12 NOISE

12.1 Introduction

12.1.1 This Chapter has been prepared by Brookbanks Consultants Ltd to present the findings of an assessment of the effects of the Proposed Development on noise and vibration during both the construction and post-completion stages.

12.1.2 Environmental noise rarely reaches the sound pressure levels associated with hearing impairment. However, noise can cause annoyance; it is commonly blamed for sleep disturbance and has been linked by researchers to less obvious effects, such as cardiovascular and mental health problems and reduced performance at work or school.

12.1.3 Human subjects, under laboratory conditions, are generally only capable of noticing changes in steady noise levels of no less than 3 dB(A).

12.1.4 The Proposed Development has the potential for noise impacts associated with operational traffic; and also during the construction phase.

12.1.5 The following sections outline the site conditions and assess the appropriateness of the site for the Proposed Development in accordance with local and national guidance.

Noise Terminology

12.1.6 The scale used to identify noise sources is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ear recognises sound based on pitch and frequencies. Microphones cannot record noise in the same way, so to counter the noise-measuring instrument applies a correction to correspond more closely to the frequency response of the ear. The correction factor is called “A Weighting” and the resulting measurements are written as dB(A). Typical dB(A) noise levels for familiar noise are indicated below.

Table 12.1 Familiar Noise Levels (dB(A))

Approximate Noise Level	Noise Example
10	Normal breathing
20	Rustling leaves, mosquito
30	Whisper
40	Stream, refrigerator humming
50	Quiet office
60	Normal conversation
70	In car noise without radio
80	Vacuum cleaner / washing machine
90	Lawnmower
100	Train
110	Pneumatic Drill
120	Thunder
130	Plane taking off
140	Threshold of pain

12.1.7 The noise levels indicated above are sound pressure levels (SPL) and describe the noise level at a single point in space. Noise levels at a receptor vary over time depending on the occurring noise generating activities. The following indices are used to take into account noise level variation over time:

- LAeq T is the equivalent continuous sound level and is the sound level over the time period (T). It is possible to consider this level as the ambient noise encompassing all noise at a given time. LAeq T is considered the best general purpose index for environmental noise;
- LA90 T represents the noise level exceeded for 90% of the measurement period and is used to indicate quieter times during the measurement period. It is usually referred to as the background noise level;
- LA10 T refers to the level exceeded for 10% of the measurement period. LA10 T is widely used as a descriptor of traffic noise; and
- LAmax is maximum recorded noise level during the measurement period.

12.2 Scope and methodology

12.2.1 A wider study to assess the impact within the local road network is based on the Calculation of Road Traffic Noise (CRTN) procedures and has been based on the study area adopted within the Transport Assessment (ES Volume 2) which identifies the roads experiencing the highest increase in flows.

12.2.2 An assessment against BS8233 will be provided in order to confirm the internal and external noise environment.

Significance Criteria

12.2.3 The format of this section of the ES follows a standard study pattern, by setting out an appraisal of the baseline conditions, followed by a description of the Proposed Development features and an identification of the potential environmental effects due to the Proposed Development. The importance of each mechanism and an assessment of each potential effect are then considered along with any mitigation measures and recommendations for further investigations where necessary.

12.2.4 Methods of assessment have been employed that are consistent with current guidance and recommendations in the form of statutory documents and recognised publications to ensure that the findings represent a robust approach to the Assessment.

12.2.5 The criteria for determining the sensitivity of receptors is provided in Table 12.2 below.

Table 12.2 Description of Sensitivity Rating

Sensitivity	Descriptors
Very High	Internationally or nationally protected endangered species which is also known to be noise sensitive (i.e. noise may change breeding habits or threaten species in some other way)
High	Dwellings, habitats supporting locally important wildlife communities that are sensitive to noise
Medium	Schools, hospitals, quiet recreation areas
Low	Officers, cafes/bars with external areas
Negligible	Industrial, retail

12.2.6 The DMRB Volume 11, Section 3, Part 7: Environmental Assessment Procedure is used for the assessment of operational noise impacts for road schemes and gives guidance on the magnitude of impact from noise changes upon the local environment. The significance of predicted increases in road traffic noise as a result of the Proposed Development has been assessed according to the criteria described below.

12.2.7 The tables below outline the criteria for determining the magnitude in relation to changes in traffic noise, with short term relating to the first occupation of the development with longer term relating to 10 years after opening.

Table 12.3 Magnitude of impact - short term

Magnitude	Change in traffic noise (dB)
Major	5 +
Moderate	3 – 4.9
Minor	1 – 2.9
Negligible	0.1 – 0.9

Table 12.4 Magnitude of impact – long term

Magnitude	Change in traffic noise (dB)
Major	10 +
Moderate	5 – 9.9
Minor	3 – 4.9
Negligible	0.1 – 2.9

12.2.8 BS5228: 'Code of Practice for noise and vibration control on construction and open sites' is the methodology for the prediction of construction noise, and control of noise and vibration. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the addition of construction noise for the purposes of the Proposed Development. This significance can be assessed using the criteria below.

