Greater Cambridge Partnership

CAMBOURNE TO CAMBRIDGE

Technical Report 1 – Acoustics

70086660
AUGUST 2023

PUBLIC

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TYPE OF DOCUMENT (VERSION) PUBLIC

PROJECT NO. 70086660

OUR REF. NO. 70086660

DATE: AUGUST 2023

WSP

62-64 Hills Road
Cambridge
CB2 1LA

Phone: +44 1223 558 050

WSP.com

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1 INTRODUCTION AND SUMMARY

1.1.1. The Cambourne to Cambridge (C2C) Scheme will include a 13.6km long mainly dedicated busway connecting Cambourne in the west with Cambridge in the east. A service road and maintenance track, which is able to be used as an active travel path, will run alongside the segregated sections of busway. The C2C Scheme will use hybrid vehicles (and in due course, electric vehicles), providing a service of around 10 buses per hour each way. The Scotland Farm travel hub (a park and ride facility) will be situated along the route, just north of the A428, approximately 5km west of Cambridge. Further details about the Scheme proposal are set out in Chapter 3, Scheme Description, of the ES[1].

1.1.2. This ES Technical Report presents the assessment of the C2C Scheme in relation to the potential noise and vibration effects it may have on nearby sensitive receptors. It considers the likely significant effects of the C2C Scheme of noise and vibration on existing sensitive receptors during both the construction and operation phases.

1.1.3. This ES Technical Report describes the assessment methodology and the baseline conditions relevant to the assessment, as well as the likely residual significant effects and any monitoring that may be required to determine actual effects and the effectiveness of mitigation measures that have been employed.

1.1.4. The scope of the assessment, includes consideration of the potential noise and vibration effects on nearby receptors resulting from:

- Noise and/or vibration generated by on-site activities during the construction phase;
- Noise arising from the operation of the scheme as a result of changes in road traffic;
- Noise arising from the operation of the travel hub; and
- Noise arising from the operation of the new busway.

1.1.5. A glossary of acoustic terminology is included in **Appendix A**.

[1] Environmental Statement (Document reference: C2C-10-00-Environmental Statement (Volume 1))

