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A47/A11 Thickthorn Junction

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6.3 Environmental Statement Appendices
Appendices 11.1 – 11.5

APFP Regulation 5(2)(a)

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Infrastructure Planning

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

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ENVIRONMENTAL STATEMENT APPENDICES
Appendices 11.1 – 11.5

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SCHEDULE OF APPENDICES INCLUDED IN THIS APPLICATION DOCUMENT

Appendix Title	Appendix number (BIM)
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Appendix 11.2 - Legislation and Policy Framework	HE551492-GTY-ENV-000-RP-LA-00002
Appendix 11.3 – Baseline Noise Survey	HE551492-GTY-ENV-000-RP-LA-00002
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Appendix 11.1 - Glossary of terms

Table 11.1.1: Terms and definitions from DMRB LA 111

Term	Definition
Absorptive noise barrier	A noise barrier that has an absorptive lining
Ambient noise	Ambient noise is the total sound in a given situation at a given time usually composed of sound from many sources, near and far.
AAWT	Annual Average Weekday Traffic.
A-weighting	In addition to its non-linear amplitude response, the human ear has a non-linear frequency response; it is less sensitive at low and high frequencies and most sensitive in the mid-range frequencies. NOTE 1: The A-weighting is applied to measured sound pressure levels so that these levels correspond more closely to the subjective response. NOTE 2: A-weighted noise levels are often expressed in dB(A).
Baseline scenario	A description of the state of the environment without implementation of the project.
Basic noise level	The basic noise level (BNL) is a measure of source noise as defined in Appendix A.
Calculation of road traffic noise	The technical memorandum that describes the procedures for calculating noise from road traffic (CRTN).
Construction noise assessment	An assessment which compares predicted noise levels from construction tasks to ambient noise levels at nearby noise sensitive receptors.
Construction vibration assessment	An assessment of magnitude of predicted vibration from construction activities.
Decibel	The unit of measurement used for sound pressure levels and noise levels quoted in decibels (dB). NOTE 1: The decibel scale is logarithmic rather than linear; the threshold of hearing is zero decibels while, at the other extreme, the threshold of pain is about 130 decibels. NOTE 2: These limits are seldom experienced and typical levels lie within the range of 30dB(A) (a quiet night time level in a bedroom) to 90dB(A) (at the kerbside of a busy road).
Diversion route	A set of approved routes to follow in case of closure of motorway / major A-roads.
Do-minimum	Scenario without the project.
Do-something	Scenario with the project.
Environmental Noise Directive quiet area	A location formally designated as a 2002/49/EC (END) quiet area.
Facade sound level	Sound level that is determined 1 metre (m) in front of a window or door in a facade.
Free-field sound level	The sound level, which is measured or calculated, in the open, without any reflections from nearby surfaces except the ground.

Term	Definition
Future year	The 15th year after opening.
Insertion loss	A measure of the effectiveness of noise control devices such as silencers and enclosures. NOTE: The insertion loss of a device is the difference, in dB, between the noise level with and without the device present.
L_{A10}	The A-weighted sound level, in dB, that is exceeded 10% of the measurement period. NOTE: This is the standard index used within the UK to describe traffic noise.
$L_{A10,18hr}$	The noise level, in dB, that is exceeded 10% of the time between 0600 and 2400.
L_{Aeq}	The equivalent continuous sound level (L_{Aeq}) is the level of a notional steady sound, which at a given position and over a defined period of time, would have the same A-weighted acoustic energy as the fluctuating noise.
L_{Amax}	The maximum A-weighted level measured during a given time period.
L_{day}	Equivalent continuous sound pressure level where the time interval is the 12 hour period between 07:00 and 19:00.
$L_{evening}$	Equivalent continuous sound pressure level where the time interval the 4 hour period between 17:00 and 23:00.
L_{night}	For the purpose of night-time noise assessment, the $L_{night,outside}$ is the equivalent continuous sound level $L_{Aeq,8hr}$ for the period 23:00 to 07:00 hours assessed outside a dwelling and is free-field.
Long-term	Noise change based on the +15 year assessment (for example Do-minimum opening year scenario (DMOY) against Do-minimum future year scenario (DMFY) and DMOY against Do-something future year scenario (DSFY).
Lowest observed adverse effect level (LOAEL)	Level above which adverse effects on health and quality of life can be detected.
NIA (Noise Important Area)	Noise Important Areas are areas particularly affected by noise. They are defined in DEFRA's Noise Action Plans as the area where the 1% of the population that are affected by the highest noise levels from major roads are located according to the results of the strategic noise mapping.
Noise	Unwanted sound.
Noise mapping	The production of computer software generated maps showing how the predicted levels of outdoor noise vary with location.
Noise modelling	Software to predict noise levels. NOTE: This can be undertaken either by specialist software to provide a 3D representation of the project and nearby noise sensitive receptors or a simple spreadsheet.
Noise monitoring	Measurement of noise levels.
Noise sensitive receptor	Receptors which are potentially sensitive to noise. NOTE: Examples include dwellings, hospitals, healthcare facilities, education facilities, community facilities, END quiet areas or potential END quiet areas, international and national or statutorily designated sites, public rights of way and cultural heritage assets.

Term	Definition
Non-project noise change	Noise change based on the DMOY against DMFY scenario, with no project implementation.
Opening year	The first year of operation.
Operational noise assessment	An assessment to determine the operational noise impacts and effects of a road project.
Point source attenuation	A source of noise/sound that radiates from a single point, decreasing by 6dB every time the distance between the source and receiver is doubled.
Reflective noise barrier	A noise barrier that reflects noise.
Sensitive buildings	Dwellings, including those that are listed, hospitals, healthcare facilities, education facilities or other buildings where noise or vibration can cause disturbance to people using the buildings.
Short-term	Noise change based on parallel assessment year (for example DMOY against Do-something opening year scenario (DSOY)).
Significant observed adverse effect level (SOAEL)	The level above which significant adverse effects on health and quality of life occur.
Vibration	A to-and-fro motion which oscillates about a fixed equilibrium position.
Vibration sensitive receptor	Receptors which are potentially sensitive to vibration. NOTE: Examples include dwellings, hospitals, healthcare facilities, education facilities, community facilities, buildings containing vibration sensitive equipment and cultural heritage assets.

Appendix 11.2 - Legislation and Policy Framework

National Legislation

Control of Pollution Act 1974

11.2.1. Whilst residents may accept that there would be some disturbance caused to those living in proximity to construction activity, the Control of Pollution Act 1974 offers them protection.

11.2.2. Section 60 of the Act enables a local authority to serve a notice specifying its noise control requirements covering plant or machinery hours of working, and levels of noise that can be emitted.

11.2.3. Section 61 relates to prior consent in which the contractor consults with the local authority and provides an application prior to construction works commencing to obtain approval for the methods to be used and the steps proposed to minimise noise resulting from the works. If the local authority considers that the application contains sufficient information and that “best practicable means” of noise control are being implemented, and if works are being carried out in accordance with the applications, it would not serve a notice under Section 60.

Noise Insulation Regulations 1975 (amended 1988)

11.2.4. The Noise Insulation Regulations 1975 (amended 1988) were made under Part 2 of the Land Compensation Act 1973 for the obligatory and discretionary provision of noise mitigation measures for dwellings adjacent to new highways. Among the criteria for a property to qualify for insulation in living rooms and bedrooms is that the façade noise level is at least 68dB $LA_{10,18h}$ and that noise from the new or altered highways causes the total level to increase by at least 1dB.

National Policy

National Policy Statement for National Networks

11.2.5. The National Policy Statement for National Networks (NPS NN) (2014) sets out the Government’s vision and policy for the future development of the Nationally Significant Infrastructure Projects (NSIP) on the national road and rail networks in England. The NPS NN provides guidance for promoters of NSIP and also provides the basis for examination by Planning Inspectorate and decision-making by the Secretary of State for Transport.

11.2.6. Paragraph 5.193 of the NPS NN states “Due regard must have been given to the relevant sections of the Noise Policy Statement for England, National Policy Framework and the Government’s associated planning guidance on noise”.

11.2.7. Paragraph 5.200 states “Applicants should consider opportunities to address the noise issues associated with the Important Areas as identified through the noise action planning process”.

11.2.8. Paragraph 5.198 states “Mitigation measures for the projects should be proportionate and reasonable and may include one or more of the following:

- Engineering: containment of noise generated.
- Materials: use of materials that reduce noise (for example low noise road surfacing).
- Lay-out: adequate distance between source and noise-sensitive receptors; incorporating good design to minimise noise transmission through screening by natural or purpose-built barriers.
- Administration: specifying acceptable noise limits or times of use (for example in the case of railway station PA systems).”

National Planning Policy Framework 2019

11.2.9. The revised National Planning Policy Framework (NPPF) published in July 2018 and updated on 19 February 2019 sets out the Government’s planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for house and other developments can be produced”.

11.2.10. Paragraph 170 of the NPPF states “Planning policies and decisions should contribute to and enhance the natural and local environment by: … preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water, or noise pollution or land instability.”

11.2.11. Paragraph 180 states “Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and natural environment, as well as potential sensitivity of the site or wider area to impacts that could arise from the development. In doing so they should:

- mitigate and reduce to a minimum potential adverse impacts results from noise from new development – and avoid noise giving rise to significant adverse impacts on health and quality of life; (and)
- identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason”

Noise Policy Statement for England

11.2.12. The Noise Policy Statement for England (NPSE) was published in March 2010 to "Promote good health and good quality of life through effective management of noise with the context of Government policy on sustainable development".

11.2.13. The aims of the NPSE in paragraph 1.7 state "Through 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 the improvement of health and quality of life".

11.2.14. As part of these aims there are several key phrases that lead to additional concepts now considered in the assessment of noise impact. They are:

- No Observed Effect Level (NOEL)
  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 noise.
- Lowest Observed Adverse Effect Level (LOAEL)
  This is the level above which adverse effects on health and quality of can be detected.
- Significant Observed Adverse Effect Level (SOAEL)
  This is the level above which significant adverse effects on health and quality of life occur.

11.2.15. The NPSE states that "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 difference receptors and at different times."

11.2.16. As such, levels for LOAEL and SOAEL have been defined for this assessment in line with DMRB LA111.

Planning Practice Guidance

11.2.17. Planning Practice Guidance (PPG), last updated in last updated 22 July 2019, is a Government web-based resource which provides guidance on how the policy set out NPPF may be interpreted in practice for a range of issues. Under the title "How to determine the noise impact" PPG states:

11.2.18. "Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- whether or not a significant adverse 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.

11.2.19. 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 stage wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level."

11.2.20. Table 11.2.1 summarises the noise exposure hierarchy given in PPG based on the likely average response.

Table 11.2.1: Noise exposure hierarchy

Perception	Examples of outcomes	Increasing effect level	Perception
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

Source: Planning Practice Guidance

Noise Action Plans

11.2.21. Noise Actions Plans, which have been published by Department for Environment, Food, and Rural Affairs (DEFRA), are required by the Environmental Noise Directive (Directive 2002/49/EC). Specifically, paragraph 1.5 of the Noise Action

Plan: Roads (including Major Roads) states “the END (Environmental Noise Directive) requires, on a 5 year cycle:

- The determination, through noise mapping, of exposure to environmental noise from major sources of road, rail and aircraft noise and in urban areas (known as agglomerations).
- Provision of information to the public on environmental noise and its effects.
- Adoption of Action Plans, based upon the noise mapping results, which are designed to manage environmental noise and its effects, including noise reduction if necessary.
- Preservation of environmental noise quality where it is good, particularly in urban areas.”