Table 12.5 Magnitude of effect

Magnitude	Change in traffic noise (dB)
Major	5 +
Moderate	0.1 – 4.9

12.2.9 For operational effects, the sensitivity of the receptor and the magnitude of the impact have been combined using the matrix below to determine the significance of the effect. Where the matrix offers more than one significance option, professional judgement has been used to decide which option is most appropriate.

Table 12.6 Assessment Matrix

	Magnitude of Impact			
Sensitivity	**Negligible**	**Negligible**	**Moderate**	**Major**
Negligible	Negligible	Negligible or Minor	Negligible or Minor	Minor
Negligible	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Moderate	Negligible or Minor	Minor	Moderate	Moderate or Major
Major	Minor	Minor or Moderate	Moderate or Major	Major

12.2.10 The terms in Table 12.6 have the following definitions:

- Substantial: Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category;
- Major: These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process;
- Moderate: These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor;
- Minor: These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project; and
- Negligible: No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

12.2.11 Effects of moderate, major or substantial significance represent effects considered to be significant in terms of the EIA guidance.

12.3 Consultation undertaken

12.3.1 During the development of this chapter the following statutory bodies and interested parties have been consulted regarding the proposals:

- Environmental Health Officer: Suffolk Coastal District Council

12.3.2 This included the agreement that the BS8233:2014, being based on the CRTN, is the most appropriate method to assess the noise environment.

12.3.3 Through the discussions with the Environmental Health Officer, it has been agreed that a noise survey is required for the site.

12.4 Statutory and planning context

The Control of Pollution Act 1974

12.4.1 The Control of Pollution Act 1974 section 62 and 63 contains powers for local authorities to deal with noise and vibration from construction and demolition-sites.

The Planning and Compulsory Purchase Act 2004

12.4.2 The Planning and Compulsory Purchase Act 2004 requires local authorities to draw up local development plans. Setting the broad framework for acceptable development in their area and reconciling the conflicts inherent in development.

12.4.3 Under the Town and Country Planning Act 1990, local planning authorities may include planning conditions to Planning Consents which could include controls on the emission of noise.

National Planning Policy Framework

12.4.4 The National Planning Policy Framework ("NPPF") published in March 2012 sets out the Government's National Planning Policies for England and how these can be applied in plan-making and decision-taking. Current planning law requires Local Authorities to determine planning applications in accordance with the local development plan unless there are material considerations which require them to reach a different decision.

12.4.5 Paragraph 123 of NPPF indicates that planning policies and decisions should aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and 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.

Noise Policy Statement for England

12.4.6 The Noise Policy Statement for England (Defra 2010) provides a more overarching policy statement on the approach to noise in England. The NPSE provides guidance on the management of noise from sustainable development without placing unreasonable cost or time restraints on sustainable developments.

12.4.7 This Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy, 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.'

12.4.8 The NPSE indicates that noise should not be considered in isolation to the wider benefits of a proposal. The intention is to minimise noise impacts as far as is reasonably practicable. NSPE defines three Noise Policy Aims:

- Avoid significant adverse impact on health and quality of life;
- Mitigate and minimise adverse impacts on health and quality of life; and
- Where possible, contribute to the improvement of health and quality of life.

12.4.9 The explanatory note of NPSE defines the following terms:

- 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 occur.

12.4.10 The NPSE does not provide a numerical value for the SOAEL, stating at paragraph 2.22:

- "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."

12.4.11 The first aim of the NPSE is:

- "Avoid significant adverse impact on health and quality of life"

12.4.12 To meet the first aim of the NPSE the resultant noise levels as a result of the Proposed Development should be below the Significant Observed Adverse Effect Level (SOAEL) at the noise sensitive properties.

12.4.13 The second aim of the NPSE is:

- "Mitigate and minimise adverse impacts on health and quality of life"

12.4.14 To meet the second aim of the NPSE the resultant noise levels as a result of the Proposed Development should be below the Significant Observed Adverse Effect Level (SOAEL) but can be above the Lowest Observed Adverse Effect Level (LOAEL) at the nearest noise sensitive properties.

12.4.15 The third aim of the NPSE is where possible, the noise levels as a result of the Proposed Development at the nearest residential property should be lower than the existing noise levels improving the noise climate for the local community.

Planning Practice Guidance

12.4.16 In March 2014 Planning Practice Guidance (PPG) was published. The section entitled "Noise" provides the following general advice and relates to paragraph 123 of the NPPF.

12.4.17 The main objectives are to:

- avoid noise from giving rise to significant adverse impacts4 on health and quality of life as a result of new development.
- mitigate and 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.
- 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.

12.4.18 A summary of the effects of noise exposure associated with both noise generating developments and noise sensitive developments is presented within the PPG as indicated below.

Table 12.7 Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid

Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

12.4.19 The guidance identifies that the subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation. These factors include:

- The source and absolute level of the noise together with the time of day it occurs;
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise; and
- The spectral content of the noise (i.e. whether or not the noise contains particular high or low frequency content) and the general character of the noise.

12.4.20 More specific factors to consider when relevant:

- Where applicable, the cumulative impacts of more than one source should be taken into account;
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows; and
- If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed.

