Adverse effect level	LAeq noise level (dB)	LA10 noise level (dB)
Day	LOAEL	50	54*
Day	SOAEL	65	68**
Night	LOAEL	40	n/a
Night	SOAEL	55	n/a
*4dB correction to LA10 based on LAeq to LA10 of +2dB from BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (Ref 14-12) and Façade correction of +2.5dB rounded down ** Aligned with Noise Insulation regulations as required by Local Authority			

14.3.60 The rationale for the daytime levels of LOAEL and SOAEL are based upon daytime levels of 50dB(A) being the onset of moderate community annoyance, and long-term exposure above 65dB(A) being the onset of cardiovascular effects.

14.3.61 The night time noise levels of 40dB(A) for LOAEL and 55dB(A) for SOAEL are clearly set out by the WHO in NNG.

14.3.62 The importance or sensitivity of each resource within the study area has been assessed using the criteria provided in Table 14-8. A higher level of sensitivity has been assigned to receptors above SOAEL in the future assessment year (2036) to align the level of significance with NPSE.

Table 14-8 Determining the importance / sensitivity of resource

Importance/sensitivity of resource or receptor	Criteria
Very High	Residential dwelling where long term noise level is greater than SOAEL with or without the Scheme.
High	Residential dwelling where long term noise level is less than SOAEL Hospitals Schools Community facilities Designated areas (e.g. Area of Natural Beauty (AONB), National Park, Special Area

Importance/sensitivity of resource or receptor	Criteria
	of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Scheduled Monument (SM)) Places of Worship Public rights of way
Medium	Offices Bars/Cafes/Restaurants where external noise may be intrusive.
Low	Factories and working environments with existing high noise levels Night Clubs

Source: Determined using professional judgement

Methodology for assessing impacts

Construction noise impacts

14.3.63 BS 5228-1 Annex E recommends the ABC method to establish construction noise limits for EIAs. The ABC method involves rounding the existing ambient noise levels to the nearest 5dB for the appropriate time period (night, evening/weekends or day) and then comparing these levels to the total noise level, including construction noise. If the total noise level exceeds the existing rounded value, then a significant effect is deemed to have occurred. This method is explained further in the following paragraphs.

14.3.64 Annex E of BS 5228-1 gives several examples of methods for predicting the significance of noise impacts. The method followed for the impact assessment is that described in BS 5228 as the 'ABC method', where the change in the ambient noise level with construction noise is assessed against defined threshold values. The relevant data from Table E.1 of example threshold values in BS 5228 is reproduced below in Table 14-9.

Table 14-9 Construction noise significance thresholds

Assessment category and threshold value period	Threshold level dB LAeq		
	Category A	Category B	Category C
Night-time (23.00 – 07.00)	45 dB LAeq	50 dB LAeq	55 dB LAeq

Assessment category and threshold value period	**Threshold level dB LAeq**		
	Category A	**Category B**	**Category C**
Evenings & weekends[1]	55 dB LAeq	60 dB LAeq	65 dB LAeq
Daytime (07.00 – 19.00) and Saturday mornings[2]	65 dB LAeq	70 dB LAeq	75 dB LAeq
[1] 19.00 - 23.00 weekdays, 13.00 - 23.00 Saturdays and 07.00 – 23.00 Sundays [2] 07.00 – 13.00 Saturdays			
A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values. C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.			

Source: BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Noise'

14.3.65 A significant effect is deemed to occur if the total LAeq noise level, including construction, exceeds the threshold level for the category appropriate to the ambient noise level.

14.3.66 If the ambient noise level exceeds the threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total LAeq noise level for the period increases by more than 3dB due to construction activity. The significance criteria within Annex E of BS5228 apply to residential receptors only.

14.3.67 There are no UK legislative standards or criteria that define when groundborne noise becomes significant. The impact used for groundborne noise from the TBM has been based upon the criteria used on other UK tunnelling projects i.e. Crossrail, Thames Tunnel Tideway.

14.3.68 The assessment of TBM groundborne noise impacts at identified sensitive receptors has been undertaken using the dB LAmax, slow indicator. The criteria for different levels of predicted groundborne noise from the TBM is presented in Table 14-10.

Table 14-10 Groundborne noise significance thresholds

Ground borne noise level dB LAMax, slow	Significance of effect
< 35	Neutral
35 to 39	Slight
40 to 44	Moderate
45 to 49	Large
> 49	Very Large

Source: Professional Judgement

Construction vibration impacts

14.3.69 BS 5228-2 Annex B provides guidance on effects of vibration levels on humans in terms of peak particle velocity (ppv). The guidance is based upon human response to vibration contained within British Standard 6472-1:2008 'Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting' (BS 6472) (Ref 14-13).

14.3.70 Using the guidance provided in BS 5228-2, a significance of effect in terms of ppv has been determined and is presented in Table 14-11.

Table 14-11 Construction vibration significance thresholds

Vibration level (ppv)	Effect	Significance
0.14 $mm \cdot s^{-1}$	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.	Neutral
0.3 $mm \cdot s^{-1}$	Vibration might be just perceptible in residential environments.	Slight Adverse
1.0 $mm \cdot s^{-1}$	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.	Moderate Adverse
10 $mm \cdot s^{-1}$	Vibration is likely to be intolerable for any more than a very brief exposure to this level.	Large Adverse

Source: BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites. Vibration'

Operational road traffic noise

14.3.71 DMRB HD213/11 provides classification for the magnitude of changes in road traffic noise. A change in road traffic noise of 1dB(A) in the short term (Do Minimum to Do Something in the opening year) is the smallest that is considered perceptible. In the long term (Do Minimum in the opening year to Do Something in the future assessment year) a 3dB(A) change is considered to be perceptible.

14.3.72 The magnitudes of impact in the short and long term are therefore considered to be different. For road traffic noise the classification of magnitude of change is reproduced from HD213/11 in Table 14-12 for the short and long term respectively.