11.2.22. Paragraph 8.1 states “The Regulations require that this Action Plan should apply in particular to the most important areas as established by the strategic noise maps.”

11.2.23. Paragraph 8.5 states “It has, therefore, been decided that the Important Areas with respect to noise from major roads will be where the 1% of the population that are affected by the highest noise levels from major roads are located according to the results of the strategic noise mapping.”

Highways England policy

11.2.24. The Road Investment Strategy 2 (RIS2) for 2020-2025 lays out how the Government will use road investment to meet the needs of modern society. Specific actions in RIS2 include reducing the impact of noise pollution, continue with the Noise Important Area improvement programme and consider the opportunities provided by new road surfaces and design of the soft estate, especially in sensitive areas such as National Parks and areas of high population density. RIS2 includes noise as a Key Performance Indicator (KPI) for Highways England. The revised RIS2 metric will measure the number of households in Noise Important Areas mitigated, with a target of 7,500 households to be mitigated through a combination of offering noise insulation for affected households, constructing noise barriers and the use of quieter road surfaces within 5 years.

Local Policy

The South Norfolk Council Development Management Policies DPD (2015)

11.2.25. On October 2015, South Norfolk Council adopted The Development Management Policies Development Plan Document (DPD). The document forms part of a set of documents that together constitute a Local Plan for the future development of the area. It refers to adverse effects due to noise and makes references to the requirements of NPPF.

11.2.26. Paragraph 3.87 of The Development Management Policies DPD (2015) states (with reference to noise) “Planning decisions should avoid development that would give rise to noise that would have significant adverse impacts on health and quality of life.”

11.2.27. Policy DM 3.13 Amenity, Noise and Quality of life states “Development should ensure a reasonable standard of amenity reflecting the character of the local area. In all cases particular regard will be paid to avoiding: Introduction of incompatible neighbouring uses in terms of noise, odour, vibration, air, dusts, insects, artificial light pollution and other such nuisances. Planning permission will be refused where proposed development would lead to an excessive or unreasonable impact on existing neighbouring occupants and the amenity of the area or a poor level of amenity for new occupiers.

11.2.28. Policy DM 3.13 also states “In considering applications which may result in an increase in noise exposure, account will be taken of the operational needs of the proposed and neighbouring businesses, the character and function of the area including background noise levels at different times of day and night and the need to protect areas of rural tranquillity.

11.2.29. Policy DM 3.13 additionally states “Development will not be permitted where the proposed development would generate noise or artificial light which would be significantly detrimental to the amenity of nearby residents or the occupants of other noise sensitive uses. Proportionate mitigating measures including limiting conditions will be used to reduce the potential noise or artificial light impact to an appropriate level whenever practical to do so.

Guidance

WHO Night Noise Guidelines for Europe 2009

11.2.30. The WHO Night Noise Guidelines (NNG) for Europe 2009 was published for “the development of future legislation and policy action in the area of assessment and control of night noise exposure”.

11.2.31. The document states “There is no sufficient evidence that the biological effects observed at the level below 40dB $L_{night,outside}$ are harmful to health. However, adverse health effects are observed at the level above 40dB $L_{night,outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs or sedatives.”

11.2.32. Further to this “An interim target (IT) of 55dB $L_{night,outside}$ is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons. It should be emphasized that the IT is not a health-based limit value by itself. Vulnerable groups cannot be protected at this level. Therefore, the

IT should be considered only as a feasibility-based intermediate target which can be temporarily considered by policy-makers for exceptional local situations."

WHO Environmental Noise Guidelines for the European Region 2018

11.2.33. The main purpose of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise. The current guidelines complement the Night Noise Guidelines from 2009.

11.2.34. The guidelines set out to define recommended exposure levels for environmental noise in order to protect population health. Specific recommendations formulated for road traffic noise include the following.

- For average noise exposure, it strongly recommends reducing noise levels produced by road traffic below 53 decibels (dB) L_{den}, as road traffic noise above this level is associated with adverse health effects.
- For night noise exposure, it strongly recommends reducing noise levels produced by road traffic during night-time below 45dB L_{night}, as night-time road traffic noise above this level is associated with adverse effects on sleep.
- To reduce health effects, it strongly recommends that policy-makers implement suitable measures to reduce noise exposure from road traffic in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions, it recommends reducing noise both at the source and on the route between the source and the affected population by changes in infrastructure

British Standard (BS) 5228-1:2009+A1:2014

11.2.35. BS 5228-1 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* provides a methodology for predicting and assessing noise levels generated by fixed and mobile plant used for a range of typical construction operations. The standard includes a database of noise levels at a reference distance of 10m from the source and a simple noise propagation model that can be used to make allowance for effects such as source-receiver distances, ground properties, and utilisation time.

11.2.36. Annex E, section E.3.2 of the standard also sets criteria to assess the potential significant effect of construction noise at dwellings (example method 1 – The ABC method).

British Standard (BS) 5228-2:2009+A1:2014

11.2.37. BS 5228-2 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* provides guidance on the effect of vibration and the

likelihood it will cause complaint and cosmetic damage to buildings and gives recommendations for methods of vibration control. Vibration levels are predicted in term of Peak Particle Velocity (PPV).

11.2.38. Annex B, of the standard sets criteria to assess the potential significance of vibration effects. Section B.2 refers to human response to vibration while section B.3 refers to structural response to vibration.

The Design Manual for Roads and Bridges (DMRB) – LA 111 Noise and vibration Revision 2, May 2020

11.2.39. DMRB LA 111 Revision 2, dated May 2020, (which supersedes HD 213/11 and the accompanying IAN 185/15) sets out the requirements for noise and vibration assessments from road projects, applying a proportionate and consistent approach using best practice and ensuring compliance with relevant legislation.

11.2.40. It requires that environmental assessments of noise and vibration emissions shall include likely significant effects from construction noise, construction vibration and operational noise. Operational vibration is scoped out of the assessment methodology as a maintained road surface will not have the potential to lead to significant adverse effects.

11.2.41. DMRB LA 111 details the assessment methodology for scoping, study areas and baseline. It also sets the criteria to determine the significance of impacts, which are summarised below.

Significance of construction noise impact

11.2.42. Table 11.2.2 sets out the determination of the LOAEL and SOAEL for construction noise.

Table 11.2.2 Construction time period – LOAEL and SOAEL (DMRB LA 111 Table 3.12)

Time Period	LOAEL	SOAEL
Day (07:00 – 19:00 weekday and 07:00 – 13:00 Saturdays)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2014
Night (23:00 – 07:00)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2014
Evening and weekends (time periods not covered above)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2014

11.2.43. The magnitude of impact of construction noise is determined in accordance with the following criteria.

Table 11.2.3: Magnitude of impact for construction noise (DMRB LA 111 Table 3.16)

Magnitude of Impact	Construction Noise Level
Major	Above or equal to SOAEL +5dB
Moderate	Above or equal to SOAEL and below SOAEL +5dB
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

11.2.44. For construction traffic, the magnitude of impact is determined in accordance with the following criteria.

Table 11.2.4: Magnitude of impact for construction traffic (DMRB LA 111 Table 3.17)

Magnitude of Impact	Increase in Road Traffic Noise due to construction traffic (dB)
Major	Greater than or equal to 5.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Minor	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

11.2.45. Construction noise and construction traffic noise may then constitute a significant effect where it is determined that a major or moderate magnitude of impact would occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; or
- A total number of days or nights exceeding 40 in any 6 consecutive months

Significance of construction vibration impact

11.2.46. Table 11.2.5 sets the LOAEL and SOAEL for construction vibration.

Table 11.2.5: Construction vibration LOAELs and SOAELs for all receptors (DMRB LA 111 Table 3.31)

Time period	LOAEL	SOAEL
All time periods	0.3mm/s	1.0mm/s

11.2.47. The magnitude of impact is then determined by the following criteria.

Table 11.2.6: Vibration level – magnitude of impact (DMRB LA 111 Table 3.33)

Magnitude	Vibration level
Major	Above or equal to 10mm/s PPV
Moderate	Above or equal to SOAEL and below 10 mm/s PPV
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

11.2.48. Construction vibration may then constitute a significant effect where it is determined that a major or moderate magnitude of impact would occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights; or,
- A total number of days or nights exceeding 40 in any 6 consecutive months

Significance of operational noise impact

11.2.49. Table 11.2.7 sets the operational noise LOAELs and SOAELs for all receptors.

Table 11.2.7: Operational noise LOAELs and SOAELs for all receptors (DMRB LA 111 Table 3.49.1)

Time period	LOAEL	SOAEL
Day (06:00-24:00)	55dB $L_{A10,18hr}$ facade	68dB $L_{A10,18hr}$ facade
Night (23:00-07:00)	40dB $L_{night,outside}$ (free-field)	55dB $L_{night,outside}$ (free-field)

11.2.50. The magnitude of noise change in the short-term is defined as in Table 11.2.8.

Table 11.2.8: Magnitude of change - short-term (DMRB LA 111 Table 3.54a)

Short-term magnitude	Short-term noise change (dB $L_{A10,18hr}$ or L_{night})
Major	Greater than or equal to 5.0
Moderate	3.0 to 4.9
Minor	1.0 to 2.9
Negligible	less than 1.0

11.2.51. In the long-term, the magnitude of noise change is defined as in Table 11.2.9.

Table 11.2.9: Magnitude of change - long-term (DMRB LA 111 Table 3.54b)

Long-term magnitude	Long-term noise change (dB $L_{A10,18hr}$ or L_{night})
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3.0 to 4.9
Negligible	less than 3.0

11.2.52. The initial assessment of likely significant effect on noise sensitive buildings shall be determined using the criteria in Table 11.2.10.

Table 11.2.10: Initial assessment of operational noise significance (DMRB LA 111 Table 3.58)

Significance	Short-term noise change
Significant	Major
Significant	Moderate
Not significant	Minor
Not significant	Negligible

11.2.53. Where the magnitude of change in the short-term is negligible at noise sensitive buildings, it shall be concluded that the noise change will not give rise to a likely significant effect.

11.2.54. For noise sensitive receptors where the magnitude of change in the short-term is minor, moderate or major, further assessment using Table 11.2.10 above and

Table 11.2.11 below is required to determine the final operational significance on noise sensitive buildings.

Table 11.2.11: Determining final operational significance on noise sensitive buildings (DMRB LA 111 Table 3.60)

Local Circumstance	Influence of Significance Judgement
Noise level change (is the magnitude of change close to the minor/moderate boundary?)	1) Noise level changes within 1dB of the top of the 'minor' range can indicate that it is more appropriate to determine a likely significant effect. Noise level changes within 1dB of the bottom of a 'moderate; range can indicate that it is more appropriate to consider a change is not a likely significant effect.
Differing magnitude of impact in the long-term and/or future year to magnitude of impact in the short-term	1) Where the long term impact is predicted to be greater than the short term impact, it can be appropriate to conclude that a minor change in the short term is a likely significant effect. Where the long term impact is predicted to be less than the short term it can be appropriate to conclude that a moderate or major change in the short term is not significant. 2) A similar change in the long-term and non-project noise change can indicate that the change is not due to the project and not an indication of a likely significant effect.
Absolute noise level with reference to LOAEL and SOAEL (by design this includes sensitivity of receptor)	1) A noise change where all do-something absolute noise levels are below SOAEL requires no modification of the initial assessment. 2) Where any do-something absolute noise levels are above the SOAEL, a noise change in the short-term of 1.0dB or over results in a likely significant effect.
Location of noise sensitive parts of a receptor	1) If the sensitive parts of a receptor are protected from the noise source, it can be appropriate to conclude a moderate or major magnitude of change in the short-term and/or long-term is not a likely significant effect. 2) Conversely, if the sensitive parts of the receptor are exposed to the noise source, it can be more appropriate to conclude a minor change in the short-term and/or long term is a likely significant effect. 3) It is only necessary to look in detail at individual receptors in terms of this circumstance where the decision on whether the noise change gives rise to a significant environmental effect is marginal.
Acoustic context	1) If a project changes the acoustic character of an area, it can be appropriate to conclude a minor magnitude of change in the short-term and/or long-term is a likely significant effect.
Likely perception of change by residents	1) If the project results in obvious changes to the landscape or setting of a receptor, it is likely that noise level changes will be more acutely perceived by the noise sensitive receptors. In these cases, it can be appropriate to conclude that a minor change in the short-term and/or long-term is a likely significant effect. 2) Conversely, if the project results in no obvious changes for the landscape, particularly if the road is not visible from the receptor, it can be appropriate to conclude that a moderate change in the short-term and/or long-term is not a likely significant effect.