12.4.21 In relation to how noise can be mitigated, this is dependent on the type of development being considered and the character of the proposed location. In general, for noise making developments, there are four broad types of mitigation:

- Engineering: reducing the noise generated at source and/or containing the noise generated;
- Layout: where possible, optimising the distance between the source and noise-sensitive receptors and/or incorporating good design to minimise noise transmission through the use of screening by natural or purpose built barriers, or other buildings;
- Using planning conditions/obligations to restrict activities allowed on the site at certain times and/or specifying permissible noise levels differentiating as appropriate between different times of day, such as evenings and late at night; and
- Mitigating the impact on areas likely to be affected by noise including through noise insulation when the impact is on a building.

12.4.22 There are further considerations relating to mitigation of noise on residential developments. The noise impact may be partially off-set if the residents of those dwellings have access to:

- A relatively quiet facade (containing windows to habitable rooms) as part of their dwelling, and/or;
- A relatively quiet external amenity space for their sole use or a relatively quiet, protected, nearby external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings; and

- A relatively quiet, protected, external publically accessible amenity space (e.g. a public park or a local green space designated because of its tranquillity) that is nearby (e.g. within a 5 minutes walking distance).

Application of the Noise Policy Statement for England (Defra)

12.4.23 For the purposes of this assessment, the recommended noise levels have been defined as follows:

External Noise (Daytime)

- NOEL: noise levels less than 50 dB;
- LOAEL: noise levels between the 50 dB and 55 dB; and
- SOAEL: noise levels above the upper 55 dB.

Internal Noise (Night-time)

- NOEL: noise levels less than 30 dB;
- LOAEL: noise levels between the 30 dB and 35 dB; and
- SOAEL: noise levels above the upper 35 dB.

British Standard 8233:2014: Sound Insulation and Noise Reduction for Buildings

12.4.24 BS8233:2014 gives recommendations for the control of noise in and around buildings and suggests appropriate criteria and internal noise limits for habitable rooms of residential dwellings.

12.4.25 The standard goes on to provide details of the approach to be taken when assessing the design in terms of planning:

- Assess the site, identify significant existing and potential noise sources, measure or estimate noise levels and evaluate layout options;
- Determine design noise levels for spaces in and around the buildings;
- Determine sound insulation of the building envelope, including the ventilation strategy;
- Identify internal sound insulation requirements;
- Identify and design appropriate noise control measures; and
- Establish quality control and ensure good workmanship.

12.4.26 In accordance with the requirements of BS8233:2014, the following internal and daytime noise limits will need to be met within sensitive rooms of the residential dwellings:

Table 12.8 Noise BS8233 recommended noise levels

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35dB $LA_{eq\ (16\ hour)}$	-
Dining	Dining room	40dB $LA_{eq\ (16\ hour)}$	-
Sleeping / Daytime resting	Bedroom	35dB $LA_{eq\ (16\ hour)}$	30dB $LA_{eq\ (8\ hour)}$
External Amenity Space	Gardens	55dB $LA_{eq,\ T}$	-

12.4.27 In considering the application of the outdoor criteria, it is important to take account of the feasibility of achieving such a level. A review of 'Health effect-based noise assessment methods: A review and feasibility study' (National Physics Laboratory report CMAM16 HMSO) reported the following:

- "Perhaps the main weakness is that they fail to consider the practicality of actually being able to achieve any of the stated values. From the recent national survey of noise exposure carried out in England and Wales that around 56% of the population are exposed to daytime noise levels receding 55dB. The percentage exposed above the guideline values could not be significantly reduced without drastic action to virtually eliminate road traffic noise from the vicinity of houses. The social and economic consequences of such action would be likely to be far greater than any environmental advantages of reducing the proportion of the population annoyed by noise. There is no evidence that anything other than a small minority of the population expose at such noise levels find them to be particularly onerous in the context of their daily lives."

12.4.28 Due to the difficulty in satisfying the external criteria, the BS provides an over-arching consideration of how to treat outdoor areas:

- "However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."

Calculation of Road Traffic Noise

12.4.29 Road traffic noise levels are typically measures and predicted in units of LA10 (18 hour) dB in accordance to Calculation of Road Traffic Noise (CRTN). The LA10 is the A-weighted sound level in decibels exceeded for 10% of the measurement period, which in this case is between 06:00 and 24:00. The noise index has been shown to correlate best with people's annoyance due to road traffic noise. LA10 noise levels measured over any three hours between 10:00 to 17:00 are typically 1 dB (A) higher than the LA10 over the 18 hour period (CRTN paragraph 43).

British Standard 5228: Code of Practice for Noise and Vibration Control on Construction and Open Sites

12.4.30 BS5228: 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' (British Standards Institution 2009, as amended) sets out the methodology to predict construction noise and the control of noise and vibration. It provides guidance on methods of predicting and measuring noise and assessing its impact on those exposed to it, and also recommendations for basic methods of vibration control.