Table 14-12 Operational magnitude of impact for road traffic noise

Long term impact classification	**Short term impact classification**	**Change road traffic noise level**
No Change	No Change	0 dB
Negligible	Negligible	> 0 dB and < 1 dB
	Minor	≥ 1 dB and < 3 dB
Minor	Moderate	≥ 3 dB and < 5 dB
Moderate	Major	≥ 5 dB and < 10 dB
Major		≥ 10 dB

Source: DMRB HD213/11, Volume 11, Section 3, Part 7 (2011)

14.3.73 The significance of effects has been determined by cross referencing the value of the receptor with the magnitude of impact in the matrix presented in Table 14-13.

Table 14-13 Operational significance of effects for road traffic noise

		Magnitude of impact (degree of change)				
		No Change	Negligible	Minor	Moderate	Major
Importances	Very High	Neutral	Slight	**Moderate**	**Large**	**Very Large**

	High	Neutral	Neutral	Slight	**Moderate**	**Large**
	Medium	Neutral	Neutral	Neutral	Slight	**Moderate**
	Low	n/a	n/a	n/a	n/a	n/a

Source: DMRB H205/08, Volume 11, Section 2, Part 5 & IEMA Guidelines for Environmental Noise Impact Assessment, 2014

14.3.74 It is important to note that the change in noise level can be either beneficial or adverse, and effects can also, therefore, be either beneficial or adverse.

14.3.75 For the purpose of the noise and vibration assessment adverse impacts greater than moderate would be considered significant, as indicated by the bold text in Table 14-13.

14.3.76 Typical descriptors of significant effects in terms of noise are presented in Table 14-14.

Table 14-14 Descriptors for significance of operation road traffic noise

Importance/sensitivity of resource or receptor	**Criteria**
Very Large	Only adverse effects are assigned this level of significance. Substantial change in noise level perceived at receptor leading to psychological stress or physiological effects.
Large	Causes a material change in behaviour or attitude e.g. avoiding certain activities. Quality of life diminished/enhanced due to change in noise level.
Moderate	Change in noise can be heard and causes small changes in behaviour or attitude e.g. opening/closing windows.
Slight	Change in noise level can be heard but does not cause any change in behaviour or attitude. Can slightly affect the receptor but not such that there is a perceived change in the quality of life.
Neutral	No effects or those that are beneath levels of perception.

Source: IEMA Guidelines for Environmental Noise Impact Assessment (2014)

Operational tunnel ventilation noise

14.3.77 An assessment of the likely impacts from the tunnel ventilation system has been undertaken in accordance with BS 4142 by subtracting the measured background sound level from the rating level, and considers the following:

- typically, the greater this difference, the greater the magnitude of the impact;
- a difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- a difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and
- 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.

14.3.78 Based on the advice presented in BS 4142 Table 14-15 below provides the significance criteria used in the assessment of noise impact from the tunnel ventilation system.

Table 14-15 Operational significance for tunnel ventilation noise

Rating level above existing background noise level	**Significance criteria**
≥ 10 dB	Very Large
≥ 5 dB and < 10 dB	Large
≥ 3 dB and < 5 dB	Moderate
≥ 0 dB and < 3 dB	Slight
< 0 dB	Neutral

Limitations and assumptions

14.3.79 At present, the final construction methodologies and plant are not known. The construction noise assessment has been undertaken based upon an indicative programme and plant itinerary taking into account worst case assumptions as to the types of activities and plant that are likely to be used. For the construction assessment a pessimistic percentage on time of 80% has been assumed for construction plant.

14.3.80 During the consultation with London Borough of Newham, three additional sites in Newham were proposed to consider for noise surveys. However as noise survey work needs to be undertaken during school term time, these additional sites will be monitored in autumn 2015 and results will be incorporated in the ES.

14.4 Description of the baseline conditions

Existing baseline

14.4.1 There are a total of 29,100 existing residential dwellings located within the detailed Study Area.

14.4.2 Other Sensitive Receptors defined within HD213/11 as hospitals, schools, community facilities, designated areas (e.g. AONB, National Park, SAC, SPA, SSSI, SAM), and public rights of way have been identified and are presented in Table 14-16 and presented in Drawing 14.4.

Table 14-16 Other sensitive receptors within operational noise study area

Identified other sensitive receptors (Refer to Drawing 14.4)	
Abrahams Nursery & Kids Club (OSR1)	Ravenbourne Collage (OSR18)
Britannia Village Primary School (OSR2)	Royal Docks Community Church (OSR19)
Christ Church School (OSR3)	Selmo Community Centre (OSR20)
Cubitt Town Infants School (OSR4)	Spectrum Educational (OSR21)
Express By Holiday Inn (OSR5)	St Fidelis Friary (OSR22)
Faraday School (OSR6)	St Joseph's Community Centre (OSR23)
Hallsville Primary School (OSR7)	St Joseph's RC Primary School (OSR24)
Holiday Inn Express (OSR8)	St Luke's C of E Primary School (OSR25)
Ibis London Excel (OSR9)	St Luke's Community Centre (OSR26)
Keir Hardie Methodist Church (OSR10)	St Luke's Health Centre (OSR27)

Identified other sensitive receptors (Refer to Drawing 14.4)	
Keir Hardy Primary School (OSR11)	St Margaret's RC Church (OSR28)
King William IV Hotel (OSR12)	Teddies Day Nursery (OSR29)
Leapfrog Nursery (OSR13)	The Bridge Nursery (OSR30)
Millennium Mini's Day Nursery (OSR14)	The Celestial Church of Christ (OSR31)
Millennium Village School (OSR15)	Travellers Camp Site (OSR32)
Newham Primary Care Trust (OSR16)	Tunnel Avenue Hotel (OSR33)
Novotel London Excel (OSR17)	Woodland Surgery (OSR34)
	World Church (OSR35)

14.4.3 Noise levels across the Study Area vary with a variety of noise sources present. These noise sources include road traffic noise from the existing highways, rail noise from the Docklands Light Railway (DLR) system and aircraft noise from commercial flights. There are also sources of industrial noise along the River Thames.