NOTE 1 In relation to the location of sensitive parts of the receptor, an example of a situation where sensitive parts of a receptor would be protected from the noise source would include a house with no, or very few, windows of sensitive rooms facing the road, and its outdoor spaces protected from the road by buildings.

NOTE 2 In relation to the location of sensitive parts of the receptor, an example of a situation where sensitive parts of a receptor would be exposed to the noise source would include a house with most windows of sensitive rooms facing the road, and/or outdoor spaces facing the road.

Calculation of Road Traffic Noise, CRTN, HMSO, 1988

11.2.55. Calculation of Road Traffic Noise (CRTN) provides procedures for predicting noise levels for a given flow of road traffic at sensitive receptors. These methodologies are used in the determination of entitlement under the Noise Insulation Regulations and for traffic noise change assessments undertaken in accordance with the DMRB guidance noted above.

Appendix 11.3 – Baseline Noise Survey

Study area

11.3.1. The priority for undertaking measurements was given to residential properties considered to have the potential to be affected by the Proposed Scheme. The closest accessible position of each property was used.

11.3.2. All long-term (LT) measurements were conducted over a week from the 16 May 2018 to the 24 May 2018. Short-term (ST) measurements were conducted during Wednesday 16 and Thursday 17 May 2018 during the daytime (10:00 to 17:00).

11.3.3. The positions used for the measurements are indicated in ES Figure 11.1 (Noise location plan) **(TR010037/APP/6.2)**.

Methodology

Measurement procedure

11.3.4. Table 11.3.1 presents details of the noise measurement equipment used. The sound level meters were designed to conform to:

- Type 1 standard as defined within International Electro-technical Commission (1979) IEC 651:1979. *Sound level meters*
- Class 1 standard as defined within International Electro-technical Commission (2002) IEC 61672-1:2013. *Electroacoustics-Sound level meters: Specifications*

11.3.5. All sound level meters were calibrated by an UKAS accredited laboratory, traceable to national and international standards and no more than two years before the period of all measurements.

11.3.6. The field calibrator used was designed to be in compliance with International Electro-technical Commission (2003) IEC 60942:2003 Electroacoustics-Sound calibrators. The field calibrator was calibrated by an UKAS accredited laboratory, traceable to national and international standards and no more than one year before the period of all measurements.

11.3.7. Before and after each measurement session, the reference calibration of all sound level meters was checked using the field calibrator. Variations of no greater than 0.2dB were noted over all the measurement periods.

Table 11.3.1: Summary of equipment used for surveys

Measurements type	Sound level meter	
	Model	Serial number
Long-term (1 week)	Rion NL-52	1143538
	Rion NL-52	754168
	Rion NL-52	1176426
	Rion NL-52	1176427
Short-term	Rion NL-52	1143539
Calibrator	Larson Davis CAL200	5132

11.3.8. For short-term and long-term measurements, the microphones were supported using a tripod at a height of 1.2 to 1.5m above the ground and fitted with a windshield suitable for outdoor use. Unless stated otherwise, measurements were conducted in the acoustic free field, i.e. more than 3.5m away from any walls or vertical reflecting surfaces. Where measurements were undertaken in close proximity to buildings (a façade measurement), the horizontal distance between the microphone and the façade was 1m, where possible or otherwise stated.

11.3.9. For all the long-term measurements, the A-weighted equivalent continuous noise level ($L_{Aeq,8hr}$ and $L_{A10,18hr}$) were obtained along with a number of statistical indices (L_{Amax}, L_{A10}, L_{A90}) over contiguous one hour intervals.

11.3.10. The duration of each short-term measurement was 15 minutes.

11.3.11. Photographs, to allow repeatability of the measurement locations (from Figures 11.3.5 to 11.3.13 within this appendix) and descriptions of the site, noise climate and weather conditions were noted at each measurement position. Where possible, measurements were conducted under dry conditions. Wind speeds were checked using a hand-held anemometer to be within the guideline limit of 5m/s for noise monitoring.

11.3.12. Significant extraneous noise events were excluded from the attended measurements unless they were regular features of the noise climate in that area.

11.3.13. All measurements were undertaken by consultants competent in environmental noise monitoring, and completed in accordance with the principles of BS 7445-1: 2003 *Description and measurement of environmental noise. Guide to quantities and procedures.*

Weather conditions

11.3.14. The weather conditions during the survey (short-term measurement and installation and collection of long-term measurements) were considered suitable to undertake noise measurements. Historic meteorological data have been supplied by the Met Office © Crown copyright 2018, the Met Office, at https://wow.metoffice.gov.uk/ from Marham and TSA01 observation site. Actual wind speeds at the site would be expected to be less than those recorded at the meteorological station as the microphone was located closer to the ground.

11.3.15. On 16 May 2018, the weather was dry and overcast. Based on meteorological data collected at each location, wind speeds varied between 1.2m/s and 3.6m/s and direction was mainly to north east. There was rain between 14:30 and 15:00. Temperatures were between 12°C and 15°C.

11.3.16. On 17 May 2018, the weather was dry with variable cloud cover up to a maximum of 50%. Based on meteorological data collected at each location, wind speeds varied between 0.0m/s and 3.0m/s and direction was mainly to north-north east. Temperatures were between 5°C and 13°C.

11.3.17. On 18 May 2018, historic meteorological data indicates that the wind speeds varied between 0.5m/s and 4.5m/s and direction was mainly to north-north west. Temperatures were between 4°C and 15°C.

11.3.18. On 19 May 2018, historic meteorological data indicates that the wind speeds varied between 0.5m/s and 3.6m/s and direction was mainly to the east. Temperatures were between 3°C and 20°C.

11.3.19. On 20 May 2018, historic meteorological data indicates that the wind speeds varied between 1.3m/s and 4.5m/s direction was mainly to the east-south east. Temperatures were between 6°C and 20°C.

11.3.20. On 21 May 2018, historic meteorological data indicates that the wind speeds varied between 0.5m/s and 7.0m/s and direction was mainly to the north east. Temperatures were between 7°C and 23°C.

11.3.21. On 22 May 2018, historic meteorological data indicates that the wind speeds varied between 4.0m/s and 9.8m/s and direction was mainly to the north-north east. Temperatures were between 9°C and 16°C.

11.3.22. On 23 May 2018, historic meteorological data indicates that the wind speeds varied between 6.3m/s and 8.5m/s and direction was mainly to the north-north east. Temperatures were between 9°C and 15°C.

11.3.23. On 24 May 2018, historic meteorological data indicates that the wind speeds varied between 3.6m/s and 7.0m/s and direction was mainly to the north-north east. There was rain between 17:00 and 17:30, and between 19:00 and 20:30. Temperatures were between 10°C and 20°C.

Results

11.3.24. A summary of all the results of the baseline noise measurements is provided in Table 11.3.2 for the short term and in Table 11.3.3 for the long term while full results of each position are within Table 11.3.4 to Table 11.3.12. Additionally, the results of the long-term noise measurement are presented graphically in Figure 11.3.1 to Figure 11.3.4 within this appendix.

Summary results

11.3.25. Table 11.3.2 summarises the short-term data collected for each of the measurement positions. All levels have been rounded to the nearest whole number.

Table 11.3.2: Summary of all short-term noise measurement data

Position	Dates	Range of $L_{Aeq,15min}$ dB	Range of $L_{Amax,15min}$ dB	Range of $L_{A10,15min}$ dB
ST1	16-17/05/2018	62-63	71-77	64-65
ST2	16-17/05/2018	48-51	57-62	50-53
ST3	16-17/05/2018	60-61	69-76	63-64
ST4	16-17/05/2018	60-62	74-78	63-65
ST5	16-17/05/2018	53-58	65-73	56-60

11.3.26. Table 11.3.3 summarises the free field values of the LT data per each of the measurement positions for representative weekdays only (16 to 18 May 2018, 21 to 23 May 2018). All levels have been rounded to the nearest whole number. The time range of each parameter is:

- dB $L_{A10,18hr\ daytime}$ - between 06:00 and 24:00;
- dB $L_{Aeq,12hr\ daytime}$ - between 07:00 and 19:00;
- dB $L_{Aeq,4hr\ evening\ time}$ - between 19:00 and 23:00;
- dB $L_{Aeq,8hr\ night\text{-}time}$ - between 23:00 and 07:00.

11.3.27. Partial measurements of periods at the start and end of the survey have not been included.

Table 11.3.3: Summary of free field LT data for representative weekdays

Position	Location	$L_{A10,18hr}$ dayti dB	$L_{Aeq,12hr}$ daytime dB	$L_{Aeq,4hr}$ evening time dB	$L_{Aeq,8hr}$ night-time dB
LT1	[redacted]	54	57	50	50
LT2	[redacted]	59	60	55	55
LT3	[redacted]	67	65	61	56
LT4	[redacted]	60	55	55	50

Short-term measurement results

11.3.28. Position ST1 was located at the end of [redacted] (refer to ES Figure 11.1 (Noise location plan) ([redacted] Summary of results are presented in Table 11.3.4.

Table 11.3.4: ST1 data summary

Date	Start time	$L_{Aeq,15min}$ dB	$L_{AFmax,15min}$ dB	$L_{A10,15min}$ dB	$L_{A90,15min}$ dB
16/05/2018	12:58	63	71	65	59
17/05/2018	10:40	62	75	65	57
17/05/2018	14:43	62	77	64	58

11.3.29. Position ST2 was located between [redacted] Residential buildings are approximately [redacted]. Summary of results are presented in Table 11.3.5.

Table 11.3.5: ST2 data summary

Date	Start time	$L_{Aeq,15min}$ dB	$L_{AFmax,15min}$ dB	$L_{A10,15min}$ dB	$L_{A90,15min}$ dB
16/05/2018	13:38	51	59	53	50
17/05/2018	11:12	48	58	50	46

Date	Start time	$L_{Aeq,15min}$ dB	$L_{AFmax,15min}$ dB	$L_{A10,15min}$ dB	$L_{A90,15min}$ dB
17/05/2018	15:14	51	62	52	48
17/05/2018	15:30	50	57	51	48

11.3.30. Position ST3 was located in a [redacted] (refer to Figure 11.1 (Noise location plan) [redacted]. Summary of results are presented in Table 11.3.6.