12.4.31 At this stage, the detailed means of construction, including matters such as the actual plant and equipment to be used, is not known. Such matters can be controlled through the use of appropriate conditions on any planning consent. The lack of detail at this stage means that the assessment of construction effects can only be qualitative, but nonetheless the detail available is sufficient to demonstrate that the construction phase can proceed without undue or significant adverse effects on the surrounding community.

12.4.32 Annex B in BS5228-2:2009 sets out guidance on effects of vibration levels of construction noise. Receptors to vibration have been identified as heritage sites such as nearby listed buildings and other noise sensitive receptors.

12.4.33 Human beings are very sensitive to vibration, BS5228-2:2009 suggesting that the threshold of perception typically being in the peak particle velocity (PPV) range of 0.14mm/s to 0.3mm/s. Vibration above these levels can disturb, startle, cause annoyance or interfere with work activities. Vibration nuisance is often associated with the assumption that if vibration can be felt then damage is inevitable. However, considerably greater levels of vibration are required to cause damage to buildings and structures.

12.4.34 The standard provides guidance for identifying the significance of noise and vibration levels from surface construction activity. Significance can be considered in relation to fixed limits for noise and vibration, or alternatively in considering the potential change in the ambient noise level with the addition of construction noise.

12.4.35 There are no national noise criteria for limiting noise from construction-sites. BS 5228 Annex E gives guidance on the significance of noise effects from construction and recommends the ABC method to establish construction noise limits.

12.4.36 The ABC method involves rounding the existing ambient noise levels to the nearest 5 dB for the appropriate time period 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.

Building Bulletin 93: Acoustic Design of Schools

12.4.37 BB93 provides guidance on external and internal noise levels to be achieved at school development sites. The BB93 identifies that the following daytime noise levels should be achieved:

- An upper limit of 60db LAeq (30 minutes) at the boundary of external premises for teaching and recreation;
- 55 db LAeq (30 minutes) in unoccupied playgrounds, playing fields and other outdoor areas;
- 50 db LAeq (30 minutes) in at least one area of the unoccupied playgrounds, playing fields and other outdoor areas, to ensure suitable noise levels for outdoor teaching; and
- Indoor ambient noise limits in schools between 30 and 40 db LAeq (30 minutes) depending on the use of the room.

12.4.38 The most dominant noise source which could affect the primary school is traffic related. The application is submitted in outline with all matters reserved. The precise location of the school building will be subject to future reserved matters applications.

12.5 Existing environment

12.5.1 Noise measurements have been carried out on the adjacent roads forming the site boundary. The results have been used to validate the 3D noise mapping produced by SoundPLAN. Daytime and night time noise levels have been monitored over a 24 hour period.

12.5.2 All noise measurements have been undertaken by an experienced consultant competent in environmental noise monitoring, and, in accordance with the principles of BS 7445: 2003: Description and measurement of environmental noise.

12.5.3 All acoustic measurement equipment used during the noise surveys conformed to Type 1 specification of British Standard 61672: 2003: Electroacoustics, Part 1 Specifications. A full inventory of the equipment is shown below:

Table 12.9 Noise Monitoring Equipment Inventory

Equipment	Manufacturer and Type	Serial Number	Calibration Certificate
Sound Level Meter	Norsonic 118	28952	08074
Sound Level Meter	Norsonic 118	30559	5280
Acoustic Calibrator	Norsonic 1251	32856	5279

12.5.4 The noise measurement equipment used during the daytime survey was calibrated at the start and end of the measurement period. No significant drift in calibration was found to have occurred on the sound level meter.

12.5.5 Traffic noise was identified as the predominant noise source, with no other significant noise events recorded. The results of the survey are indicated below.

Table 12.9 Noise Monitoring Positions

Table 12.10 Noise Monitoring Results – Position 1

Measurement	Daytime	Hour Ending / Period	Night Time	Hour Ending / Period
Minimum dB $L_{Aeq\ 1hr}$	58	22:00	42	03:00
Minimum dB $L_{Aeq\ 1hr}$	70	09:00	63	07:00
Average dB $L_{Aeq\ 16hr\ /\ 8hr}$	66	07:00 to 23:00	56	23:00 to 07:00

Table 12.11 Noise Monitoring Results – Position 2

Measurement	Daytime	Hour Ending / Period	Night Time	Hour Ending / Period
Minimum dB $L_{Aeq\ 1hr}$	58	23:00	47	03:00
Minimum dB $L_{Aeq\ 1hr}$	66	09:00	62	07:00
Average dB $L_{Aeq\ 16hr\ /\ 8hr}$	63	07:00 to 23:00	56	23:00 to 07:00

Table 12.12 Noise Monitoring Results – Position 3

Measurement	Daytime	Hour Ending / Period	Night Time	Hour Ending / Period
Minimum dB $L_{Aeq\ 1hr}$	60	23:00	46	03:00
Minimum dB $L_{Aeq\ 1hr}$	69	09:00	64	07:00
Average dB $L_{Aeq\ 16hr\ /\ 8hr}$	67	07:00 to 23:00	57	23:00 to 07:00

Table 12.13 Noise Monitoring Results – Position 4

Measurement	Daytime	Hour Ending / Period	Night Time	Hour Ending / Period
Minimum dB $L_{Aeq\ 1hr}$	50	23:00	33	03:00
Minimum dB $L_{Aeq\ 1hr}$	58	09:00	54	07:00
Average dB $L_{Aeq\ 16hr\ /\ 8hr}$	57	07:00 to 23:00	46	23:00 to 07:00

12.6 Predicted impacts

Assessment of Construction Effects

12.6.1 During the construction stage, it is envisaged that limited demolition, earthworks, installation of necessary services and building construction would create the main noise impacts upon existing residential properties in the environs of the site.