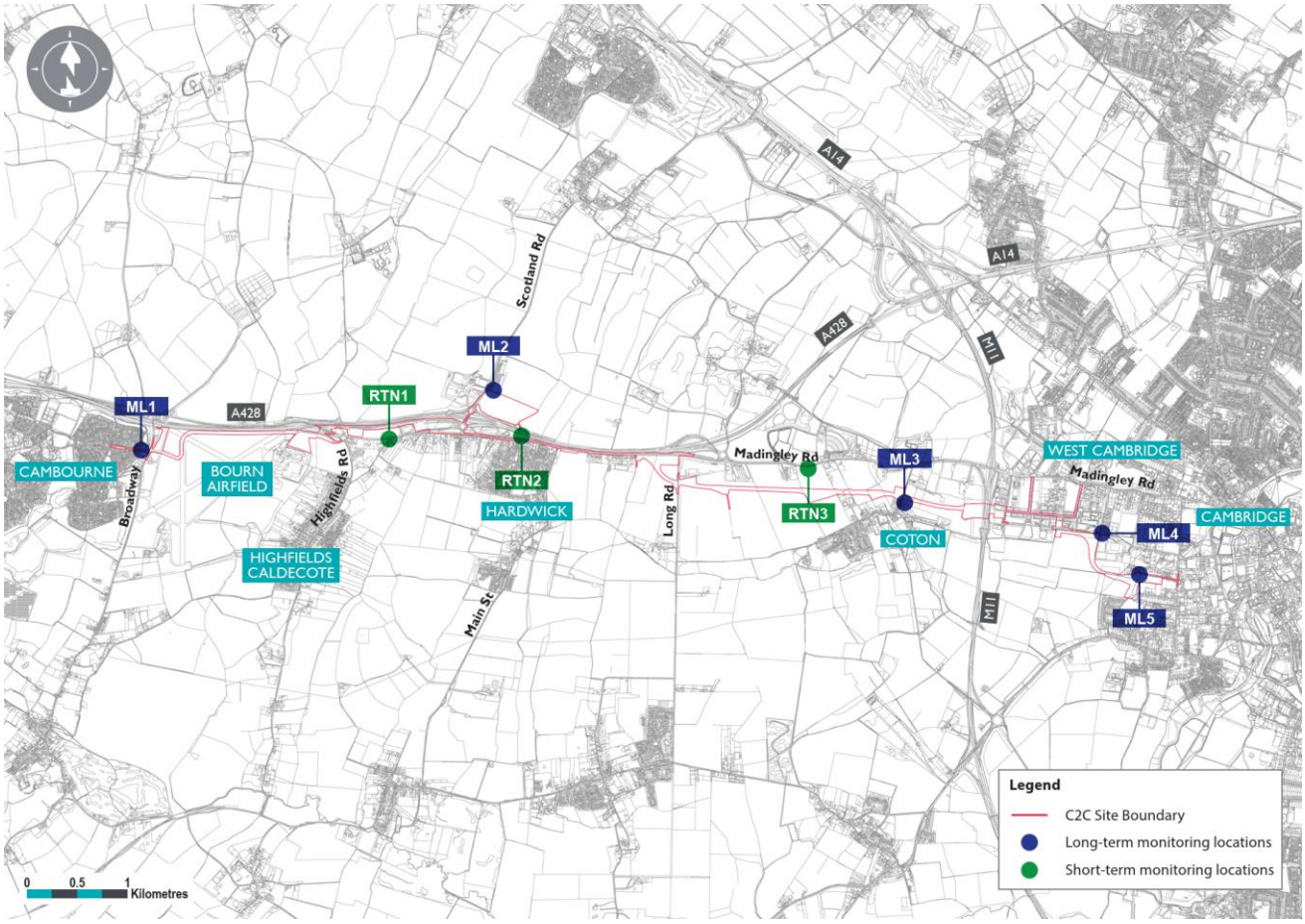
2 BASELINE ENVIRONMENT

2.1.1. A summary of the key sources influencing the baseline noise environment is summarised in ES Chapter 5, the Environment along the route[1] and elaborated on here.

2.1.2. In order to help quantify the existing baseline noise environment, a comprehensive baseline noise survey was undertaken along the scheme alignment in January 2022 at five long-term monitoring locations (ML) and three short-term road traffic noise (RTN) locations; these are marked on the map below.

2.1.3. The purpose of the noise survey was to establish the existing noise levels close to the C2C Scheme alignment and at locations nearby with potentially sensitive receptors. It has also been used to verify the outputs from the 3D noise model that has been created for the C2C Scheme to help understand how noise propagation might be affected by landform or engineered features, such as bunds and embankments.

Plate TR1-2-1 - Noise survey monitoring locations



2.1.4. A summary of the noise levels measured at each of the monitoring locations, which includes the ranges and averages of those levels, is presented in **Table TR1-2-1** below. The daytime $L_{A10,18h}$ values for the short-term attended positions (RTN) have been derived by subtracting 1 dB from the measured $L_{A10,3h}$ values in line with the guidance in CRTN. These values have been presented to verify the outputs, also in terms of $L_{A10,18h}$, from the 3D noise model.

2.1.5. Further details of the exact positions of the monitoring locations and the sound level meter setups are presented in **Appendix B**.

Table TR1-2-1 - Measured noise levels at ML1-5 and RTN1-3

Monitoring location	Daytime noise levels $L_{Aeq,16h}$	Daytime noise levels $L_{A10,18h}$	Night-time noise levels $L_{Aeq,8h}$
ML1	44 – 56 dB Average: 50 dB	44 – 52 dB Average: 50 dB	34 – 43 dB Average: 39 dB
ML2	50 – 55 dB Average: 54 dB	52 – 58 dB Average: 55 dB	43 – 50 dB Average: 45 dB
ML3	48 – 55 dB Average: 52 dB	50 – 59 dB Average: 55 dB	42 – 51 dB Average: 48 dB
ML4	51 – 56 dB Average: 53 dB	50 – 56 dB Average: 53 dB	42 – 51 dB Average: 48 dB
ML5	46 – 51 dB Average: 49 dB	48 – 55 dB Average: 52 dB	43 – 48 dB Average: 45 dB
	Daytime $L_{A10,3h}$		Daytime noise levels $L_{A10,18h}$
RTN1	72 dB		71 dB
RTN2	77 dB		76 dB
RTN3	78 dB		77 dB

2.1.6. Whilst there were still some COVID-19 restrictions in place in January 2022, these were at a minimum (including the requirement to wear face coverings). Consequently, the measured baseline noise levels are considered to be representative of the existing noise climate. If traffic volumes were lower than previous years (or will be in the future), the resultant lower measured noise levels would represent a worst-case scenario as the data have been used as a basis for the increase in noise as a result of the new bus route.

3 METHODOLOGY SUMMARY

3.1 LEGISLATION, NATIONAL AND LOCAL POLICY, AND GUIDANCE DOCUMENTS

3.1.1. This section presents a summary of the relevant legislation, national and local planning policies, and standards applicable to the assessment of noise and vibration from the C2C Scheme. Further details are presented in **Appendix C**.

LEGISLATION

3.1.2. The applicable legislative is set out below:

- The Control of Pollution Act (CoPA) 19742 which was introduced to cover a wide range of environmental pollution including construction noise. Parts of the Act have been superseded by the Environmental Protection Act (please see below).
- The Environmental Protection Act (EPA) 19903 (as amended) which, amongst many other things, requires local authorities to issue a noise abatement notice where it is satisfied that a noise nuisance exists or is likely to occur or recur.
- The Land Compensation Act 1973 which provides a means by which compensation can be paid to owners of land or property which has experienced a loss in value caused by the use of public works, such as new or altered roads or busways. Noise and vibration are two of the factors which would be considered in any claim for compensation; however the claim should consider all changes and effects, including betterment.
- The Noise Insulation Regulations 1975 (as amended) Regulation 3 imposes a duty, and Regulation 4 a power, on the relevant Highway Authority to undertake or make a grant in respect of the cost of undertaking noise insulation work in eligible buildings affected by a new or altered highway. This is subject to meeting a range of criteria relating to road traffic noise levels and distance from the works as specified in the Regulations. Regulation 5 also provides discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in eligible buildings with respect to construction noise.