Table 11.3.6: ST3 data summary

Date	Start time	$L_{Aeq,15min}$ dB	$L_{AFmax,15min}$ dB	$L_{A10,15min}$ dB	$L_{A90,15min}$ dB
16/05/2018	14:03	61	76	64	55
17/05/2018	09:19	60	70	64	53
17/05/2018	11:36	60	69	63	53

11.3.31. Position ST4 was located on a [redacted] (refer to Figure 11.1 (Noise location plan) [redacted]. Summary of results are presented in Table 11.3.7.

Table 11.3.7: ST4 data summary

Date	Start time	$L_{Aeq,15min}$ dB	$L_{AFmax,15min}$ dB	$L_{A10,15min}$ dB	$L_{A90,15min}$ dB
16/05/2018	14:33	62	75	65	58
17/05/2018	09:42	60	74	63	56
17/05/2018	12:03	60	78	63	54

11.3.32. Position ST5 was located in [redacted] (refer to ES Figure 11.1 (Noise location plan) [redacted] GPS coordinates: [redacted] Summary of results are presented in Table 11.3.8.

Table 11.3.8: ST5 data summary

Date	Start time	$L_{Aeq,15min}$ dB	$L_{AFmax,15min}$ dB	$L_{A10,15min}$ dB	$L_{A90,15min}$ dB
16/05/2018	15:11	58	73	60	54
17/05/2018	10:10	55	69	57	51
17/05/2018	12:55	53	65	56	50

Long-term measurement results

11.3.33. $LA_{eq,8h}$ night time is between 23:00-07:00, whilst LA10,18hr day time is 06:00-24:00. Partial measurements of periods at the start and end of the survey have not been included.

11.3.34. Position LT1 was located in the [redacted] GPS coordinates [redacted]. Summary of results are presented in Table 11.3.9.

Table 11.3.9: LT1 data summary

Date	$L_{A10,18hr\ daytime}$ dB	$L_{Aeq,8hr\ night\ time}$ dB
16/05/2018	---	48
17/05/2018	53	50
18/05/2018	54	50
19/05/2018	50	51
20/05/2018	53	51
21/05/2018	53	50
22/05/2018	56	50
23/05/2018	55	---

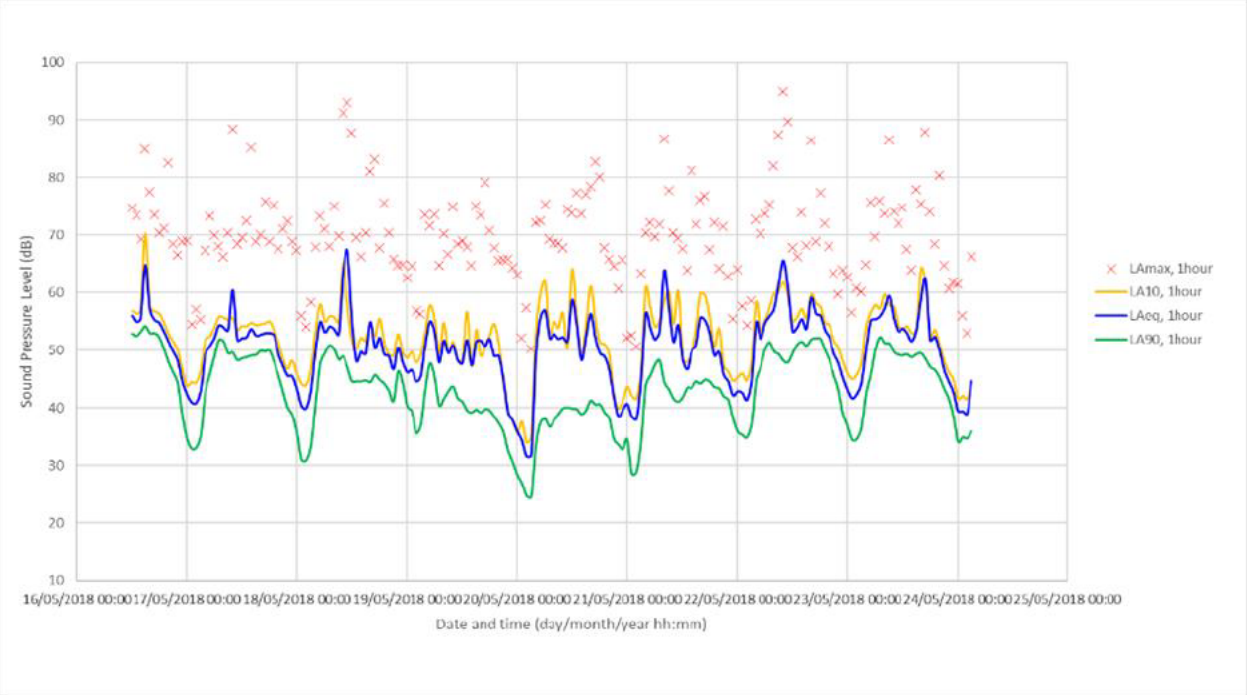

Figure 11.3.1: LT1 plot of results

11.3.35. Position LT2 was located in the [redacted]). GPS coordinates [redacted] Summary of results are presented in Table 11.3.10.

Table 11.3.10: LT2 data summary

Date	$L_{A10,18hr\ daytime}$ dB	$L_{Aeq,8hr\ night\ time}$ dB
16/05/2018	---	55
17/05/2018	59	54
18/05/2018	59	55
19/05/2018	58	53
20/05/2018	58	57
21/05/2018	58	56
22/05/2018	60	55
23/05/2018	60	55

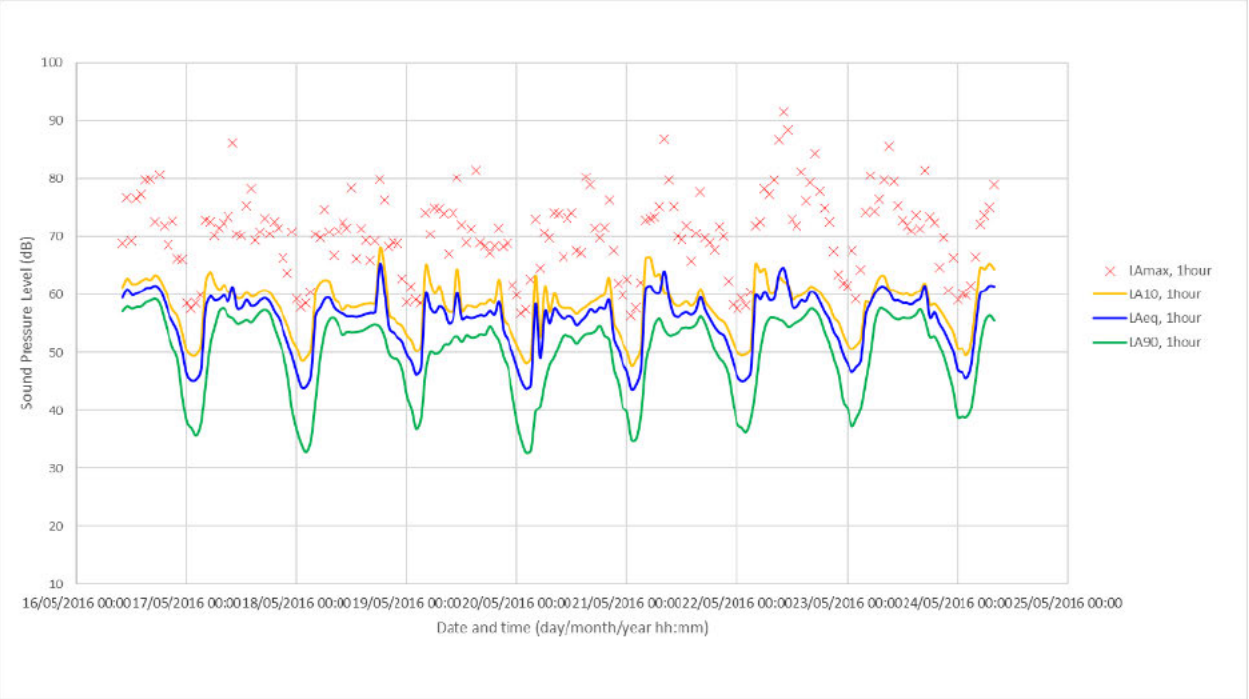

Figure 11.3.2: LT2 plot of results

11.3.36. Position LT3 was located in the [redacted] The residential property [redacted] GPS coordinates: [redacted]. This position is representative of the Noise Important Area NIA 4965. Summary of results are presented in Table 11.3.11.

Table 11.3.11: LT3 data summary

Date	$L_{A10,18hr\ daytime}$ dB	$L_{Aeq,8hr\ night\ time}$ dB
16/05/2018	---	59
17/05/2018	67	59
18/05/2018	67	50
19/05/2018	66	56
20/05/2018	65	58
21/05/2018	67	47
22/05/2018	67	47
23/05/2018	67	58

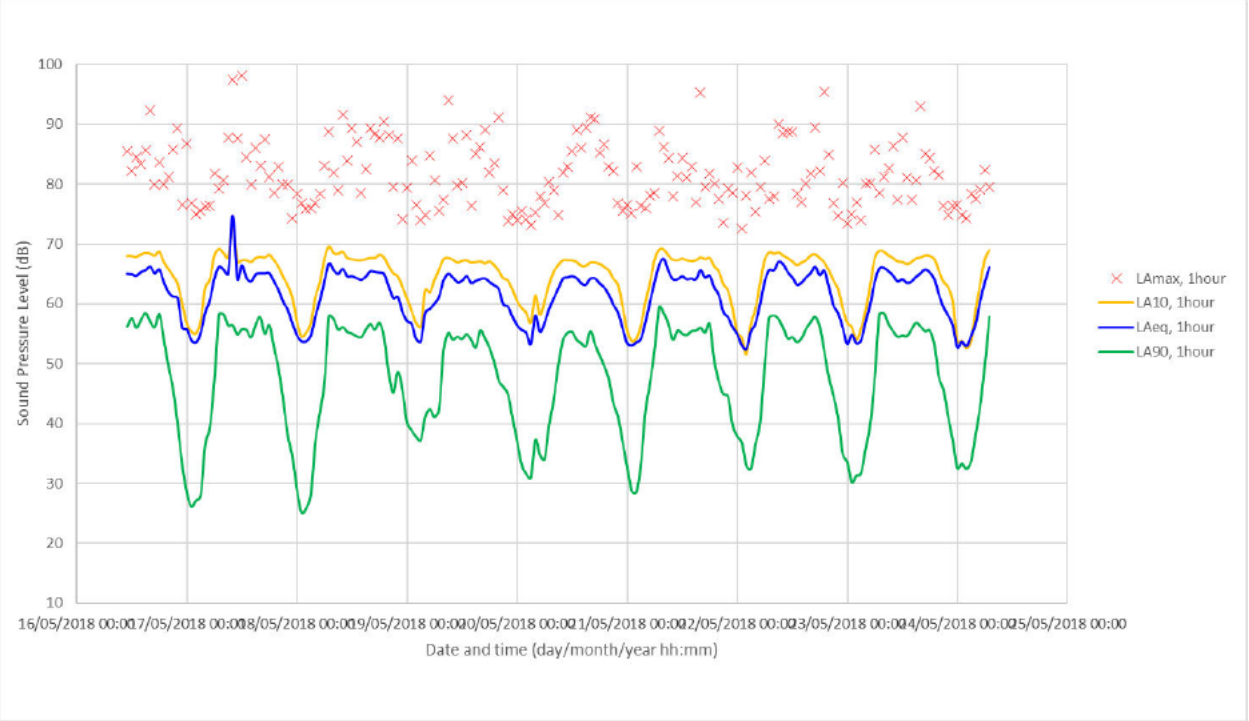

Figure 11.3.3: LT3 plot of results

11.3.37. Position LT4 was located in the [redacted]). Residential property is to the [redacted] GPS coordinates [redacted]. This position is within the Noise Important Area NIA 4966, although this NIA lays outside of the study area. Summary of results are presented in Table 11.3.12.