14.4.4 Table 14-17 and Table 14-18 present the noise levels which have been monitored at various locations to the Scheme.

14.4.5 Table 14-17 presents noise data collected at the Locations shown on Figure 14.3, in the form of averages, collected and interpreted from daytime surveys (recorded between 10:00 – 17:00) at 14 separate locations within 1km of the Scheme. The conditions were considered acceptable for noise surveys with no rain and wind speeds below 5m/s.

Table 14-17 Monitored daytime noise survey levels

	$L_{Aeq\ 3\text{-}Hour}$	$L_{A10\ 3\text{-}Hour}$	$L_{A90\ 3\text{-}Hour}$	$L_{A10\ 18\ Hour}$	$L_{Aeq\ 16\ Hour}$
NML 1	66.8	69.7	55.8	68.7	66.7
NML 2	62.2	61.8	51.5	60.8	48.6
NML 3	63.4	54.5	52.5	80.1	50.9
NML 4	62.1	63.9	52.3	62.9	60.9
NML 5	69.9	61.0	59.0	84.2	58.7

	$L_{Aeq\ 3\text{-}Hour}$	$L_{A10\ 3\text{-}Hour}$	$L_{A90\ 3\text{-}Hour}$	$L_{A10\ 18\ Hour}$	$L_{Aeq\ 16\ Hour}$
NML 6	66.7	59.9	49.9	58.9	56.9
NML 7	67.1	70.5	68.5	67.5	65.5
NML 8	67.0	58.0	56.0	81.4	56.3
NML 9	61.0	56.8	54.8	76.0	55.7
NML 10	61.0	63.3	56.5	62.3	60.3
NML 11	61.4	62.2	54.5	61.2	59.2
NML 12	61.3	63.1	52.8	62.1	60.1
NML 13	61.1	60.8	51.8	59.8	57.8
NML 14	61.3	62.0	50.9	61.0	59.0

14.4.6 Table 14-18 presents data, in the form of averages, collected and interpreted from baseline night time surveys (recorded between 11:00-02:00) at 14 separate locations within 1km of the scheme. The conditions were considered acceptable for noise surveys with no rain and wind speeds below 5m//s.

Table 14-18 Monitored night-time noise survey levels

	$L_{Aeq\ 3\text{-}Hour}$	$L_{A10\ 3\text{-}Hour}$	$L_{A\ Max}$	$L_{A\ Min}$
NML 1	60.5	63.7	78.0	44.7
NML 2	47.9	49.2	65.8	38.8
NML 3	55.5	55.1	75.0	40.5
NML 4	53.1	56.0	71.6	39.7
NML 5	53.0	56.9	65.5	39.4
NML 6	51.0	50.8	70.8	40.1
NML 7	60.7	62.9	73.4	52.8
NML 8	56.0	54.2	75.8	46.4
NML 9	49.1	51.1	57.8	42.7
NML 10	57.5	59.9	71.4	46.7
NML 11	57.3	60.2	72.3	46.9
NML 12	49.7	47.7	59.4	40.8
NML 13	52.3	53.0	68.5	45.4
NML 14	52.7	53.6	65.2	47.9

Future baseline

14.4.7 An assessment of the future baseline in the absence of the Scheme from the Do Minimum 2021 to Do Minimum 2036 scenario has been assessed in accordance with DMRB and is reported in Section 14.6.

14.4.8 Without the Scheme, sensitive receptors within the Study Area are predicted to experience negligible/slight changes in noise level in the year 2036.

14.5 Scheme design and mitigation

Construction

14.5.1 The Preliminary Code of Construction Practice (CoCP) (Volume 3, Appendix 4.A of this PEIR) includes a requirement for a Construction Environmental Management Plan (CEMP) and Noise and Vibration Management Plan to be prepared and agreed with Local Authorities prior to commencing construction. Mitigation measures set out in the CoCP and to be taken forward into the CEMP and Noise and Vibration Management Plan are set out below.

14.5.2 The following measures will be undertaken prior to construction:

- Pre-construction noise monitoring surveys would be undertaken and agreed with the relevant local authority to establish a pre-construction baseline for monitoring compliance with construction noise limits.
- Night time works would be re-assessed in accordance with BS 5228 using specific manufacturer's data and position of equipment. Results of the assessment should be presented to local environmental health departed prior to commencement of night time works.
- Any changes to the Reference design, the Design, Build, Finance and Maintain (DBFM) contractor would ensure that an updated noise assessment be carried out to ensure there would be no additional or increase in negative effects on receptors.

14.5.3 The DBFM contractor will obtain consents from the relevant local authority under Section 61 of the Control of Pollution Act 1974 (which will include noise and vibration limits where relevant) for the proposed construction works. However, Section 61 process may not be appropriate in the case of some types of tunnelling operations. Site specific management and mitigation requirements for noise and vibration will be further defined in

the Section 61 consents. By exception, the contractor may agree with the local authority that, for certain activities not anticipated to be noise sensitive, such as normal site investigation and site set up (subject to these being in accordance with the CoCP), that a Section 61 consent will not be necessary.

14.5.4 The DBFM contractor will be responsible for notifying the local residents of particularly noisy work prior to commencement. Effective communication should be established, keeping local residents informed of the type and timing of works involved, paying particular attention to potential evening and night time works and activities which may occur in close proximity to receptors.

14.5.5 A set of generic best practice working practices referred to as Best Practicable Means (BPM) would be employed during the construction phase. Examples of typical BPM include:

- closed board fencing will be installed around the construction areas;
- provision of contact details for a site representative in the event that disturbance due to noise or vibration from the construction works occurs; ensuring that any complaints are dealt with pro-actively and that subsequent resolutions are communicated to the complainant;
- site access routes would be in good condition and well maintained with no potholes or other significant surface irregularities;
- plant machinery would be turned off when not in use;
- all vehicles and mobile plant would be well maintained such that loose body fittings or exhausts do not rattle or vibrate;
- silenced equipment would be used where possible, in particular silenced power generators and pumps;
- the most modern equipment available would be used and the equipment used would be properly maintained and operated by trained staff;
- plant and equipment covers and hatches would be properly secured and there would be no loose fixings causing rattling;
- static noisy plant, including generators, would be located as far away from noise sensitive receptors as is feasible for the particular activity.