NATIONAL AND LOCAL POLICY

3.1.3. The applicable national and local planning policy for the noise and vibration assessment is set out below:

- The Noise Policy Statement for England (NPSE)4, issued by the Department for Environment, Food and Rural Affairs (Defra) in 2010;
- The National Planning Policy Framework (NPPF)5, revised in 2021;

[2] UK Government, (1974); The Control of Pollution Act 1974, HMSO.
[3] UK Government, (1990); Environmental Protection Act.
[4] Department for Environment Food and Rural Affairs (DEFRA) (2010). The Noise Policy Statement for England.
[5] Ministry of Housing, Communities and Local Government 2021, National Planning Policy Framework.

- Planning Practice Guidance (PPG) Noise, 2019[6];
- South Cambridgeshire Local Plan, adopted in 2018;
- City of Cambridge Local Plan, adopted in 2018; and
- Greater Cambridge Sustainable Design and Construction Supplementary Planning Document, adopted in 2020.

GUIDANCE DOCUMENTS

3.1.4. The guidance documents used in this noise and vibration assessment are summarised below.

3.1.5. The following documents have been used for the prediction and assessment of construction noise and vibration at existing sensitive receptors close to the C2C Scheme:

- BS 5228:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites* Part 1: *Noise*[7] and Part 2: *Vibration*[8].

3.1.6. The following documents have been referenced for predicting and assessing operational road traffic noise, noise associated with the travel hub and noise associated with the busway, affecting the existing receptors:

- Department of Transport/Welsh Office (1988) *Calculation of Road Traffic Noise* (CRTN)[9];
- Highways England, Transport Scotland, Welsh Government and the Department for Infrastructure (Northern Ireland) *Design Manual for Roads and Bridges*. Sustainability & Environment Appraisal. LA 111 *Noise and vibration*[10];
- BS 4142: 2014+ A1:2019 *Methods for rating and assessing industrial and commercial sound;*
- BS 8233: 2014 *Guidance on sound insulation and noise reduction for buildings;* and
- World Health Organisation (WHO) *Guidelines for community noise* (1999).

3.2 ASSESSMENT METHODOLOGY

CONSTRUCTION NOISE

3.2.1. The construction noise predictions have been undertaken and assessed in line with the methodologies in BS 5228:2009+A1:2014 Part 1: *Noise,* which is also specified in DMRB LA 111 for this purpose. **Table TR1-3-1** presents the magnitude of impact scale for construction noise.

[6] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities and Local Government (2019); Planning Practice Guidance, Noise.
[7] British Standards Institution, (2014). BS 5228:2009+A1:2014 *Noise and vibration control on construction and open sites* Part 1: *Noise*. British Standards Institution.
[8] British Standards Institution, (2014). BS 5228:2009+A1:2014 *Noise and vibration control on construction and open sites* Part 2: *Vibration*. British Standards Institution.
[9] Department of Transport, (1988); *Calculation of Road Traffic Noise*. HMSO.
[10] Highways England, Transport Scotland, Welsh Government and the Department for Infrastructure (Northern Ireland) *Design Manual for Roads and Bridges*. Sustainability & Environment Appraisal. LA 111 *Noise and vibration*, Revision 2, dated May 2020.

Table TR1-3-1 - Scale of effect: construction noise

Level of noise solely from construction works $L_{Aeq,T,}$ dB	Magnitude of impact	Significance of effect
Less than 52	Negligible	Not significant
52 – 65	Minor	
65 – 70	Moderate	Significant
Greater than 70	Major	

3.2.2. Construction noise predictions have been based on generic construction phases and plant lists for a realistic worst-case scenario, as set out in **Appendix D**. Noise levels have been predicted at existing receptors in proximity to the C2C Scheme.

3.2.3. Construction noise may be considered 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 exceeding 40 in any 6 consecutive months.

CONSTRUCTION VIBRATION

3.2.4. For construction vibration the magnitude of impact scale has been determined based on guidance contained within BS 5228 Part 2 *Vibration,* which is also referenced in DMRB LA 111. presents the magnitude of impact scale for construction vibration.

Table TR1-3-2 - Scale of effect: construction vibration for residential receptors

Vibration level, PPV mm/s	Magnitude of impact	Significance of effect
≤0.3	Negligible	Not significant
0.4 – 0.9	Minor	
1.0 – 4.9	Moderate	Significant
≥5.0	Major	

3.2.5. Construction vibration predictions have been based on the operation of a vibratory roller. Vibration levels have been predicted at existing receptors in proximity to the C2C Scheme.