Table 11.3.12: LT4 data summary

Date	$L_{A10,18hr\ daytime}$ dB	$L_{Aeq,8hr\ night\ time}$ dB
16/05/2018	---	52
17/05/2018	60	52
18/05/2018	60	51
19/05/2018	59	50
20/05/2018	58	52
21/05/2018	59	41
22/05/2018	60	41
23/05/2018	60	52

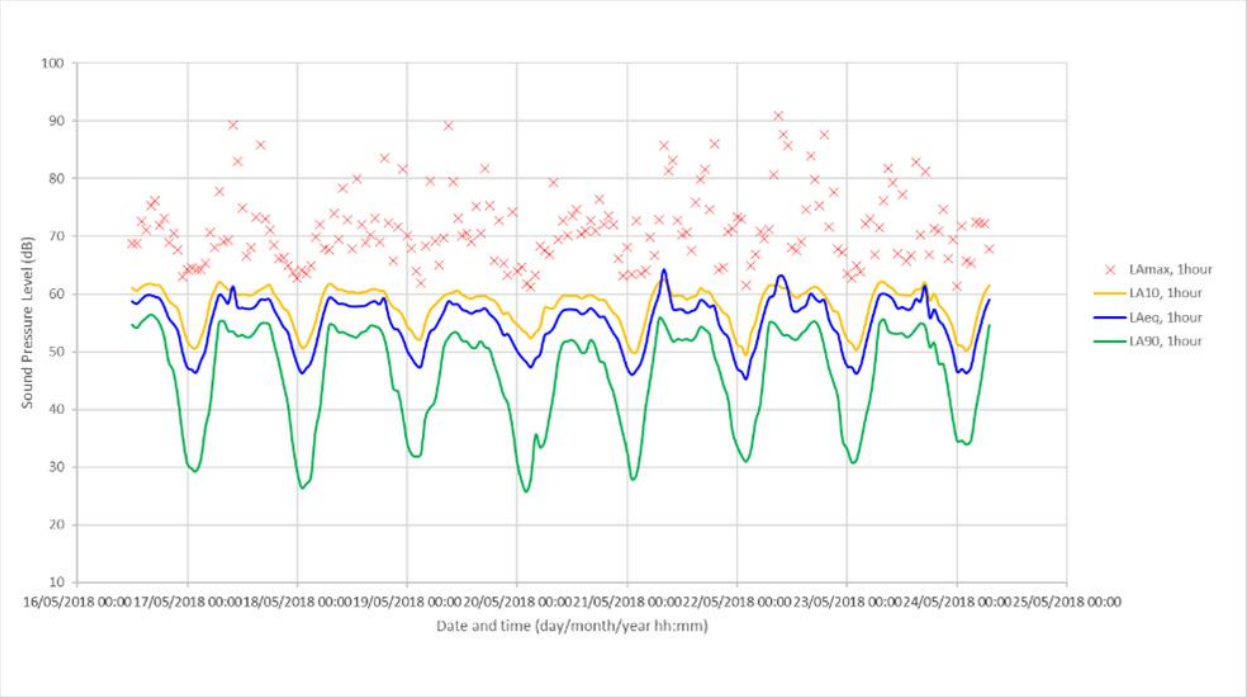

Figure 11.3.4: LT4 plot of results

Photographs

Short-term measurement positions

Figure 11.3.5: ST1

Figure 11.3.6: ST2

Figure 11.3.7: ST3

Figure 11.3.8: ST4

Figure 11.3.9: ST5

Long-term measurement positions

Figure 11.3.10: LT1

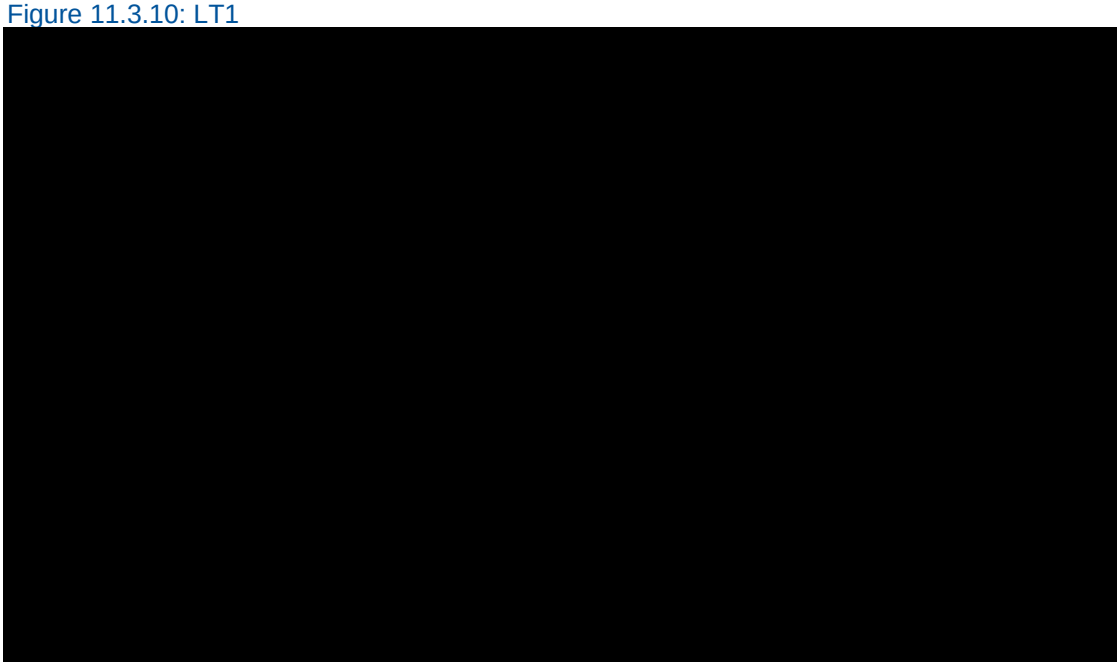

Figure 11.3.11: LT2

Figure 11.3.12: LT3

Figure 11.3.13: LT4

Appendix 11.4 – Noise model validation

11.4.1. Measured baseline survey results have been compared with the predicted road traffic noise index for the Do-Minimum Opening Year scenario. This comparison is shown in Table 11 4-1.

Table 11.4.1: Comparison of noise measurements and predictions (DMOY scenario)

Noise monitoring positions	Closest distance to the Proposed Scheme (m)	Predicted dB $L_{A10,18hr}$ (DMOY model output)	Measured dB $L_{A10,18hr}$ (2018 noise survey)	Difference dB $L_{A10,18hr}$
LT1	18	59	54	+5
LT2	20	63	59	+4
LT3	700	71	67	+4
LT4	1150	62	60	+2
ST1	40	72	64-65	+7/+8
ST2	340	60	50-53	+7/+10
ST3	23	64	63-64	0/+1
ST4	40	66	63-65	+1/+3
ST5	305	59	56-60	-1+3

11.4.2. The above comparison demonstrates that there is a reasonable correlation at all long-term measurement results with a difference of no more than 5 dB.

11.4.3. Predicted road traffic noise levels at position LT1 are higher than measured road traffic noise levels. This position is circa 320m to the south-east of the A11, which was noted to be the dominant noise source. The prevailing wind direction during the survey was north-east whereas the predictions assume downwind sound propagation.

11.4.4. Predicted road traffic noise levels at position LT2 are higher than measured road traffic noise levels. This location is partially screened due to the garden boundary fence, which was not included in the model. This would explain the higher predicted road traffic noise levels.

11.4.5. Predicted road traffic noise levels at position LT3 are higher than measured noise levels. This location is partially screened due to low front walls, which are not included in the model. This would explain the higher predicted road traffic noise levels.

11.4.6. Predicted road traffic noise levels at position LT4 show a good correlation with measured road traffic noise levels.

11.4.7. Measured road traffic noise levels at the short-term locations are subject to a greater uncertainty due to the limited survey period.

11.4.8. Predicted road traffic noise levels at position ST1 and ST2 are considerably higher than measured noise levels. This is believed to be due to congestion or lower speeds on the A11 during the short-term survey, compared to the assumed free flow traffic within the road traffic noise model. These positions were also upwind during the survey (prevailing wind direction north-east) whereas the predictions assume downwind sound propagation.

11.4.9. Predicted road traffic noise levels at positions ST3, ST4 and ST5 show a good correlation with measured road traffic noise levels.

11.4.10. It should be noted that there will rarely be perfect agreement between predicted and measured noise levels due to the comparison of relatively short-term measurement data against predicted noise levels using annual average traffic data. The measured noise levels are influenced by the local traffic conditions and the meteorological conditions at the time of the survey. In addition, the CRTN prediction method assumes light downwind propagation to every prediction point in the model. This is unlikely to occur in reality at all measurement positions. This can result in some variation between measured noise levels and predicted baseline noise levels.

11.4.11. In accordance with DMRB LA 111 paragraph 3.45.1, noise monitoring has been used to inform baseline noise modelling results. Given the above explanations the modelled results are considered robust for representing the Do Minimum Opening Year scenario. No amendments to the noise model were considered necessary.

Appendix 11.5 - Construction noise assessment

Construction stages used to inform the assessment

11.4.12. Measured baseline survey results have been compared with the predicted road traffic noise index for the Do-Minimum Opening Year scenario. This comparison is shown in Table 11 4-1.

11.4.13. Typical construction plant used for each construction activity have been provided by the Contractor. These are based on the construction stages that are shown in ES Figure 2.1 (**TR010037/APP/6.3**). The most relevant activities in terms of potential noise impact during each stage are presented in Table 11.5.1 below.

Table 11.5.1: Outline construction stages

Construction stage	Description	Main construction activities that will occur during each stage (refer to referenced tables for plant specific to each activity)
1. Site set up	Set Site	Table 11-5.5 – P3 Site clearance
2. Utilities	Allowance for utility works	Table 11.5.5 – P3 Site clearance Table 11.5.4 – Earthworks Table 11.5.5 – P2 Drainage/utility diversion Table 11.5.5 – S7 Minor works Table 11.5.5 – E3 Ancillary Plant to Above Teams Table 11.5.5 – E1 Reinstatement Earthworks Table 11.5.5 – E5 Topsoil works
3. Structures – Cantley Lane Underpass modifications	Install through pumping, install temporary works and excavate, remove existing headwall, construct the culvert base, culvert walls, culvert soffit, culvert plinth and culvert headwall, backfill including soffit cure and complete finishing works.	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – P1 Demolition Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill
4. Structures- Ward's Wood Underpass	(Box push construction) Site preparation, construct North and South Headwall, Box Construction, Box Slide and underpass completion.	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – S4 RC works Table 11.5.5 – P4 Boundary Fencing Table 11.5.5 – S5 Reinforced Structures Backfill Weekend 24 hr working for Slide
	(Top- down construction) Phase 1 North, Phase 2 South and underpass completion.	Table 11.5.5 – P1 Demolition Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.4- Surfacing Table 11.5.5 – S5 Reinforced Structures Backfill Table 11.5.5- S6 Bridge beam assembly Normal working hours
5. Structures- S04 Cantley Lane underpass	(Box push construction) Site preparation, construct North and South Headwall, Box Construction, Box Slide and underpass completion.	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – P4 Boundary Fencing Table 11.5.5 – P6 Install kerbs Table 11.5.4 – Surfacing Table 11.5.5 – S4 RC works