- speed limits would be in place to reduce the effect of construction traffic noise. Limits would be inside the redline site boundary on all non-surfaced roads restricted to 10mph and any surfaced roads would be restricted to 15mph;
- to minimise vibration from HGV movements, there would be monthly condition assessments to inspect for defects such as pot holes which could cause an increase in noise levels. Indentations of greater than 20mm to be repaired when identified. Existing potholes would need to be considered by a condition assessments prior to the commencement of works.
- as part of the plant selection process the DBFM contractor should adopt a procedure to ensure the quietest plant and equipment, techniques and working practices available would be selected and used; and
- no music or radios would be played on site.

14.5.6 During the construction phase, day time and night time noise monitoring will be undertaken at key sensitive receptors (to be defined through development of the CEMP) to ensure that the mitigation measures suggested are working effectively. The regime would be agreed with the relevant Environmental Health Officer (EHO) prior to works commencing.

Operational road traffic noise

14.5.7 The Scheme design includes noise mitigation measures, which have been part of the design process. The proposed mitigation measures are as follows:

- 2.0m high visual/acoustic barrier around both northern and southern tunnel portals; and
- low noise surface to be laid where ever possible within the LLAU.

14.5.8 The location of the proposed noise barriers around the tunnel portals and low noise surfacing are presented in Drawing 14.5.

Tunnel ventilation noise

14.5.9 Tunnel ventilation noise impacts will be mitigated to be below existing background noise levels through the use of intelligent design and silencer units.

14.6 Assessment of impacts

Construction impacts

Construction noise impacts

14.6.1 Within the vicinity of the scheme there are a number of receptors that may be impacted by noise produced during the construction phase.

14.6.2 Noise levels will depend on the different plant type used, percentage on-time and type of activity. The assumptions made in the prediction of construction noise levels are presented in Appendix 14.A.

14.6.3 Table 14-19 presents the worst case construction noise level, the construction month it would occur in and whether it would exceed the relevant ABC category.

Table 14-19 Construction noise impacts

Receptor	Construction noise level dB LAeq	Construction month	BS 5228-ABC category	Exceed ABC category
Ardennes House	64.3	Month 35	A	NO
120 Victoria Dock Road	64.1	Month 35	A	NO
Foster Court	63.4	Month 13	A	NO
Hoola development	67.6	Month 13	B	NO
Alaska Apartments	62.6	Month 13	A	NO
Western Beach Apartments	66.8	Month 13	B	NO
Proposed New Developments with Residential Elements	63.7	Month 14	A	NO
River Way	61.9	Month 14	A	NO
Holly Court	58.4	Month 14	A	NO
Holiday Inn Express	57.9	Month 14	A	NO
Proposed New	59.5	Month 14	A	NO

Receptor	Construction noise level dB LAeq	Construction month	BS 5228-ABC category	Exceed ABC category
Hotel (planning application number 09/2796/F)				

14.6.4 Table 14-19 indicates that, as would be expected, construction noise levels at residential receptors in close proximity to the Scheme would be the highest.

14.6.5 However, daytime construction noise levels are predicted to be below the relevant ABC category at all residential receptors within 300m throughout the construction period. In accordance with BS 5228 (see Table 14-9) daytime construction noise levels are therefore not considered to be significant.

14.6.6 Although daytime construction noise levels are not considered to be significant, they may be of slightly different character to the local industrial and waste uses and as such would be considered to be **Slight Adverse**.

Construction vibration impacts from piling

14.6.7 The required construction activities necessary to construct the Scheme have the potential to cause vibrational impacts on receptors within proximity of the working site. Guidance provided within BS 5228: Part 2 on predicting ground-borne vibration has been drawn upon when carrying out these predictions.

14.6.8 Table 14-20 presents the predicted vibration levels and effects from rotary bore piling operations on residential dwellings. The levels presented assume a worst case scenario of all receptors having a wooden floor.

Table 14-20 Vibration impacts from rotary bore piling activities

Receptor ID	Receptor	PPV (mm)	Comment
SR1	Ardennes House	< 0.14	PPV below human perception
SR2	120 Victoria Dock Road	< 0.14	PPV below human perception
SR3	Foster Court	< 0.14	PPV below human perception

Receptor ID	Receptor	PPV (mm)	Comment
SR4	Hoola Development	< 0.14	PPV below human perception
SR5	Alaska Apartments	< 0.14	PPV below human perception
SR6	Western Beach Apartments	< 0.14	PPV below human perception
SR7	Proposed New Developments with Residential Elements	< 0.14	PPV below human perception
SR8	River Way	< 0.14	PPV below human perception
SR9	Holly Court	< 0.14	PPV below human perception
SR10	Holiday Inn Express	< 0.14	PPV below human perception
SR11	Proposed New Hotel (planning application number 09/2796/F)	< 0.14	PPV below human perception

14.6.9 The vibration levels presented in Table 14-20 indicate that they would be below human perception and would not have a significant effect upon the local area.

14.6.10 The predictions indicate that vibration levels from rotary bored piling would be below human perception and would be considered to have a neutral impact.

14.6.11 Table 14-21 presents the predicted vibration levels and effects from percussive piling operations for the installation of the jetty on residential dwellings. The levels presented assume a worst case scenario of all receptors having a wooden floor.

Table 14-21 Vibration effects from percussive hammer piling

Receptor	PPV (mm)	Significance of effect
Ardennes House	0.115	Slight adverse
120 Victoria Dock Road	0.117	Slight adverse

Foster Court	0.114	Slight adverse
Hoola Development	0.150	Slight adverse
Alaska Apartments	0.107	Slight adverse
Western Beach Apartments	0.173	Slight adverse

14.6.12 The greatest values predicted is 0.173 PPV, it's possible that this level is perceivable by humans but highly unlikely that it would cause any impact, especially given that the duration will be short lived.