3.2.6. Piling works are anticipated to be required for the construction of the bridge over the M11. It is understood that the piling will be continuous flight auger (CFA), which generates minimal levels of vibration (as stated in BS 5228-2), and therefore this activity has not been assessed in further detail.

3.2.7. Construction vibration may be considered 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 exceeding 40 in any 6 consecutive months.

3.2.8. Given the location of the C2C Scheme, an additional assessment has been undertaken to determine the potential vibration impact on any laboratory equipment associated with any nearby research

facilities. The threshold of significance of any laboratory equipment has been taken to be 0.1mm/s, which is considered to be suitable in most instances for microscopes to 100X magnification and other equipment of low sensitivity. The duration criteria as set out in paragraph 3.2.7 is not considered to apply to laboratory equipment.

3.2.9. It is understood that the Department of Materials Science and Metallurgy has an ultra-sensitive electron microscope located to the south of the building. This microscope is on a dampened floating slab, and consequently is designed to mitigate vibration generated either from within or external to the building and is not considered further.

OPERATIONAL ROAD TRAFFIC NOISE

3.2.10. The assessment to determine the likelihood of any changes in road traffic noise levels on the surrounding road network uses forecast traffic flow data for 2041 (the year of opening) for the scenario both with and without the C2C Scheme, and with and without the Making Connections Scheme (as conceived for public consultation in November 2022), derived from the County Council's CSRM strategic model. The Making Connections Scheme is a wide-reaching programme run by GCP to improve connectivity around Cambridgeshire generally.

3.2.11. The prediction methodology follows the procedure set out in CRTN and the assessment of any changes in noise levels has been undertaken in accordance with the DMRB.

3.2.12. The calculations have been undertaken within a 200m study buffer of the C2C Scheme. Comparisons between the two traffic scenarios (without vs. with the C2C Scheme) have been made to assess the magnitude of any effects likely from the C2C Scheme. The assessment criteria are shown in **Table TR1-3-3** below.

Table TR1-3-3 - Scale of effect: development related road traffic noise

Short-term change in noise level, dB(A) [1]	Magnitude of impact [2]	Significance of effect [3]
0 to 0.9	Negligible	Not significant
1.0 to 2.9	Minor	Significant (depending on context)
3.0 to 4.9	Moderate	
≥ 5.0	Major	

Notes:
[1] Noise level change ($L_{A10,18h}$) could be negative or positive
[2] Impact could be positive or negative
[3] Significance of effect could be beneficial or adverse

3.2.13. The DMRB LA 111 states in paragraph 3.59 that:

"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 cause changes to behaviour or response to noise and as such, will not give rise to a likely significant effect."

3.2.14. Where noise level changes in the short-term of minor, moderate or major magnitude of impact are predicted, further consideration should be given as to whether these changes could lead to significant effects and a range of contextual factors which need to be considered. These factors include:

- The absolute noise level, and whether it is above or below the Lowest Observed Adverse Effect Level (LOAEL) or the Significant Observed Adverse Effect Level (SOAEL). The LOAEL and SOAEL are defined respectively in the NPSE as the level of noise above which adverse effects on health and quality of life can be detected, and the level of noise above which significant adverse effects on health and quality of life occur.
- The acoustic context, for example if project changes the acoustic character of an area, it can be appropriate to conclude a minor magnitude of change is a likely significant effect.
- Likely perception of change by residents, for example if a 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.

3.2.15. The LOAEL and SOAEL thresholds for operational road traffic are defined in DMRB LA 111 (Table 3.49.1) and have been reproduced in **Table TR1-3-4** below.

Table TR1-3-4 - Operational road traffic noise LOAEL and SOAEL thresholds

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

OPERATIONAL NOISE ASSOCIATED WITH THE TRAVEL HUB

3.2.16. The significance of potential noise impacts from the use of the travel hub has been based on the principles of BS 4142 whereby a rating level in excess of 5 dB over the representative background sound level would be indicative of significance, subject to the consideration of all pertinent contextual factors. The assessment criteria are shown in **Table TR1-3-5** below.

Table TR1-3-5 - Scale of effect: noise associated with travel hub

Exceedance of rating level of background sound level, dB(A)	Magnitude of impact	Significance of effect
0 to 0.9	Negligible	Not significant
1.0 to 4.9	Minor	
5.0 to 9.9	Moderate	Significant (depending on context)
≥ 10.0	Major	

3.2.17. Consideration has also been given as to whether target internal and external noise criteria are in line with the guidance contained within BS 8233 and the WHO Guidelines, as summarised below.

Table TR1-3-6 - Internal and external noise criteria for residential development

	Daytime	Night-time	
	$L_{Aeq,16h}$	$L_{Aeq,8h}$	Typical L_{AFmax}
Internal noise levels (habitable rooms)	35 dB	30 dB	45 dB
External noise levels (gardens)	55 dB	-	

3.2.18. BS 8233 also states that "*where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved*".

OPERATIONAL NOISE ASSOCIATED WITH THE BUSWAY

3.2.19. The significance of potential noise impacts from the operation of the busway has been based on the principles of the noise level changes set out in the DMRB LA 111, and as presented in **Table TR1-3-3.**

3.2.20. However, the change in noise level needs to be considered in context. Consequently, consideration has been given as to whether the internal and external noise criteria, as set out in **Table TR1-3-6**, are likely to be exceeded and whether the noise levels from the busway are above or below the LOAEL and SOAEL thresholds as set out in **Table TR1-3-4**.