Construction stage	Description	Main construction activities that will occur during each stage (refer to referenced tables for plant specific to each activity)
		Table 11.5.5 – S5 Reinforced Structures Backfill Weekend 24 hr working for Slide
	(Top- down construction) Phase 1 North, Phase 2 South and underpass completion.	Table 11.5.5 – P1 Demolition Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.4 – Surfacing Table 11.5.5 – P6 Install kerbs Table 11.5.5 – S5 Reinforced Structures Backfill Table 11.5.5 – S6 Bridge beam assembly Normal working hours
6. Structures- Cantley Lane Footbridge (Removal)	Over weekend closure remove existing superstructure, prep works and remove existing north and south abutments	Table 11.5.5 – E5 Topsoil works Table 11.5.5 – P1 Demolition Table 11.5.5 – S4 RC works Weekend working as described at left
7. Structures- S18 Drainage attenuation tank	(Box push construction) Excavate inc temp works, install culvert units and chambers, backfill and install pump M&E	Table 11.5.5 – E5 Topsoil works Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill
	(Box push construction) Excavate inc temp works, install culvert units and chambers, backfill and install pump M&E	Table 11.5.5 – E5 Topsoil works Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill
8. Structures- S41 Cantley Wood Overbridge	North abutment and south abutment works and deck	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – S6 Bridge beam assembly Overnight working for Beams Table 11.5.5 – S4 RC works Overnight working for main deck pour & removal of Temp. Wks. Table 11.5.5 – S5 Reinforced Structures Backfill
9. Structures- S42- Cantley Road Link Road Overbridge	North abutment-1 and south abutment-1 works and deck-1	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill
10. Structures- S45 Cantley Lane Footbridge	North abutment, south abutment and bridge completion	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill Weekend closure for installation of bridge
11. Structures- S46- Cantley Lane South Culvert	Excavate, install culvert units, construct eastern and western headwall, backfill culvert units, construct carriageway over and complete finishing works	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill
12. Structures- S47- Cantley Stream Diversion Culvert *	Excavate, install culvert units, construct eastern and western headwall, backfill culvert units, construct carriageway over and complete finishing works	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill

Construction stage	Description	Main construction activities that will occur during each stage (refer to referenced tables for plant specific to each activity)
13. Highway Works- A11 to A47 Link Road (West of A11)	South of S42, north of S42 and online A11 works (CH225-CH450)	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – E1 Reinstatement Earthworks Overnight working for tie-in
14. Highway Works- Cantley Lane Drainage Basin	Top soil strip, excavation and fill, outlet and inlet chambers, top soil placement, access track and fencing	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – P6 Install safety fencing Table 11.5.5 – E1 Reinstatement Earthworks
15. Highways Works- A47 NB Drainage Basin	Top soil strip, excavation and fill, outlet and inlet chambers, top soil placement, access track and fencing	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – P6 Install safety fencing Table 11.5.5 – E1 Reinstatement Earthworks
16. Highway Works- A11 to A47 Link Road (East of A11)	Top soil excavation, drainage installation, carriageway construction, edge of carriageway detail, surfacing	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Structure formation Table 11.5.5 – S4 RC works Table 11.5.5 – S5 Reinforced Structures Backfill
17. Highway Works- A11 to A47 Link Road (North of A47)	(Box push construction) Top soil excavation and fill, top of batter ditch, top of batter drainage, drainage installation, carriageway construction, NFD, edge of carriageway detail, surfacing, A47 tie in	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – E1 Reinstatement Earthworks Overnight working for tie-in
	(Top- down construction) Top soil excavation and fill, top of batter ditch, top of batter drainage, drainage installation, carriageway construction, NFD, edge of carriageway detail, surfacing, A47 tie in	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – E1 Reinstatement Earthworks Overnight working for tie-in
18. Highway Works- Cantley Lane South to B1172 (East of A11) (CH325- CH0)	Top soil strip, ditch, fill from SO4 push location, EWKS/ embankment fill, underground drainage storage, embankment settlement period, embankment top up, drainage, carriageway construction, finishing and landscaping, narrow filter drain, kerbs, gullies, footpath construction, surfacing	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.5 – P6 Install kerbs & gullies / safety fencing Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – E1 Reinstatement Earthworks

Construction stage	Description	Main construction activities that will occur during each stage (refer to referenced tables for plant specific to each activity)
19. Highway Works- Works to Cantley stream culvert access	Realign stream and access track works	Table 11.5.4 – Road formation Table 11.5.4 – Surfacing
20. Highway Works- B1172 junction with new link Road	Drainage, construct carriageway, install kerbline, surfacing works	Table 11.5.4 – Road formation Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.5 – P6 Install kerbs & gullies / safety fencing Table 11.5.4 – Surfacing
21. Highway Works- Cantley Lane South to B1172 (west of A11) CH950- CH425)	(Box push construction) Fill from S02 box push works areas, top soil, drainage, drainage, S42 approach embankment fill, ditch, EWKS (box cut), carriageway construction, finishing and landscaping, narrow filter drain, gullies, kerbs, surfacing and footway construction	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – P6 Install kerbs & gullies / safety fencing Table 11.5.5 – P9 Road Restraint System Table 11.5.5 – E1 Reinstatement Earthworks
	(Top- down construction) Fill from S02 box push works areas, top soil, drainage, drainage, S42 approach embankment fill, ditch, EWKS (box cut), carriageway construction, finishing and landscaping, narrow filter drain, gullies, kerbs, surfacing and footway construction	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – P6 Install kerbs & gullies / safety fencing Table 11.5.5 – P9 Road Restraint System Table 11.5.5 – E1 Reinstatement Earthworks
22. Highway Works- carriageway across S41 & S42	(Box push construction) Complete VRS between structures, complete pavement foundation, completion of carriageway construction (CH425-CH325), surfacing across structures	Table 11.5.4 – Road formation Table 11.5.4 – Surfacing
	(Top- down construction) Complete VRS between structures, complete pavement foundation, completion of carriageway construction (CH425-CH325), surfacing across structures	Table 11.5.4 – Road formation Table 11.5.4 – Surfacing
23. Highway Works- Cantley Lane Improvements	Top soil strip, ditch, EWKS- Fill, New underground drainage storage, drainage, carriageway construction and gullies, NFD, finishing and landscaping, kerb, footway construction	Table 11.5.5 – E5 Topsoil works Table 11.5.4 – Earthworks Table 11.5.4 – Road formation Table 11.5.5 – P2 Drainage/ utility diversion Table 11.5.4 – Surfacing Table 11.5.5 – P6 Install kerbs & gullies / safety fencing Table 11.5.5 – P9 Road Restraint System Table 11.5.5 – E1 Reinstatement Earthworks

Construction stage	Description	Main construction activities that will occur during each stage (refer to referenced tables for plant specific to each activity)
24. Highway Works- Thickthorn Roundabout Gyratory works	B1172, A47 WB slip to A11 SB, roundabout works, project assurance	Table 11.5.4 – Road formation Table 11.5.4 – Surfacing Table 11.5.5 – E1 Reinstatement Earthworks
* It is noted that construction stage 12 'Structures- S47- Cantley Stream Diversion Culvert' might be removed from the final construction program.		

Noise sensitive receptors

11.4.14. A summary of a representative sample of the closest receptors to the construction works used in this assessment and their associated construction noise LOAEL and SOAEL values are presented in Tables 11.5.2 and 11.5.3 below and in ES Figure 11.1 (Noise location plan) **(TR010037/APP/6.2)**. The LOAEL and SOAEL values have been calculated from the 'Do-Minimum Opening Year' noise model, using the TRL Method 3 to convert the $L_{A10,18hr}$ index to L_{Aeq} index for non-motorways.

Table 11.5.2: Sample of receptors and daytime construction noise LOAEL and SOAEL values

Receptor reference	Address	LOAEL ($L_{Aeq,12hr}$) (dB)	SOAEL ($L_{Aeq,12hr}$) (dB)
R1	Two Tumuli in Big Wood, scheduled monument (NR4 6TE; NR4 6TD)	72	75
R2	Thickthorn Hall, NR9 3AT	64	70
R3	The Round House, NR4 6UD	64	70
R4	North Side Farm, 8 Meadow Farm Drive, Cringleford NR4 6TR	67	70
R5	Cantley House, NR4 6TF	60	65
R6	Cringleford Residential Extension Development	59	65
R7	Dwelling North of Round House Way	67	70
R8	Travelodge, Thickthorn Services	62	65
R9	Thickthorn Cottages, East Lodge, Thickthorn Lodge, Thickthorn Farm, B1172	63	70
R10	Bridge Cottages, Meadow Farm Cottages, and 128 Cantley Lane NR4 6TF	61	65
R11	102, 104, 106, 108 Cantley Lane, NR4 6TD	62	65
R12	110, 112, 114, 116, 118, 120, 122, 124 Cantley Lane, NR4 6TD	62	65

Table 11.5.3: Sample of receptors and Saturday evening construction noise LOAEL and SOAEL values

Receptor reference	Address	LOAEL ($L_{Aeq,8hr}$) (dB)	SOAEL ($L_{Aeq,8hr}$) (dB)
R1	Two Tumuli in Big Wood	69	69
R2	Thickthorn Hall, NR9 3A	56	60
R3	The Round House, NR4 6UD	64	65
R4	North Side Farm, 8 Meadow Farm Drive, Cringleford NR4 6TR	59	65
R5	Cantley House, NR4 6TF	60	65
R6	Cringleford Residential Extension Development	61	65
R7	Dwelling North of Round House Way	59	65
R8	Travelodge, Thickthorn Services	64	65
R9	Thickthorn Cottages, East Lodge, Thickthorn Lodge, Thickthorn Farm, B1172	57	60
R10	Bridge Cottages, Meadow Farm Cottages, and 128 Cantley Lane NR4 6TF	58	65
R11	102, 104, 106, 108 Cantley Lane, NR4 6TD	61	65
R12	110, 112, 114, 116, 118, 120, 122, 124 Cantley Lane, NR4 6TD	59	65

Table 11.5.4: Sample of receptors and night-time construction noise LOAEL and SOAEL values

Receptor reference	Address	LOAEL ($L_{Aeq,8hr}$) (dB)	SOAEL ($L_{Aeq,8hr}$) (dB)
R1	Two Tumuli in Big Wood	63	63
R2	Thickthorn Hall, NR9 3A	56	55
R3	The Round House, NR4 6UD	56	58
R4	North Side Farm, 8 Meadow Farm Drive, Cringleford NR4 6TR	58	55
R5	Cantley House, NR4 6TF	52	55
R6	Cringleford Residential Extension Development	51	56
R7	Dwelling North of Round House Way	58	55
R8	Travelodge, Thickthorn Services	54	58
R9	Thickthorn Cottages, East Lodge, Thickthorn Lodge, Thickthorn Farm, B1172	54	55
R10	Bridge Cottages, Meadow Farm Cottages, and 128 Cantley Lane NR4 6TF	53	55
R11	102, 104, 106, 108 Cantley Lane, NR4 6TD	54	56
R12	110, 112, 114, 116, 118, 120, 122, 124 Cantley Lane, NR4 6TD	54	55