14.6.13 The predictions for percussive piling operations indicate that vibration levels may be just perceptible and would be considered to have at worst a slight adverse significance of effect.

Noise and vibration impacts from tunnel boring machine

14.6.14 Appendix 14.C sets out the findings of the study of noise and vibration impacts from the tunnel boring machine. Receptor locations are shown on Figure 14.1. The study has shown that the level of groundborne noise is unlikely to exceed the Significant Adverse Effect level even if there were sensitive receptors directly above the tunnel. Actual sensitive receptors are located to the side of the tunnel alignment where the levels will be lower and the Lowest Observed Adverse effect level will be reached at about 75m to the side of the tunnel regardless of tunnel depth.

14.6.15 Table 14-22 presents the predicted ppv, VDV and LAmax levels from tunnel boring operations at the nearest identified sensitive receptors.

Table 14-22 Tunnel boring noise and vibration impacts

ID	LAmax	mm/s	VDV
SR1	30.00	0.0051	<0.01
SR2	30.28	0.0053	<0.01
SR3	30.20	0.0053	<0.01
SR4	32.29	0.0069	<0.01
SR5	30.39	0.0061	<0.01
SR6	32.33	0.0082	<0.01
SR7	28.77	0.0048	<0.01
SR8	28.78	0.0048	<0.01
SR9	26.97	0.0039	<0.01

ID	LAmax	mm/s	VDV
SR10	26.59	0.0038	<0.01
SR11	27.23	0.0039	<0.01

14.6.16 The vibration levels presented in Table 14-22 indicate that vibration levels would be below the threshold level of human perception, and as such would be considered to be negligible. The closest receptor (SR6) is located approximately 170m from the TBM.

14.6.17 The predicted LAmax levels would all be below 35dB LAmax which is the LOAEL for tunnel boring activities and as such would be considered to be negligible.

Operational impacts

Short term road traffic noise impacts

14.6.18 To assess short term road traffic noise impacts, a comparison is made between the Do Minimum and Do Something scenarios in the opening year (2021) in order to consider what the abrupt change would be upon the Scheme opening. Table 14-23 and Drawing 14-6 show the changes in road traffic noise in this comparison.

Table 14-23 Short term traffic noise impacts inside detailed study area

		Daytime	
Change in noise level		**Number of dwellings**	**Number of other sensitive receptors**
Increase in noise level, $L_{A10,18\text{-hour}}$	0.1 - 0.9	3,822	6
	1.0 - 2.9	1,023	1
	2.9 - 4.9	180	0
	>5	0	0
No Change	0	6,596	3
Decrease in noise level, $L_{A10,18\text{-hour}}$	0.1 - 0.9	14,974	16
	1.0 - 2.9	2,505	9
	2.9 - 4.9	0	0

		Daytime	
Change in noise level		**Number of dwellings**	**Number of other sensitive receptors**
	>5	0	0

14.6.19 In the daytime there are 5,025 dwellings predicted to experience a noise increase. The majority of these (3,822) fall within the negligible noise change band of +0.1 to +0.9dB, where the change would not be perceptible. In contrast, there are 17,479 dwellings predicted to experience a noise decrease, the majority of which (14,974) fall within the negligible noise change band. There are also 6,596 dwellings predicted to experience no change in road traffic noise.

14.6.20 The comparison of the opening year situation with and without the Scheme indicates a net benefit of 12,454 more dwellings predicted to experience decreases in road traffic noise levels than increases.

14.6.21 Predicted noise level increases are due to a combination of predicted changes in road traffic flows with the Scheme, and in some locations due to the new exit/entry roads for the tunnel. Noise increases tend to be localised around the areas of the tunnel portals.

14.6.22 180 dwellings are predicted to experience a moderate increase of greater than 2.9dB in the short term. These dwellings are located within the east tower of the Hoola development. These dwellings experience an increase due to a higher HGV percentage along Tidal Basin Road as a result of the Scheme. These impacts have been mitigated to a minimum through the use of low noise surfacing around Tidal Basin Road.

14.6.23 The 1,023 dwellings predicted to experience minor decreases in noise level occur at the northern exit of the Blackwall Tunnel due to reductions in traffic flow along this link as a result of the Scheme.

14.6.24 The assessment of Other Sensitive Receptors predicts negligible changes in road traffic noise at 25 locations with one increase (Ravensborne Collage) and nine decreases. There are three Other Sensitive Receptors where there would be no change in road traffic noise.

14.6.25 Overall, the assessment of the Scheme in the short term indicates that there would be negligible or minor changes in road traffic noise at the

majority of receptors with a net gain of 1,302 residential dwellings which would experience a perceptible decrease in noise level.

14.6.26 Table 14-24 presents the results of the basic noise calculations undertaken for road traffic links outside of the detailed calculation area.

Table 14-24 Short term traffic noise impacts outside detailed study area

Change in noise level		**Number of dwellings**
Increase in noise level, LA10,18-hour	0.1 - 0.9	964
	1.0 - 2.9	0
	2.9 - 4.9	0
	>5	0
No Change	0	3,657
Decrease in noise level, LA10,18-hour	0.1 - 0.9	1,107
	1.0 - 2.9	0
	2.9 - 4.9	0
	>5	0

14.6.27 Calculations indicate that none of the roads would exceed the threshold levels of 1dB in the short term. This provides a positive indication that any noise impacts as a result of the Scheme would be localised.

14.6.28 Table 14-25 shows a comparison in noise levels at Important Areas within the detailed study area (Drawing 14.4). There are no changes in road traffic noise level predicted in the short term that exceed 1dB suggesting that there are no detrimental effects, and Important Areas would experience a negligible impact in the short term.