12.6.2 At the time of writing, it is considered that the impact of construction traffic would be negligible. The site is accessed from the A12 Dual Carriageway and Ipswich Road. The temporary increase in traffic due to construction is likely to be indiscernible from daily variations in traffic flow. Further details regarding the levels of construction traffic are provided in the Transport Chapter.

12.6.3 Although the final details of the construction activities cannot be confirmed until contractors are appointed, construction noise levels have been predicted using the sound pressure levels for typical construction plant as described in BS 5228: 2009 Part 1. The sound pressure levels in BS 5228 have been presented as a LAeq at a distance of 10 m. A high percentage for the 'on-time' (the length of time that the equipment remains active on-site) has been assumed so as to present a reasonable worst case.

Table 12.14 Plant Description and Prevailing Noise Level on-site

Plant Description	BS5228 Reference	Sound level at 10m	On time %
Angle Grinder	Table C4 No. 93	80	40
Asphalt Paver	Table C5 No. 33	75	60
Circular Saw	Table C4 No. 72	79	40
Compressor	Table C5 No. 5	75	80
Concrete Pump & Concrete mixer truck discharging	Table C4 No. 28	79	80
Concrete Saw	Table C4 No. 71	85	10
Delivery Lorry	Table C2 No. 35	80	70
Diesel Generator	Table C4 No. 84	74	100
Dozer	Table C5 No. 12	77	60
Dumpers	Table C4 No. 9	77	60
Excavator	Table C5 No. 34	82	75
Percussion Drill	Table C4 No. 69	85	40
Pneumatic Breaker	Table D2 No.2	81	40
Poker Vibrator	Table C4 No. 33	78	80
Road Planer	Table C5 No. 7	82	70
Roller Compactor	Table C5 No. 29	76	60
Telescopic Handler	Table C4 No. 54	79	75
Tower Crane	Table C4 No. 49	77	60
Tracked Excavator	Table C5 No. 18	80	70
Tracked Excavator fitted with Breaker	Table D2 No. 5	91	70
Tracked Mobile Crane	Table C4 No. 52	75	60
Vibratory Roller (22t)	Table C5 No. 28	77	60
Water Pump	Table C2 No. 45	65	75
Welder	Table C3 No. 31	73	40
Wheeled Loader	Table C2 No. 26	79	75

12.6.4 The on-time correction factor has been extracted from Figure F5 within BS5288.

12.6.5 The construction noise impacts have been calculated using the following formula as described in BS5228:

$$k_h = 20 \times LOG \frac{R}{r}$$

Where:

Kh = the correction for propagation across hard ground

R = the distance to the receptor location

r = the distance of 10 m at which the SPL has been measured

12.6.6 Where more than one piece of the same equipment is used in a construction activity, the following equation has been used to determine the total noise level generated:

Combined noise level = x + 10*log10(N)

Where

x = noise level from a single piece

N = the number of items of equipment used

12.6.7 To calculate the combined noise level for a construction process the following equation has been used to combine the noise levels from the individual construction plant:

Combined event= 10*log10(10 L1/10 + 10 L2/10 + 10 L3/10 + …..10 Ln/10)

Where L1 = individual noise event

12.6.8 A reasonable worst case scenario has been presented by considering propagation across hard ground and by not considering screening provided by topographical features, buildings or other structures.

12.6.9 The potential noise impacts during the construction stage are presented below.

Table 12.15 Site Mobilization Noise Levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Delivery Lorry	1	78.5	72.5	64.5	58.5	52.5
Tracked Mobile Crane	1	73.0	67.0	59.0	53.0	47.0
Telescopic Handler	1	78.0	72.0	64.0	58.0	52.0
Wheeled loader	1	77.5	71.5	63.5	57.5	51.5
Dozer	1	75.0	69.0	61.0	55.0	49.0
Dumpers	2	78.0	72.0	63.0	58.0	52.0
Diesel generator	1	74.0	68.0	60.0	54.0	48.0
Total		85.2	79.2	71.0	65.2	59.2

Table 12.16 Road Construction Noise levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Road Planer	1	80.5	74.5	66.5	60.5	54.5
Tracked Excavator	1	78.5	72.5	64.5	58.5	52.5
Dozer (Spreading fill)	1	75.0	69.0	61.0	55.0	49.0
Dumpers	2	78.0	72.0	63.0	58.0	52.0
Vibratory Roller (22t)	1	75.0	69.0	61.0	55.0	49.0
Asphalt Paver	1	73.0	67.0	59.0	53.0	47.0
Diesel Generator	1	74.0	68.0	60.0	54.0	48.0
Total		85.5	79.5	71.3	65.5	59.5