4 EMBEDDED MITIGATION

4.1.1. The following mitigation measures are assumed to be embedded as part of the C2C Scheme and the construction methods as part of the C2C Scheme, and as set out in the CoCP[11] in section 10.1. The CoCP is to be secured by conditions in the deemed planning permission.

4.2 CONSTRUCTION NOISE AND VIBRATION

4.2.1. The Best Practicable Means (BPM) as defined in the Control of Pollution Act 1974 will be adopted to minimise noise and vibration from construction works. The most relevant and specific commitments with respect to noise and vibration are set out below:

- Noise and vibration control at source - for example, the selection of equipment that is quiet and generates low levels of vibration, review of construction programme and methodology to consider quieter methods, location of equipment on site, control of working hours (see Section 3.8 of the ES), the provision of acoustic enclosures and the use of less intrusive alarms, such as broadband vehicle reversing warnings;
- Acoustic screening - for example, local screening of equipment, perimeter hoarding or the use of temporary stockpiles;
- Public Communications – for example, letter drops to nearby residents to inform them of the construction programme and any periods of significant work, as well as a phone number to contact for any complaints; and
- Avoidance of potentially sensitive periods or events which, for example, may have been flagged during the community liaison exercise.

4.2.2. The embedded mitigation set out above is anticipated to reduce the overall effect of the construction activities at nearby receptors. Therefore, the noise levels predicted as a result of the construction works, as set out in Section 5, have been reduced by 5 dB based on professional judgment and experience.

4.3 OPERATIONAL NOISE AND VIBRATION

4.3.1. The assessment has identified no need for any specific measures to mitigate noise and vibration impacts from the operational scheme.

[11] Code of Construction Practice (Document reference: C2C-26-00-Code of Construction Practice)

5 ASSESSMENT OF IMPACTS AND EVALUATION OF EFFECTS

5.1 CONSTRUCTION NOISE

5.1.1. This assessment considers the noise effects likely to arise during construction works associated with the C2C Scheme. It is expected that there will be some disruption in terms of noise impacts at existing sensitive receptors, however, disturbance will be localised, and works will be temporary.

5.1.2. Due to the scale of the C2C Scheme, the receptors that are predicted to be significantly affected have been determined by their proximity to specific construction activities.

5.1.3. There are two overarching activities associated with the construction of the Proposed Scheme including:

- Activity 1 – Site clearance and earthworks; and
- Activity 2 – Road / structure construction.

5.1.4. The overall noise level associated with these activities has been determined and the distance within which a significant effect (deemed to be >65 dB $L_{Aeq,T}$, see **Table TR1-3-1**) would occur has been calculated. Using this distance to mark the maximum geographical extent of the area likely to be affected by this level of noise, receptors within this buffer have been identified.

5.1.5. There are a number of compounds proposed along the route. Compounds often comprise site offices, welfare facilities, parking, and storage of material. No batching plants will be required, and materials required for the M11 overbridge will maximise DfMA (Design for Manufacture and Assembly) opportunities. Significant works are therefore unlikely to occur in these areas, and therefore a detailed assessment of potential noise or vibration impacts has not been undertaken. However, the mitigation measures set out in Section 4 should be employed to minimise any potential effects.

5.1.6. The calculation methodology contained in BS 5228-1 has been used to predict the levels of noise that are likely to be generated by the works. The construction plant emission data have been taken from Annex C of BS 5228-1. Details of these plant and their noise emission levels, as well as their assumed 'on-time', are shown in **Appendix D**.