Table 14-25 Short term impacts on Important Areas within detailed study area

Important Area ID	**Do Minimum 2021**	**Do Something 2021**	**Change**
13678	72.4	70.6	-0.8
13906	70.5	70.3	0.9
573	71.0	70.0	-0.1
1113	70.2	68.3	-0.9

595	71.4	69.9	-0.6
1110	74.8	73.4	-0.4
905	7.5	74.4	0.0

Long term road traffic noise impacts

14.6.29 The comparison between the Do-Minimum situation in the opening year (2021) and Do-Something in the future assessment year (2036) provides an appreciation of the long-term noise impact of the scheme. Table 14-26 and Drawing 14.7 shows the changes in road traffic noise in this comparison.

Table 14-26 Long term traffic noise impacts inside detailed study area with Scheme

Change in noise level		**Number of dwellings**	**Number of other sensitive receptors**	**Number of dwellings**
		Daytime		**Night-Time**
Increase in noise level, LA10,18-hour	0.1 - 2.9	1597	15	502
	3.0 - 4.9	181	2	0
	5.0- 9.9	0	0	0
	>10	0	0	0
No Change	0	4877	1	149
Decrease in noise level, LA10,18-hour	0.1 - 2.9	22445	17	8389
	3.0 - 4.9	0	0	193
	5.0- 9.9	0	0	0
	>10	0	0	0

14.6.30 In the future year daytime Do-Something situation, 1,778 dwellings are predicted to experience a noise increase, the majority of which fall within the negligible noise change band of +0.1 to +2.9dB, where the change would not be perceptible over the longer term. In contrast, there are 22,445 dwellings predicted to experience a noise decrease, the majority of which fall within the negligible noise change band of -0.1 to -2.9dB. There are also 4,877 dwellings where no-change in road traffic noise levels is predicted.

14.6.31 The assessment of Other Sensitive Receptors in the daytime period predicts negligible changes in road traffic noise at all 35 sensitive receptor locations with 24 increases and three decreases. There are eight Other Sensitive Receptors where there would be no-change in road traffic noise.

14.6.32 The assessment of the Scheme in the long term indicates that there would be negligible, or no-change, in road traffic noise at the majority of receptors in the day time. Moderate adverse effects would occur at the east tower of the Hoola development due to an increase in percentage of HGVs.

14.6.33 In the future year night time Do-Something situation, 502 dwellings are predicted to experience a noise increase, all of which fall within the negligible noise change band of +0.1 to +2.9dB, where the change would not be perceptible over the longer term. In contrast, there are 8,582 dwellings predicted to experience a noise decrease, the majority of which fall within the negligible noise change band of -0.1 to -2.9dB. There are also 149 dwellings where no-change in road traffic noise levels is predicted. The large amount of decreases in noise levels are due to all roads in the design year having a low noise surface.

14.6.34 Table 14-27 presents the results of the basic noise calculations undertaken for road traffic links outside of the detailed calculation area.

Table 14-27 Long term traffic noise impacts outside detailed study area with Scheme

Change in noise level		**Number of dwellings**
Increase in noise level, LA10,18-hour	0.1 - 2.9	4573
	3.0 - 4.9	0
	5.0- 9.9	0
	>10	0
No Change	0	632
Decrease in noise level, LA10,18-hour	0.1 - 2.9	523
	3.0 - 4.9	0
	5.0- 9.9	0
	>10	0

14.6.35 Calculations indicate that none of the roads would exceed the threshold levels of 3dB in the long term. This provides a positive indication that any noise impacts as a result of the Scheme would be localised.

14.6.36 Table 14-28 presents a comparison in noise levels at Important Areas within the detailed study area. There are no changes in road traffic noise level predicted in the long term that exceed 3dB, suggesting that there are no detrimental effects, and Important Areas would experience a negligible impact in the long term.

Table 14-28 Long term impacts in Important Areas in detailed study area

IA	Do Minimum 2021	Do Something 2036	Change
13678	72.4	71.1	-1.3
13906	70.5	73.0	2.6
573	71.0	70.0	-1.1
1113	70.2	71.6	1.4
595	71.4	71.3	-0.2
1110	74.8	73.5	-1.4
905	75.5	72.7	-2.7

Long term road traffic noise impacts without the Scheme

14.6.37 A comparison is made between the Do-Minimum situations in the opening year (2021) and future assessment year (2036) in order to appreciate how road traffic noise levels would change at receptors over time without the implementation of the Scheme. Table 14-29 and Drawing 14.8 shows the changes in road traffic noise in this comparison.

Table 14-29 Long term traffic noise impacts inside detailed study area without Scheme

Change in noise level		Number of dwellings	Number of other sensitive receptors	Number of dwellings
		Daytime		Night-Time
Increase in noise level,	0.1 - 2.9	1,162	30	584
	3.0 - 4.9	0	0	0

Change in noise level		Number of dwellings	Number of other sensitive receptors	Number of dwellings
		Daytime		Night-Time
LA10,18-hour	5.0- 9.9	0	0	0
	>10	0	0	0
No Change	0	4788	4	126
Decrease in noise level, LA10,18-hour	0.1 - 2.9	23150	1	8563
	3.0 - 4.9	0	0	0
	5.0- 9.9	0	0	0
	>10	0	0	0

14.6.38 This assessment comparison indicates that there would be no change in road traffic noise levels at 4,788 dwellings, a negligible noise increase at 1,162 dwellings and a negligible noise decrease at 23,150 dwellings.

14.6.39 Similarly, the assessment of Other Sensitive Receptors indicates 30 negligible increases in road traffic noise, four predicted to experience no change and one with a negligible decrease in road traffic noise.

14.6.40 In the future year night time Do-Minimum situation, 584 dwellings are predicted to experience a noise increase, all of which fall within the negligible noise change band of +0.1 to +2.9dB, where the change would not be perceptible over the longer term. In contrast, there are 8,563 dwellings predicted to experience a noise decrease, all of which fall within the negligible noise change band of -0.1 to -2.9dB. There are also 126 dwellings where no-change in road traffic noise levels is predicted. The large amount of decreases in noise levels are due to all roads in the future Year (2036) assuming a low noise surface.