Table 12.17 Building Construction Noise Levels

Plant	Number	Noise level at 10m	Noise level at 20m	Noise level at 50m	Noise level at 100m	Noise level at 200m
Tracked Excavator	1	78.5	72.5	64.5	58.5	52.5
Diesel Generator	1	74.0	68.0	60.0	54.0	48.0
Dumpers	1	75.0	69.0	61.0	55.0	49.0
Telescopic Handler	1	78.0	72.0	64.0	58.0	52.0
Concrete Pump &	1	78.0	72.0	64.0	58.0	52.0

Concrete mixer truck discharging						
Poker Vibrator	2	80.0	74.0	66.0	60.0	54.0
Compressor	2	77.0	71.0	63.0	57.0	51.0
Total		86.1	80.1	72.1	66.1	60.1

12.6.1 Construction activities can produce high noise levels, particularly close to source. Construction noise tends to fluctuate and is usually of fairly short duration related to particular activities. The construction noise impacts would depend on the proximity of construction activities to nearby receptor locations.

12.6.2 The demolition and construction noise impacts predicted above indicate that the impacts could be observed by sensitive receptors within 200m of the site. The predicted noise levels are based on a possible worst case scenario. Propagation across hard ground has been assumed and no screening from topographical features or other structures has been assumed.

12.6.3 The majority of existing residential dwellings lie over 200m from the site, meaning the highest value identified for noise levels at 200m (maximum) would be 64.3 dB, which is below the Category A threshold (ABC method) of 65 dB.

12.6.4 As set out in the Mitigation section, where necessary for the small number of dwellings affected, construction plant would be located, as far as reasonably practicable, away from adjacent occupied buildings or as close as possible to noise barriers or site hoardings located between the plant and the buildings. Such measures to control construction noise would be implemented through the BS 5228 Code of Practice for Noise and Vibration Control on Construction and Open Sites, which would also minimise operations during sensitive time periods.

12.6.5 Therefore, given the nature of the construction activities, it is not anticipated that the significance thresholds would be exceeded for long periods of time. Overall, it is considered that the magnitude of the noise impact in relation to the closest receptors would be low and at most would have a negligible effect.

Operational Noise Impacts – NPPF/ PPG 24 Noise Assessment

12.6.6 The BS 8233 boundaries for the existing situation were modelled initially. This indicated a close relationship between the modelled noise levels and those recorded through the noise survey.

12.6.7 Noise level prediction of the existing situation has been completed using the computer modelling software SoundPLAN. The noise model incorporated accurate ground level information including all relevant site features. The BS8233 boundaries for the baseline scenario were modelled for the day time and night time traffic flows initially.

12.6.8 To ensure that the future year models are reflective of the future year scenarios, the base line model was calibrated against the 24 hour noise levels recorded across the site during the monitoring.

12.6.9 The results of the sound modelling survey compared to the results of the SoundPLAN noise map are shown below.

12.18 Calibration of noise model

Position	Modelled Daytime LAeq 16hr	Predicted Daytime LAeq 16hr	Modelled Night time LAeq 8hr	Predicted Night time LAeq 8hr
1	66	65	56	56
2	63	64	56	55
3	67	67	57	58
4	57	56	46	53

12.6.10 The resultant daytime noise contours indicate that the majority of the site falls within the requirements of BS 8233.

12.6.11 A difference of up to 3dB between the actual and modelled noise levels is considered an acceptable variation in results, as human subjects, under laboratory conditions, are generally not capable of noticing changes in steady noise levels of less than 3 dB(A).

12.6.12 While there is an anomaly of a 7dB difference in the night-time results at Monitoring Point 4 adjacent to Ipswich Road, the results for daytime noise monitoring are similar. This is attributable to Soundplan assuming a constant flow of traffic along Ipswich Road in calculating an average noise level during the periods. In reality, due to Ipswich Road being a lightly trafficked road at night-time, traffic noise may have been lower than the model predicted. Therefore this means that there might be variation in the results.

12.6.13 Table 12.19 demonstrates a close relationship between the SoundPLAN model and the current 24 hour recorded noise levels across the site. However, this could be a result of less traffic than predicted on the day. This difference in noise level has not been considered as a significant concern due to the many other modelled levels falling in line with the actual recordings. Therefore the SoundPLAN model is sufficiently reflective of the actual noise environment and suitable to use in modelling future scenarios.

12.6.14 The SoundPLAN models to predict the future noise environment across the site are based on the calibrated base line model. The future year traffic flows have been based on a Paramics transport model produced by Vectos on behalf of BCL which includes the future committed developments and the Proposed Development.

12.6.15 At the time of writing, an Illustrative Framework Masterplan has been used to assess the impact of the introduction of the development on the noise environment. The potential location of the residential units has been considered. This indicates that the site falls predominantly within the requirements of BS 8233.

12.6.16 Through the site assessment presented here, it has been identified that noise screening from road traffic noise generated by the A12 Dual Carriageway will be required. This could take the form of a 5m high solid earth bund or a combination of a bund together with an acoustic barrier.