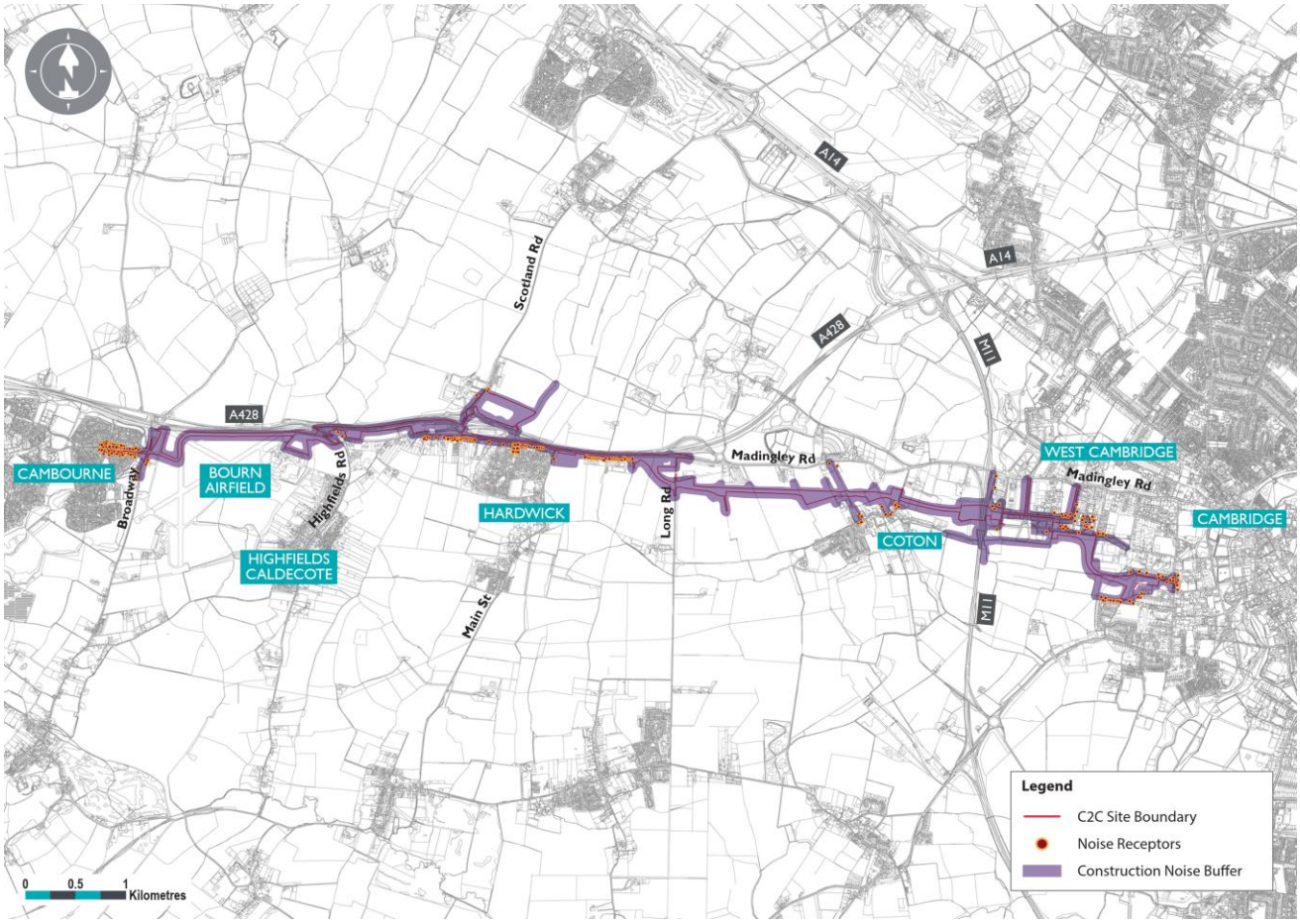
5.1.7. The noise mitigation embedded into the C2C Scheme has been identified in Section 4. The mitigation will reduce the overall effect of the construction activities at nearby receptors therefore the overall noise levels predicted have been reduced by 5 dB in the process of determining the distance at which a significant effect may occur. The furthest distance from construction activities where it is predicted that a significant effect may occur is identified in **Table TR1-5-1**.

Table TR1-5-1 - Distance at which a significant effect is predicted to occur

Activity	Overall noise level at 10m (dB)	Maximum distance at which a significant effect may occur (m)
Site clearance/ earthworks	76	40
Road / structure construction	75	36

5.1.8. A 40m buffer (as a worst-case scenario) around the limits of land to be acquired and used (LLAU) for the C2C Scheme is presented in **Plate TR1-5-1** to help identify the locations of receptors where it is predicted that a significant noise effect may occur as a result of the construction works.

Plate TR1-5-1 - Sensitive receptors within significant construction noise effect buffer



5.1.9. Potentially significant adverse noise impacts are predicted to be possible at approximately 279 receptors as a result of the construction works during the site clearance, earthworks and road/structure construction.

5.1.10. As stated in paragraph 3.2.3, significant noise effects are only anticipated if the works extend beyond 10 or more days or nights in any 15 consecutive days or nights or a total number of days exceeding 40 in any 6 consecutive months. With the exception of works for the travel hub, the retaining walls north of St Neots Road and the construction of Bin Brook Bridge, the construction works are very unlikely to exceed these duration criteria. Whilst the construction of the M11 would also exceed the duration criteria, there are no sensitive receptors nearby.

5.1.11. Consequently, only six receptors in proximity to the travel hub, the retaining walls north of St Neots Road and the Bin Brook Bridge are predicted to experience significant adverse effects as a result of the construction works, as shown on **Plate TR1-5-2** and **Plate TR1-5-3** below.