14.6.41 Table 14-30 presents the results of the basic noise calculations undertaken for road traffic links outside of the detailed calculation area of the do minimum 2021 compared with do minimum 2036

Table 14-30 Long term traffic noise impacts outside detailed study area without Scheme

Change in noise level	Number of dwellings

Increase in noise level, LA10,18-hour	0.1 - 2.9	4605
	3.0 - 4.9	0
	5.0- 9.9	0
	>10	0
No Change	0	612
Decrease in noise level, LA10,18-hour	0.1 - 2.9	511
	3.0 - 4.9	0
	5.0- 9.9	0
	>10	0

14.6.42 Calculations indicate that none of the roads outside the detailed Study Area would exceed the threshold levels of 3dB in the long term without the Scheme. Future noise impacts outside of the detailed Study Area would be considered to be Neutral.

14.6.43 Table 14-31 presents a comparison in noise levels at Important Areas within the detailed study area. There are no changes in road traffic noise level predicted in the long term that exceed 3dB suggesting that there are no detrimental effects and Important Areas would experience a negligible effect in the long term without the Scheme.

Table 14-31 Long term impacts on Important Area's within the detailed study area without the Scheme

IA	Do min 2021	Do min 2036	Change
13678	72.4	71.5	0.1
13906	70.5	70.1	0.6
573	71.0	70.1	0.1
1113	70.2	69.3	0.1
595	71.4	70.6	0.1
1110	74.8	74.0	0.1
905	75.5	74.0	0.0

Tunnel Ventilation Noise Impacts

14.6.44 Table 14-32 presents the predicted noise levels from the operation of the tunnel ventilation system. The predicted noise levels presented account for noise from the ventilation stack and from the jet fans located in the

tunnel portal itself. A full detailed assessment is provided in Appendix 14.D and 14.E.

Table 14-32 BS4142 Tunnel ventilation noise assessment

Receptor ID	Receptor description	Background sound level dB L_{A90}		Rating level dB(A)	Excess over/under background level	
		Day	Night		Day	Night
SR4	Hoola Development	54	42	29	-25	-13
SR6	Western Beach Apartments	59	40	32	-27	-8
SR8	River Way	57	45	23	-34	-22
SR12	Nearest Residential Element of Greenwich Peninsula Masterplan	58	48	33	-25	-15

14.6.45 BS4142 states

> *'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'*

14.6.46 The assessment of rating levels from the tunnel ventilation system for both daytime and night time periods are predicted to be below existing background sound levels. This is a positive indication that the tunnel ventilation would not have a significant impact upon identified sensitive receptors.

14.6.47 Based upon the assessment presented in Table 14-32 noise impacts from the tunnel ventilation system would be considered to be negligible.

14.7 Cumulative impacts

Construction impacts

14.7.1 Cumulative construction noise impacts would be localised to within 300m of the Scheme LLAU. The location of potential cumulative developments are shown on Drawing 17.1 and 17.2 located in Volume 3 of the PEIR.

14.7.2 On the northern side of the Scheme within the London Borough of Newham the Hoola development is the only development within 300m and this is forecast for completion at the end of 2016 two years before construction of the Scheme would begin and as such cumulative construction noise impacts on the northern side of the Scheme are considered to be Neutral.

14.7.3 On the southern side of the Scheme there is anticipated to be large scale redevelopment along the Greenwich Peninsula during the construction phase of the Scheme. It is likely that these developments would employ mitigation measures to minimise the noise impact upon the local area and as such cumulative construction noise impacts in Greenwich would be considered to be Slight Adverse.

Operational impacts

14.7.4 The traffic data used in the operational road traffic noise assessment takes into account and includes any future development which could increase or decrease traffic flows and the assessment provided in section 14.6 has taken into account the developments which would be built by the opening year of the Scheme.

14.7.5 After the opening of the Scheme the areas on both the northern and southern sides of the Scheme are anticipated to have large amounts of development. Table 14-33 presents a summary of predicted changes in noise level anticipated for the year 2036.

Table 14-33 Noise impact upon future developments for the year 2036

ID (Refer to Drawing 17.2)	Planning reference and use	Impact
1	PA/11/03670 – Mixed Use	Negligible
2	PA/13/02966 – Mixed Use	Negligible
3	PA/14/03594 – Mixed Use	Negligible
4	PA/12/00360 – Residential Development	Negligible
5	PA/12/02107 – Residential Development	Negligible
6	PA/12/00001 – Mixed Use	Minor Decrease
7	PA/11/01426 – Residential Development	Negligible

ID (Refer to Drawing 17.2)	Planning reference and use	Impact
8	PA/14/00074 Residential Development	Minor Decrease
9	PA/15/1005 – Mixed Use	Negligible
10	13/0146/FUL – Mixed Use	Negligible
11	13/00530/FUL – Residential Development	Negligible
12	STRATEGIC SITE S8 – Planned Development (Infrastructure)	Moderate Increase
13	10/00369/FUL –Mixed Use	Negligible
14	14/00395/FUL – Infrastructure	Negligible
15	11/00856/OUT – Mixed Use	Negligible
16	14/01065/OUT – Mixed Use	Negligible
17	13/1773/F -Infrastructure and redevelopment	Negligible
18	13/1529/F - Retail	Negligible
19	13/3285/0 – retail	Negligible
20	15/0716/0 – Mixed Use	Negligible
21	15/0716/0 – Mixed Use	Negligible
22	15/0716/0 – Mixed Use	Negligible
23	15/0716/0 – Mixed Use	Negligible
24	15/0716/0 – Mixed Use	Negligible
25	15/0716/0 – Mixed Use	Moderate Increase
26	15/0716/0 – Mixed Use	Negligible
28	15/0716/0 – Mixed Use	Negligible
29	15/0716/0 – Mixed Use	Negligible

14.7.6 The majority of the sites planned for future development would experience negligible impacts. Sites 7 and 8 would experience slight decrease in noise due to reductions in flow within Tower Hamlets near to the Blackwall Tunnel.