12.6.17 It has also been identified that noise screening from road traffic noise generated by the Ipswich Road will be required to protect the school playing fields. This could take the form of an 2m high solid earth bund or an acoustic barrier

12.6.18 However, opening windows for ventilation purposes would reduce the insulation provided by the building façade and may cause internal design standards to be exceeded. Therefore, if it is considered necessary to satisfy internal noise standards with a degree of ventilation, mitigation measures may be required to enable occupiers to obtain ventilation with windows closed. This can be achieved through the use of 'trickle' vents within the window frames.

12.6.19 The layout of the project and the internal arrangements of properties will be subject to further detailed design. Before the consideration of double glazing and trickle vents, priority would be given to the internal layout of the properties such that sensitive areas, i.e. bedrooms, are located to avoid facing onto the primary routes directly and consideration would be given to orientating buildings to minimise windows that face onto the noise source.

12.6.20 As set out above, these measures would be adopted as part of the project, together with noise screening along the eastern site boundary (discussed further below).

BS:8233 Assessment of Day Time Noise Levels in Living Rooms

12.6.21 BS8233 indicates that a daytime internal noise level of 30 dB LAeq represents the desirable noise standard. The calculated noise levels have been used to determine likely noise levels at the worst case locations (the A12 Dual Carriageway and Ipswich Road).

12.6.22 However, opening windows for ventilation purposes would reduce the insulation provided by the building façade and may cause internal design standards to be exceeded. However, an open window will still provide noise attenuation, with attenuation of 10-15dB will be delivered.

12.6.23 Trickle vents are widely used as a suitable ventilation method throughout the industry. The introduction of trickle vents has the potential for additional noise leakage. It is considered that this could lead to a difference of between 1dB and 2dB close to trickle vents, however, human subjects, under laboratory conditions, are generally only capable of noticing changes in steady noise levels of more than 3dB. Therefore the impacts of the trickle vents are considered negligible.

12.6.24 The layout of the development and internal arrangements of properties will be subject to further detailed design. Consideration should be given to the internal layout of the properties such that sensitive locations i.e. bedrooms, are located to avoid facing onto the A12 Dual Carriageway and Ipswich Road directly and finally consideration should be given to orientating buildings to minimise windows that face onto the noise source.

12.6.25 The Illustrative Framework Masterplan indicates how the development could be delivered, although details of development zones and the precise location of dwellings will be determined at the reserved matters stage. Therefore, typical housing locations representing the worst cases have been selected. These locations have considered the noise levels of dwellings situated adjacent to the A12 Dual Carriageway and Ipswich Road, before and after the addition of a noise bund (further details on the noise bund have been provided within the External Noise Standards section).

12.6.26 The worst case locations adjacent to the remaining highways have also been considered, although no additional noise bunds are necessary along these highways.

A12 Dual Carriageway - Day Time Levels

12.6.27 The typical day time façade noise level fronting the A12 Dual Carriageway is 63.4 dB. This noise level reduces to 30.4 dB when taking into account noise reductions through thermal double glazing, therefore indicating that the desired internal noise standard is easily achieved.

Ipswich Road - Day Time Levels

12.6.28 This indicates that the typical day time façade noise level fronting the Ipswich Road is 58.4 dB. This noise level reduces to 25.4 dB when taking into account noise reductions through thermal double glazing, therefore indicating that the desired internal noise standard is easily achieved.

Primary School - Day Time Levels

12.6.29 This indicates that the typical day time façade noise level at the site of the primary school is 50.4 dB. This noise level reduces to 17.4 dB when taking into account noise reductions through thermal double glazing, which achieves the desired internal noise standards.

12.6.30 No additional mitigation measures are considered necessary for these locations.

12.6.31 This indicates that appropriate attenuation can be achievable for all of the properties and school through the use of thermal double glazing, with facades of properties further into the site being protected and screened by other buildings. Orientating properties and consideration of the internal layout to avoid direct sight lines onto the main roads will further mitigate and reduce internal noise sources.

BS:8233 Assessment of Night Time Noise Levels in Bedrooms

12.6.32 BS8233 indicates that a night-time internal noise level of 30 dB LAeq is desired. The calculated noise levels, as previously indicated, have been used to determine likely noise levels at the worst case locations (the A12 Dual Carriageway and Ipswich Road).

A12 Dual Carriageway – Night Time Levels

12.6.33 The typical night time first floor façade noise level fronting the A12 Dual Carriageway is 60.5 dB. This noise level reduces to 27.5 dB when taking into account noise reductions through thermal double glazing, which achieves the desired internal noise standard.

Ipswich Road – Night Time Levels

12.6.34 The typical night time façade noise level fronting Ipswich Road is 58.4 dB. This noise level reduces to 25.4 dB when taking into account noise reductions through thermal double glazing, which achieves the desired internal noise standard.

External Noise Standards

12.6.35 The BS8233 highlight the requirement of managing noise in external living spaces. The agreed average noise limit should not exceed 55dB. As a result of this standard, the day time and night time boundaries have been modelled and contained within Appendix I.