Plate TR1-5-2 - Sensitive receptors with significant construction noise effects – near travel hub and St Neots Road

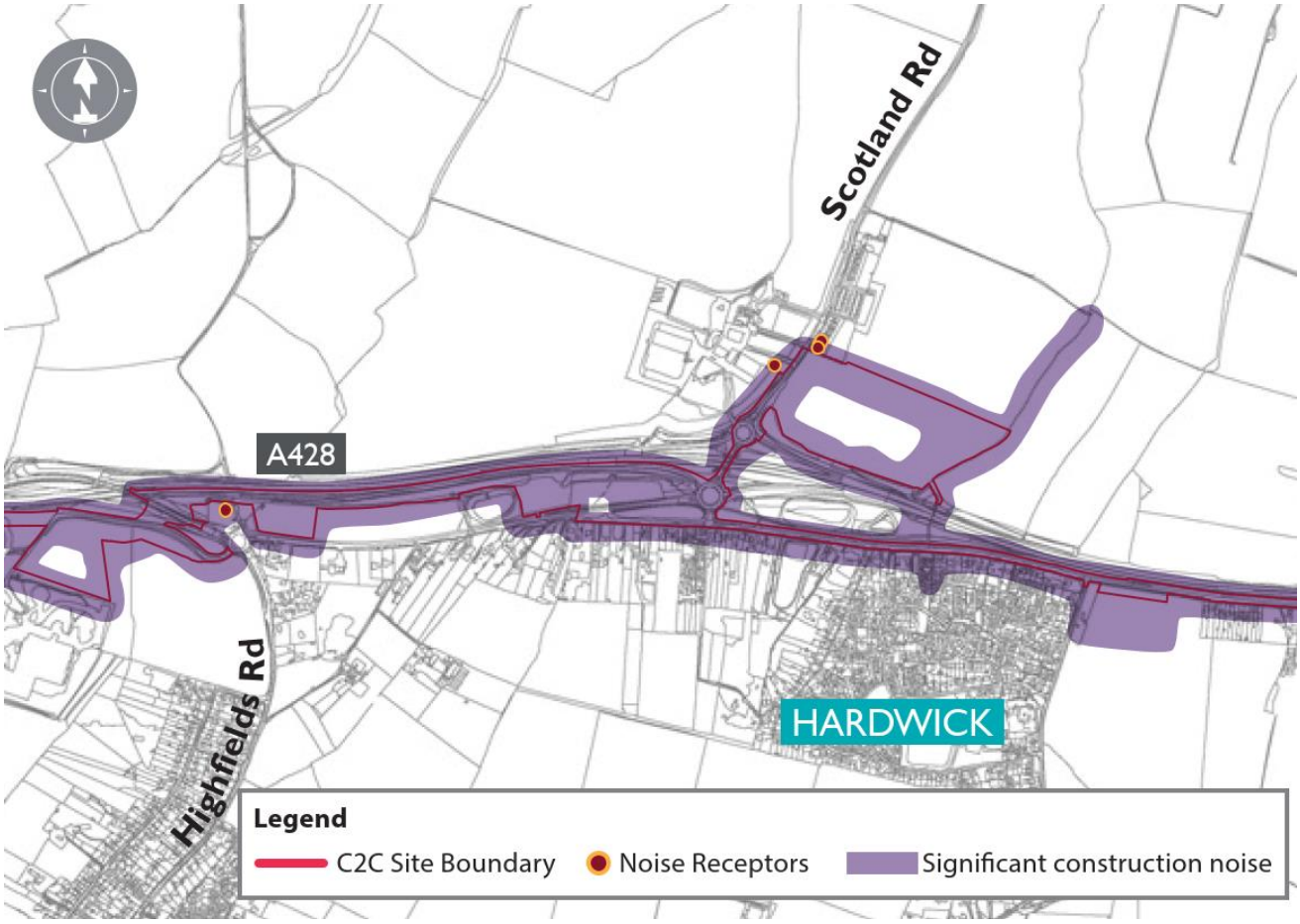
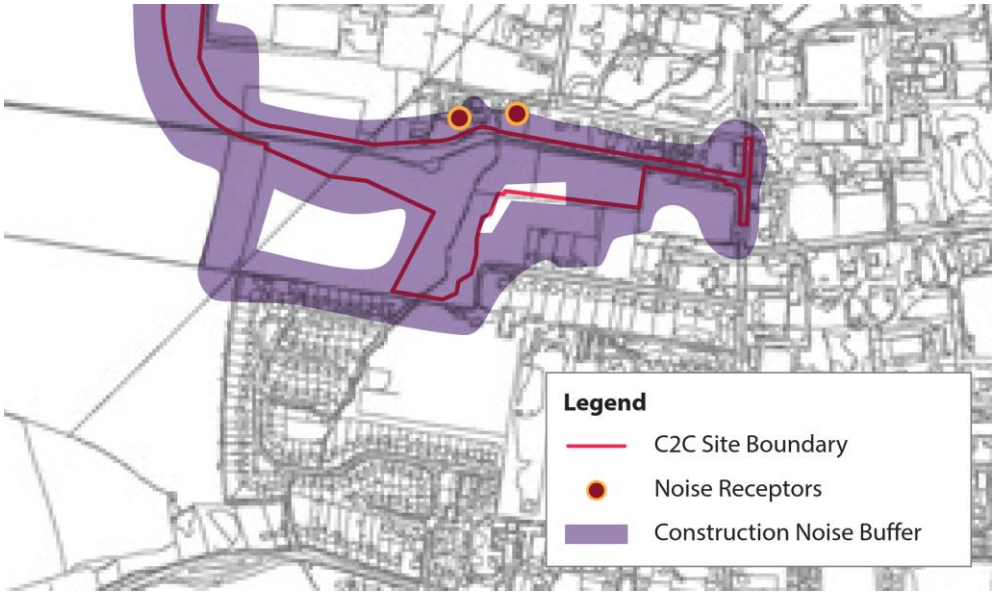