14.7.7 Site 12 and Site 25 would experience moderate increases due to their proximity to the tunnel portals. The possibility of vibration impacts upon the proposed new film studio at Site 25 may also arise. Given that road traffic vibration levels are generally very low and the sensitivity of these premises this impact could be considered to be Moderate.

14.8 Further work to be done

14.8.1 Prior to the final submission further assessment of any night time construction impacts and HGV construction movements will need to be considered when data becomes available.

14.8.2 An investigation into traffic induced vibration impacts upon the proposed film studio, which is part of the Greenwich Masterplan may be required.

14.9 National Road and Rail Networks: National Policy Statement (NN NPS)

14.9.1 The NN NPS sets out the requirements in paragraph 5.189 where a development is subject to EIA and significant noise impacts are likely to arise from the proposed development. The requirements are listed in Table 14-34 along with the Schemes response.

Table 14-34 National Road and Rail Networks: National Policy Statement application requirements in terms of noise and vibration

NN NPS	Scheme response
A description of the noise sources including likely usage in terms of number of movements, fleet mix and diurnal pattern. For any associated fixed structures, such as ventilation fans for tunnels, information about the noise sources including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise.	The operation road traffic noise assessment has been based upon the most likely mix of light vehicles and heavy goods vehicles based over an 18 hour period during the daytime and 8 hours during the night. A description of likely noise sources has been provided in the construction noise assessment and ventilation noise assessment. The assessment of any tonal or impulsive characteristics from the tunnel ventilation has been taken into account in accordance with British Standard 4142 *'Methods for rating and assessing industrial and commercial sound'.*
Identification of noise sensitive premises and noise sensitive areas	Noise sensitive premises and areas have been identified with the detailed study

NN NPS	Scheme response
that may be affected.	area and are presented in Drawing 14-4.
The characteristics of the existing noise environment.	Noise surveys during the daytime and night time have been undertaken at 14 locations within 1km of the Scheme to understand the existing noise environment and are detailed in section 14.4
A prediction on how the noise environment will change with the proposed development in the shorter term such as during the construction period	Short term noise impacts from construction have been considered in accordance with British Standard 5228. The assessment has also considered short term impacts from the operation of the Scheme in the opening year.
A prediction on how the noise environment will change with the proposed development in the longer term during the operating life of the infrastructure;	The assessment has considered long term operational noise impacts by assessing future road traffic noise fifteen years after opening in section 14.6
A prediction on how the noise environment will change with the proposed development at particular times of the day, evening and night as appropriate.	Noise impacts during the night time have been assessed for construction, operational road traffic noise and tunnel ventilation noise in section 14.6
An assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas.	The noise and vibration assessment has predicted changes in noise level at identified sensitive receptors in the opening year of the Scheme and 15 years after opening in accordance with DMRB in section 14.6
Measures to be employed in mitigating the effects of noise.	Mitigation measures for the Scheme have been recommended in section 14.5
Applicants should consider using best available techniques to reduce noise impacts.	The mitigation measure suggested in section 14.5 for both construction and operation have considered best available techniques to reduce noise impacts to a minimum
The nature and extent of the noise assessment should be proportionate to the likely noise impact.	The assessment has been undertaken using DMRB guidance and relevant British Standards and is considered

NN NPS	Scheme response
	proportionate to the likely noise impact of the Scheme

14.9.2 In terms decision making NN NPS and the Noise Policy for England (NPSE) share the following common themes:

- avoid significant adverse impacts on health and quality of life from noise as a result of the new development;
- mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and
- contribute to improvements to health and quality of life through the effective management and control of noise, where possible.

<u>Avoid significant adverse impacts on health and quality of life from noise as a result of the new development</u>

14.9.3 Throughout the construction period mitigation methods described in Section 14.5 would be implemented in order to avoid significant adverse health impacts. Strict adherence to the Construction Environmental Management Plan (CEMP) would ensure that no significant adverse impacts on health and quality of life would arise.

14.9.4 Through the use of mitigation adverse road traffic noise impacts as a direct result of the Scheme would be considered using the worst case adverse change as moderate. The Scheme would result in more residential dwellings experiencing a decrease in road traffic noise level than without it.

14.9.5 Significant effects from the operation of the tunnel ventilation system would be negligible through the use of intelligent design to ensure that the noise emissions including any penalties for tonality or unusual characteristics would be below existing background noise levels.

<u>Mitigate and minimise other adverse impacts on health and quality of life from noise from the new development</u>

14.9.6 Noise impacts from the construction phase of the Scheme will be mitigated to a minimum through the use of best available techniques and implementation of the measures set out in a CEMP.

14.9.7 Where possible noise mitigation measures such as low noise surfacing and noise barriers have been incorporated into the Schemes design to minimise noise impacts as a direct result of the Scheme.

14.9.8 Design considerations for the tunnel ventilation system have also been implemented to minimise noise impacts.

Contribute to improvements to health and quality of life through the effective management and control of noise, where possible

14.9.9 In terms of contributing to health and quality of life the implementation of the Scheme would result in more residential dwelling being below SOAEL in the future design year than without it.

14.10 Summary

14.10.1 A tabular summary of the significance of overall noise and vibration impacts is provided in the Table 14-35.

Table 14-35 Noise and Vibration - impact summary table

Impact description	Temporary/Permanent	Significance of effect
Construction Noise	Temporary	Slight Adverse
Construction Piling (rotary boring)	Temporary	Negligible
Construction Piling (percussive)	Temporary	Slight Adverse
Construction TBM - Noise	Temporary	Negligible
Construction TBM - Vibration	Temporary	Negligible
Short Term Road Traffic Noise Impacts	Permanent	Slight/Moderate Adverse
Long Term Road Traffic Noise Impacts	Permanent	Slight/Moderate Adverse
Tunnel Ventilation Noise Impact	Permanent	Negligible

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