12.6.36 With the site falling so close to the A12 Dual Carriageway, it is anticipated that significant noise mitigation, potentially in the form of an 5m noise barrier, will be required alongside the A12 Dual Carriageway to reduce the impacts of the traffic noise on the proposed dwellings.

12.6.37 A 2m noise barrier is required to mitigate the primary school playing fields adjacent to Ipswich Road.

12.6.38 At the time of writing it is considered that the noise barrier could consist of a combination an acoustic fence located on the top of an earth bund. The proposed housing is likely to be further offset from the base of the bund. The height of the noise barrier may vary across the site depending on the noise environment.

12.6.39 This impact of noise bund has been included within the detailed noise modelling. This shows that the noise levels adjacent to the A12 Dual Carriageway and Ipswich Road can be significantly reduced to an acceptable level. Therefore, indicating that the external noise requirements are achievable.

12.7 Mitigation

Direct and indirect noise and vibration from construction

12.7.1 To minimise the impact on receptors during the construction process, the following generic noise and vibration mitigation measures need to be implemented as appropriate for all works and would be incorporated into the future Construction Environmental Management Plan (CEMP):

- Construction activities should be confined to times of the day when they are least likely to be disturbing;
- Careful selection of plant, construction methods and programming. Only plant conforming with relevant national or international standards, directives and recommendations on noise and vibration emissions should be used;
- Construction plant should be located, as far as is reasonably practicable, away from adjacent occupied buildings or as close as possible to noise barriers or site hoardings where these are located between the plant and the buildings;
- Static and semi-static plant/equipment (e.g. compressors and generators) should be fitted with suitable enclosures where practicable;
- Personnel will be instructed on best practice to reduce noise and vibration as part of their induction training and as required prior to specific work activities;
- When plant is not being used, it should be shut down and not left to idle;
- Methods of work and vehicular routes will be selected with regard to minimising noise and vibration impact; and
- Given the phasing of construction, certain areas of the Proposed Development will be occupied while construction is still underway in adjacent areas. Where possible, the occupancy of completed phases of construction should be planned in such a way that there is a buffer between occupied areas and areas where construction is being carried out.

12.7.2 Given the nature of the construction activities expected on-site, the impact could be significant without mitigation. However the construction noise and vibration impacts can be mitigated effectively through the CEMP.

Direct façade noise levels on the proposed dwellings

12.7.3 Following this initial review of the proposed noise environment across the site, taking into account the future traffic levels, the following noise mitigation measures need to be implemented as appropriate:

- Trickle ventilation systems and double glazing for residential properties fronting onto the A12 Dual Carriageway and Ipswich Road;

- A noise screening barrier of height 5m adjacent to the A12 Dual Carriageway following further noise and viability assessments;
- A noise screening barrier of height 2m adjacent to Ipswich Road following further noise and viability assessments;
- Internal layout of properties to consider the location of lounge and bedroom areas for those properties fronting onto the A12 Dual Carriageway and Ipswich Road;
- Site layout to consider the internal layout of residential buildings to reduce sight lines onto the A12 Dual Carriageway and Ipswich Road;
- Site layout to consider locating houses with habitable in loft space rooms outside the first row of housing adjacent to A12 Dual Carriageway and Ipswich Road; and
- Orientation of buildings along the A12 Dual Carriageway and Ipswich Road to provide noise screening to ensure external noise thresholds can be achieved.

12.7.4 It has been demonstrated through noise modelling that the aforementioned noise mitigation measures will be effective.

12.8 Summary of effects

Residual Effects

12.8.1 The assessments completed above have considered both the proposed land uses and the impact on existing properties within immediate vicinity of the site. As a whole, the assessments do not identify any significant adverse impacts and thus no residual effects are anticipated.

Summary

Table 12.19 Summary Table

Receptor	Mitigation Measures Proposed	Residual Impact
Operational	• Trickle vent ventilation systems and double glazing for residential properties fronting onto the A12 Dual Carriageway and Ipswich Road; • A noise screening barrier of height 5m adjacent to the A12 Dual Carriageway following further noise and viability assessments; • A noise screening barrier of height 2m adjacent to Ipswich Road following further noise and viability assessments; • Internal layout of properties to consider the location of lounge and bedroom areas for those properties fronting onto the A12 Dual Carriageway and Ipswich Road; • Site layout to consider the internal layout of residential buildings to reduce sight lines onto the A12 Dual Carriageway and Ipswich Road; • Site layout to consider locating houses with habitable in loft space rooms outside the first row of housing adjacent to A12 Dual Carriageway and Ipswich Road; and	Negligible

	• Orientation of buildings along the A12 Dual Carriageway and Ipswich Road to provide noise screening to ensure external noise thresholds can be achieved.	
Construction	Application of the CEMP	Negligible

12.9 References

- Highways Agency (2008) Design Manual for Roads and Bridges. London, DFT
- Calculation of Road Traffic Noise, Department of Transport 1988
- Communities and Local Government NPPF (2012)
- British Standard 8233:2014; Sound Insulation and Noise Reduction for Buildings
- British Standard 5228: 'Code of Practice for Noise and Vibration Control on Construction and Open Sites'