Table 11.5.5: Construction plant assumptions

Plant and equipment	No. of Plant	BS 5228 Reference	% On time	SPL@10 m (dB(A))	Sound pressure levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
Earthworks												
Tracked excavator (40t)	4	C.2.14	80%	79	85	78	77	77	73	71	68	63
Articulated dump truck tipping fill (23t)	8	C.2.32	10%	74	80	76	73	70	69	66	63	58
Articulated dump truck drive by (23t)	8	C.2.33	60%	81	85	87	77	75	76	73	69	62
Dozer (28t)	2	C.2.11	80%	79	75	79	77	77	74	71	65	57
Vibrating roller (8.9t)	4	C5.20	80%	75	90	82	73	72	70	65	59	54
Diesel generator (7.5kW)	4	C4.87	80%	65	77	72	64	60	59	57	54	42
Tracked excavator (40t)	2	C.2.14	80%	79	85	78	77	77	73	71	68	63
Tracked excavator (40t)	4	C.2.14	80%	79	85	78	77	77	73	71	68	63
Road Formation												
Tracked excavator (40t)	1	C.2.14	80%	79	85	78	77	77	73	71	68	63
Vibrating roller (8.9t)	1	C.5.20	60%	75	90	82	73	72	70	65	59	54
Dozer (28t)	4	C.2.11	80%	79	75	79	77	77	74	71	65	57
Tracked excavator (40t)	2	C.2.14	80%	79	85	78	77	77	73	71	68	63
Structure Formation												
Tracked Excavator (35T)	2	C.2.14	80%	79	85	78	77	77	73	71	68	63

Plant and equipment	No. of Plant	BS 5228 Reference	% On time	SPL@10 m (dB(A))	Sound pressure levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
Articulated dump truck drive by (23t)	5	C2.33	50%	81	85	87	77	75	76	73	69	62
Concrete mixer truck (discharging) & concrete pump (pumping)	2	C.4.28	20%	75	79	80	73	72	69	68	59	53
Wheeled mobile crane (70t)	2	C.3.30	80%	70	80	72	71	67	65	62	57	49
Diesel generator (15kW)	2	C4.86	80%	65	78	71	66	62	59	55	56	49
Large rotary bored piling rig (110t)	1	C.3.14	50%	83	84	92	81	80	78	76	68	61
Surfacing												
Road roller (8.9t)	2	C.5.19	80%	75	90	82	73	72	70	65	59	54
Vibratory roller (8.9t)	4	C.5.20	80%	75	90	82	73	72	70	65	59	54
Asphalt paver	2	C.5.33	80%	75	82	82	78	72	69	67	61	54
Tipper Lorry (Full Time Equivalent)	5	C.2.34	80%	80	73	78	78	78	74	73	68	66
Diesel generator (7.5kW)	4	C4.87	80%	65	77	72	64	60	59	57	54	42

Table 11.5.6: Construction plant proposals continued.

Plant and equipment	No. of Plant	BS 5228 Ref.	% On time	SPL@10m (dB(A))	Sound power levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
P1 Demolition												
Excavator 40T	1	C2.14	80	79	113	106	105	105	101	99	96	91
Dump Truck (23T)	2	C2.33	60	81	85	87	77	75	76	73	69	62
Hydraulic crusher	1	C1.14	80	82	121	114	107	109	103	99	94	87
P2 Drainage/utility diversion												
Excavator 20T	2	C2.21	80	71	103	104	100	96	93	91	85	77

Plant and equipment	No. of Plant	BS 5228 Ref.	% On time	SPL@10m (dB(A))	Sound power levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
Dump Truck (10T)	2	C2.33	60	81	85	87	77	75	76	73	69	62
Sump pump	2	C4.88	100	69	98	93	94	92	92	91	84	74
Generator	2	C4.85	100	66	97	97	95	88	87	88	84	81
P3 Site Clearance												
Excavator 20T	2	C2.21	90	71	103	104	100	96	93	91	85	77
Dump Truck (23T)	2	C2.33	60	81	85	87	77	75	76	73	69	62
Chainsaw	2	D2.14	50	86	-	-	-	-	-	-	-	-
P4 Boundary Fencing												
Agricultural tractor/trailer with auger	1	C4.75	90	79	121	114	104	104	101	100	92	87
P5 Placing Subbase												
Cat D6LGP Tracked Dozer	2	C2.12	90	81	113	102	104	101	100	106	90	84
Tipper Lorry (Road taxed)	5	C8.20	80	79	88	82	74	74	74	73	70	67
CS 76 Self Propelled Roller	1	C2.37	90	80	100	103	109	106	102	98	91	83
P6 Install kerbs and gullies/safety fencing												
JCB3c	1	C2.8	90	68	102	94	92	92	91	88	87	78
Dumper (5T)	1	C4.7	80	78	90	86	72	71	71	71	66	59
Bobcat	1	C2.28	90	76	86	82	77	74	70	66	62	55
Compressor (250cfm)	1	C5.5	25	66	112	101	92	87	85	83	86	75
Road breaker	1	C5.3	25	82	110	103	101	96	91	95	108	97
P7 Lay Blacktop (as per surfacing in Table 11-5.4)												
P8 Install Lamp Columns												

Plant and equipment	No. of Plant	BS 5228 Ref.	% On time	SPL@10m (dB(A))	Sound power levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
MEWP	1	C4.57	90	67	106	104	90	91	88	87	86	77
S2 Bored piling (18m deep 750 dia)												
CFA piling rig (large)	1	C3.21	90	79	109	109	106	104	102	100	96	91
Tracked mobile crane (50t)	1	C3.29	10	70	109	105	97	95	90	88	89	79
Generator	1	C4.85	90	66	97	97	95	88	87	88	84	81
Excavator 20T	1	C2.21	50	71	103	104	100	96	93	91	85	77
Dump Truck (23T)	1	C2.33	50	81	85	87	77	75	76	73	69	62
S3 Excavation & Trimming bored piles												
Excavator 20T	1	C2.21	90	71	103	104	100	96	93	91	85	77
Dump Truck (10T)	1	C2.33	50	81	85	87	77	75	76	73	69	62
Pile cropper	1	C1.2	50	92	107	112	110	112	116	113	112	110
Stihl saw	1	C3.34	50	68	102	102	100	89	88	86	84	84
Compressor (250cfm)	1	C5.5	50	66	112	101	92	87	85	83	86	75
Small breaking tool	2	C1.6	90	84	111	111	109	102	101	104	106	105
S4 RC Works												
Mobile crane 40T	1	C3.29	90	70	109	105	97	95	90	88	89	79
Concrete pump	1	C3.25	25	78	112	104	98	99	101	101	94	86
Compressor (250cfm)	1	C5.5	50	66	112	101	92	87	85	83	86	75
Air/diesel poker	2	C4.34	25	69	90	98	98	92	90	89	87	84
Generator	1	C4.85	50	66	97	97	95	88	87	88	84	81
Jet wash	1	C3.13	10	63	103	103	90	86	83	82	76	68

Plant and equipment	No. of Plant	BS 5228 Ref.	% On time	SPL@10m (dB(A))	Sound power levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
S5 Reinforced Structures Backfill												
Excavator 20T	1	C2.21	90	71	103	104	100	96	93	91	85	77
Dump Truck (23T)	1	C2.33	50	81	85	87	77	75	76	73	69	62
Vibrating plate	2	C2.41	75	80	98	102	99	106	102	103	91	86
Pedestrian roller	2	C5.28	75	77	110	108	104	101	98	98	91	87
S6 Bridge Beam Assembly												
250T mobile crane	1	C2.21	90	71	103	104	100	96	93	91	85	77
Articulated delivery vehicle	2	C4.8	50	56	96	84	75	77	80	78	69	60
MEWP	2	C4.58	90	63	100	99	87	87	84	84	80	73
Compressor (250cfm)	1	C5.5	75	66	112	101	92	87	85	83	86	75
Air gun	2	C4.95	25	73	63	65	65	66	65	69	64	61
S7 Minor Works												
25T mobile crane	1	C4.43	90	70	108	104	99	91	92	91	84	78
E1 Reinstatement Earthworks												
Tracked excavator (40t)	1	C2.14	90	79	85	78	77	77	73	71	68	63
Articulated dump truck tipping fill (23t)	2	C2.32	10	74	80	76	73	70	69	66	63	58
Articulated dump truck drive by (23t)	2	C2.33	60	81	85	87	77	75	76	73	69	62
Dozer (28t)	2	C2.11	90	79	75	79	77	77	74	71	65	57
E3 Ancillary Plant to Above Teams												
Fuel Bowser	1	C6.36	10	89	108	109	112	109	112	113	104	94
Water Bowser	1	C6.36	10	89	108	109	112	109	112	113	104	94

Plant and equipment	No. of Plant	BS 5228 Ref.	% On time	SPL@10m (dB(A))	Sound power levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
E4 Merge/Diverge Earthworks												
Komatsu 350 - 35tne Tracked Excavator	1	C2.15	90	76	105	113	98	101	98	96	91	85
Cat D6LGP Tracked Dozer	1	C2.12	90	81	113	102	104	101	100	106	90	84
CS 76 Self Propelled Roller	1	C2.37	90	80	100	103	109	106	102	98	91	83
Volvo A25 - 25tne Articulated Dump Truck	2	C4.8	50	56	96	84	75	77	80	78	69	60
E5 Topsoil Works – Initial Strip												
Tracked excavator (40t)	3	C2.14	90	79	85	78	77	77	73	71	68	63
Articulated dump truck tipping fill (23t)	5	C2.32	10	74	80	76	73	70	69	66	63	58
Articulated dump truck drive by (23t)	5	C2.33	60	81	85	87	77	75	76	73	69	62
Dozer (28t)	2	C2.11	90	79	75	79	77	77	74	71	65	57
S4 Night Time RC Works												
Mobile crane 40T	1	C3.29	100	70	109	105	97	95	90	88	89	79
Concrete pump	1	C3.25	100	78	112	104	98	99	101	101	94	86
Compressor (250cfm)	1	C5.5	100	66	112	101	92	87	85	83	86	75
Air/diesel poker	2	C4.34	50	69	90	98	98	92	90	89	87	84
Generator	1	C4.85	100	66	97	97	95	88	87	88	84	81
Jet wash	1	C3.13	25	63	103	103	90	86	83	82	76	68
S6 Night Time Bridge Assembly												
250T mobile crane	1	C2.21	100	71	103	104	100	96	93	91	85	77
Articulated delivery vehicle	2	C4.8	50	56	96	84	75	77	80	78	69	60
MEWP	1	C4.58	100	63	100	99	87	87	84	84	80	73

Plant and equipment	No. of Plant	BS 5228 Ref.	% On time	SPL@10m (dB(A))	Sound power levels (SPL) octave band (Hz)							
					63	125	250	500	1000	2000	4000	8000
Compressor (250cfm)	1	C5.5	100	66	112	101	92	87	85	83	86	75
Air gun	2	C4.95	25	73	63	65	65	66	65	69	64	61
CC Construction Compound												
Power generator	1	C4.84	100	74	103	100	104	98	97	93	84	75

Predicted construction noise levels

Table 11.5.7: Predicted construction noise levels and magnitude of impact at sensitive receptors (unmitigated)

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
1. Site set up	R1	60	Negligible
	R2	53	Negligible
	R3	52	Negligible
	R4	60	Negligible (Minor)
	R5	54	Negligible
	R6	67	Minor (Moderate)
	R7	55	Negligible
	R8	60	Negligible
	R9	56	Negligible
	R10	66	Minor (Moderate)
	R11	62	Negligible (Minor)
	R12	60	Negligible (Minor)
2. Utilities	R1	57	Negligible
	R2	50	Negligible
	R3	51	Negligible
	R4	61	Negligible
	R5	53	Negligible
	R6	68	Moderate
	R7	55	Negligible
	R8	59	Negligible
	R9	56	Negligible
	R10	74	Major
	R11	72	Major
	R12	71	Major
3. Structures – Cantley Lane Underpass modifications	R1	47	Negligible
	R2	38	Negligible
	R3	42	Negligible
	R4	39	Negligible
	R5	39	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R6	51	Negligible
	R7	45	Negligible
	R8	54	Negligible
	R9	40	Negligible
	R10	45	Negligible
	R11	53	Negligible
	R12	51	Negligible
4. Structures- Ward's Wood Underpass – box push and top down methods	R1	55	Negligible
	R2	45	Negligible
	R3	43	Negligible
	R4	41	Negligible
	R5	45	Negligible
	R6	49	Negligible
	R7	46	Negligible
	R8	61	Negligible
	R9	46	Negligible
	R10	50	Negligible
	R11	48	Negligible
	R12	49	Negligible
4. Structures- Ward's Wood Underpass (night) – box push only	R1	55	Negligible
	R2	45	Negligible
	R3	43	Negligible
	R4	41	Negligible
	R5	45	Negligible
	R6	49	Negligible
	R7	46	Negligible
	R8	61	Moderate
	R9	46	Negligible
	R10	50	Negligible
	R11	48	Negligible
	R12	49	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
5. Structures- S04 Cantley Lane underpass – box push and top down methods	R1	45	Negligible
	R2	38	Negligible
	R3	49	Negligible
	R4	46	Negligible
	R5	41	Negligible
	R6	58	Negligible
	R7	50	Negligible
	R8	49	Negligible
	R9	39	Negligible
	R10	47	Negligible
	R11	62	Negligible (Minor)
	R12	56	Negligible
5. Structures- S04 Cantley Lane underpass (night) – box push only	R1	45	Negligible
	R2	38	Negligible
	R3	49	Negligible
	R4	46	Negligible
	R5	41	Negligible
	R6	58	Moderate
	R7	50	Negligible
	R8	49	Negligible
	R9	39	Negligible
	R10	47	Negligible
	R11	62	Major
	R12	56	Moderate
6. Structures- Cantley Lane Footbridge (Removal)	R1	37	Negligible
	R2	30	Negligible
	R3	35	Negligible
	R4	41	Negligible
	R5	34	Negligible
	R6	62	Negligible (Minor)
	R7	36	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R8	35	Negligible
	R9	30	Negligible
	R10	39	Negligible
	R11	50	Negligible
	R12	46	Negligible
7. Structures- S18 Drainage attenuation tank – box push and top down methods	R1	47	Negligible
	R2	36	Negligible
	R3	33	Negligible
	R4	31	Negligible
	R5	35	Negligible
	R6	35	Negligible
	R7	36	Negligible
	R8	47	Negligible
	R9	38	Negligible
	R10	42	Negligible
	R11	38	Negligible
	R12	40	Negligible
8. Structures- S41 Cantley Wood Overbridge	R1	57	Negligible
	R2	43	Negligible
	R3	37	Negligible
	R4	37	Negligible
	R5	43	Negligible
	R6	40	Negligible
	R7	39	Negligible
	R8	48	Negligible
	R9	45	Negligible
	R10	49	Negligible
	R11	43	Negligible
	R12	44	Negligible
8. Structures- S41 Cantley Wood Overbridge (night)	R1	57	Negligible
	R2	43	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R3	37	Negligible
	R4	37	Negligible
	R5	43	Negligible
	R6	40	Negligible
	R7	39	Negligible
	R8	48	Negligible
	R9	45	Negligible
	R10	49	Negligible
	R11	43	Negligible
	R12	44	Negligible
9. Structures- S42- Cantley Road Link Road Overbridge	R1	60	Negligible
	R2	46	Negligible
	R3	40	Negligible
	R4	39	Negligible
	R5	46	Negligible
	R6	43	Negligible
	R7	42	Negligible
	R8	51	Negligible
	R9	47	Negligible
	R10	51	Negligible
	R11	45	Negligible
	R12	47	Negligible
10. Structures- S45 Cantley Lane Footbridge	R1	43	Negligible
	R2	36	Negligible
	R3	43	Negligible
	R4	46	Negligible
	R5	40	Negligible
	R6	69	Minor (Moderate)
	R7	46	Negligible
	R8	43	Negligible
	R9	37	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R10	45	Negligible
	R11	67	Minor
	R12	55	Negligible
11. Structures- S46- Cantley Lane South Culvert	R1	49	Negligible
	R2	37	Negligible
	R3	37	Negligible
	R4	39	Negligible
	R5	46	Negligible
	R6	42	Negligible
	R7	38	Negligible
	R8	42	Negligible
	R9	38	Negligible
	R10	79	Major
	R11	45	Negligible
	R12	48	Negligible
12. Structures- S47- Cantley Stream Diversion Culvert	R1	50	Negligible
	R2	37	Negligible
	R3	37	Negligible
	R4	38	Negligible
	R5	47	Negligible
	R6	41	Negligible
	R7	38	Negligible
	R8	42	Negligible
	R9	38	Negligible
	R10	79	Major
	R11	46	Negligible
	R12	47	Negligible
13. Highway Works- A11 to A47 Link Road (West of A11)	R1	56	Negligible
	R2	44	Negligible
	R3	39	Negligible
	R4	38	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R5	44	Negligible
	R6	41	Negligible
	R7	41	Negligible
	R8	52	Negligible
	R9	45	Negligible
	R10	49	Negligible
	R11	45	Negligible
	R12	46	Negligible
13. Highway Works- A11 to A47 Link Road (West of A11) (night)	R1	56	Negligible
	R2	44	Negligible
	R3	39	Negligible
	R4	38	Negligible
	R5	44	Negligible
	R6	41	Negligible
	R7	41	Negligible
	R8	52	Negligible
	R9	45	Negligible
	R10	49	Negligible
	R11	45	Negligible
	R12	46	Negligible
14. Highway Works- Cantley Lane Drainage Basin	R1	53	Negligible
	R2	46	Negligible
	R3	38	Negligible
	R4	37	Negligible
	R5	44	Negligible
	R6	40	Negligible
	R7	40	Negligible
	R8	48	Negligible
	R9	47	Negligible
	R10	47	Negligible
	R11	43	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R12	44	Negligible
15. Highways Works- A47 NB Drainage Basin	R1	39	Negligible
	R2	34	Negligible
	R3	37	Negligible
	R4	61	Negligible (Minor)
	R5	39	Negligible
	R6	50	Negligible
	R7	40	Negligible
	R8	39	Negligible
	R9	34	Negligible
	R10	41	Negligible
	R11	46	Negligible
	R12	44	Negligible
16. Highway Works- A11 to A47 Link Road (East of A11) – box push and top down methods	R1	53	Negligible
	R2	43	Negligible
	R3	47	Negligible
	R4	45	Negligible
	R5	44	Negligible
	R6	50	Negligible
	R7	49	Negligible
	R8	57	Negligible
	R9	44	Negligible
	R10	52	Negligible
	R11	59	Negligible
	R12	59	Negligible
17. Highway Works- A11 to A47 Link Road (North of A47) – box push and top down methods	R1	44	Negligible
	R2	38	Negligible
	R3	47	Negligible
	R4	59	Negligible
	R5	41	Negligible
	R6	65	Minor

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R7	47	Negligible
	R8	46	Negligible
	R9	39	Negligible
	R10	46	Negligible
	R11	59	Negligible
	R12	54	Negligible
17. Highway Works- A11 to A47 Link Road (North of A47) (night) – box push and top down methods	R1	34	Negligible
	R2	28	Negligible
	R3	37	Negligible
	R4	49	Negligible
	R5	31	Negligible
	R6	55	Negligible
	R7	37	Negligible
	R8	36	Negligible
	R9	29	Negligible
	R10	36	Negligible
	R11	49	Negligible
	R12	44	Negligible
18. Highway Works- Cantley Lane South to B1172 (East of A11) (CH325- CH0)	R1	54	Negligible
	R2	45	Negligible
	R3	39	Negligible
	R4	38	Negligible
	R5	43	Negligible
	R6	41	Negligible
	R7	42	Negligible
	R8	52	Negligible
	R9	47	Negligible
	R10	48	Negligible
	R11	43	Negligible
	R12	45	Negligible
	R1	58	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
19. Highway Works- Works to Cantley stream culvert access	R2	46	Negligible
	R3	41	Negligible
	R4	41	Negligible
	R5	49	Negligible
	R6	44	Negligible
	R7	43	Negligible
	R8	52	Negligible
	R9	48	Negligible
	R10	63	Minor
	R11	47	Negligible
	R12	48	Negligible
20. Highway Works- B1172 junction with new link Road	R1	43	Negligible
	R2	45	Negligible
	R3	39	Negligible
	R4	37	Negligible
	R5	37	Negligible
	R6	39	Negligible
	R7	43	Negligible
	R8	50	Negligible
	R9	61	Minor
	R10	40	Negligible
	R11	41	Negligible
	R12	41	Negligible
21. Highway Works- Cantley Lane South to B1172 (west of A11) CH950- CH425) – box push and top down methods	R1	48	Negligible
	R2	46	Negligible
	R3	39	Negligible
	R4	37	Negligible
	R5	40	Negligible
	R6	40	Negligible
	R7	42	Negligible
	R8	51	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R9	54	Negligible
	R10	44	Negligible
	R11	41	Negligible
	R12	43	Negligible
22. Highway Works- carriageway across S41 & S42 – box push and top down methods	R1	56	Negligible
	R2	44	Negligible
	R3	37	Negligible
	R4	37	Negligible
	R5	43	Negligible
	R6	40	Negligible
	R7	40	Negligible
	R8	48	Negligible
	R9	46	Negligible
	R10	48	Negligible
	R11	43	Negligible
	R12	44	Negligible
23. Highway Works- Cantley Lane Improvements	R1	63	Negligible
	R2	41	Negligible
	R3	35	Negligible
	R4	38	Negligible
	R5	47	Negligible
	R6	41	Negligible
	R7	37	Negligible
	R8	45	Negligible
	R9	43	Negligible
	R10	69	Moderate (Major)
	R11	45	Negligible
	R12	45	Negligible
24. Highway Works- Thickthorn Roundabout Gyratory works	R1	44	Negligible
	R2	38	Negligible
	R3	45	Negligible

Stage	Receptor reference	Predicted noise $L_{Aeq,T}$, levels (dB), façade Levels	Magnitude of impact without mitigation (Saturday evening in brackets when different impact)
	R4	37	Negligible
	R5	37	Negligible
	R6	54	Negligible
	R7	51	Negligible
	R8	56	Negligible
	R9	40	Negligible
	R10	43	Negligible
	R11	48	Negligible
	R12	47	Negligible

11.4.15. BS 5228-1 states that as a working approximation, a barrier between the source and the receiving provides an approximate attenuation of 5dB when the top of the plant is just visible to the receiver over the noise barrier, and of 10dB when the noise barrier completely hides the sources from the receiver. It also adds that specifically designed and positioned noise barriers could provide greater attenuation.

11.4.16. In order to mitigate potential moderate or major construction noise impacts at the receptors identified above, temporary noise barriers shall be erected where construction activity in the vicinity of the receptor will exceed 10 days or nights in any 15 consecutive days or nights; or for a total number of days exceeding 40 in any six consecutive months. Well-designed noise barriers would provide a 10dB reduction at the receptor as commented above.

11.4.17. The residual significant effects due construction noise impact once temporary mitigation in the form of noise barriers are considered, are summarised in Table 11.12 of ES Chapter 11 Noise and vibration **(TR010037/APP/6.1)**.