Plate TR1-5-3 - Sensitive receptors with significant construction noise effects – near Bin Brook Bridge



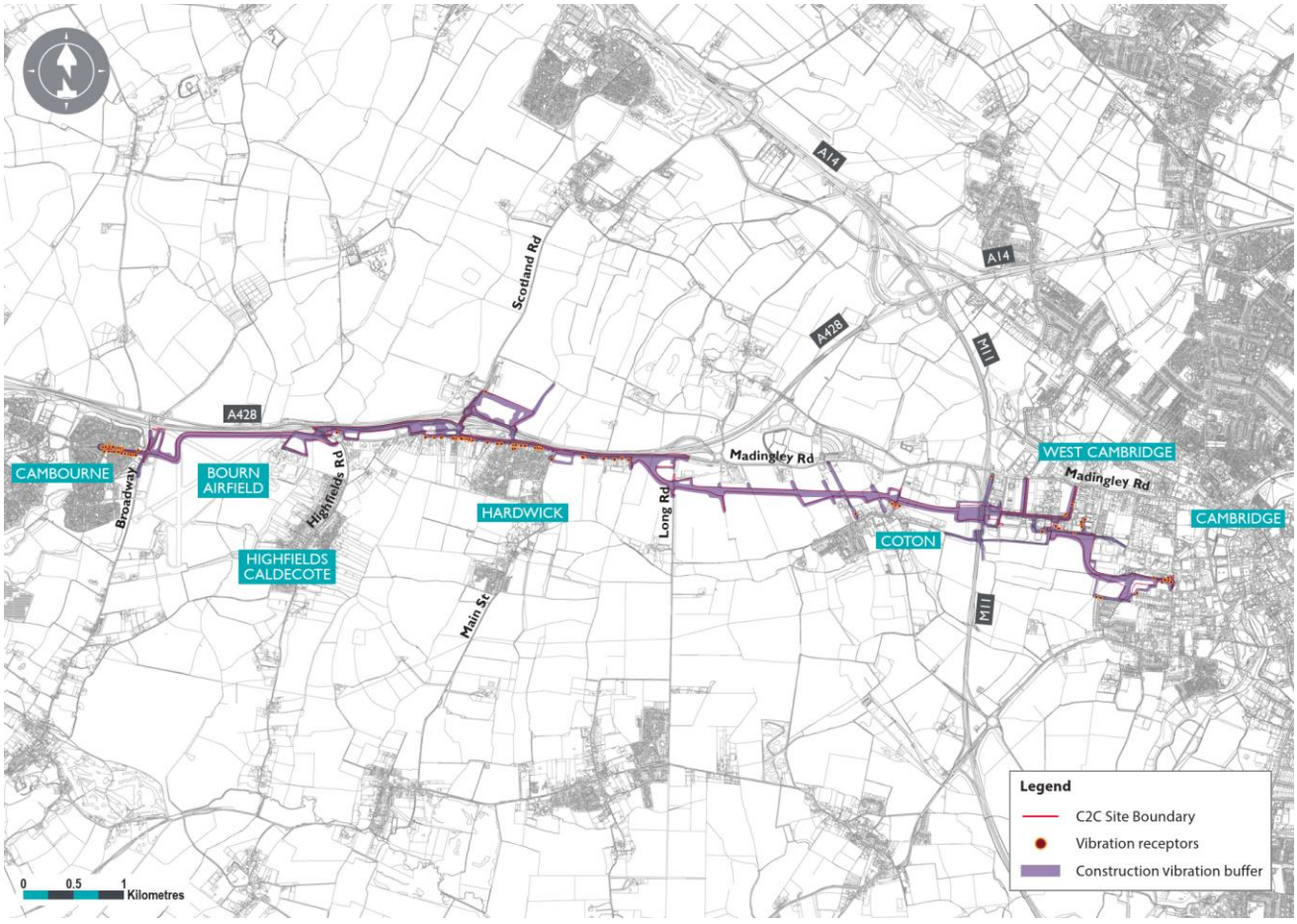
5.2 CONSTRUCTION VIBRATION

DWELLINGS

5.2.1. The main vibration generating activity anticipated in the construction activities is the use of vibratory rollers used in the road construction activity. In order to determine where a significant effect may occur at nearby dwellings due to the use of vibratory rollers, calculations in line with BS 5228-2 Table E.1 have been carried out. The distance at which a significant effect (1mm/s) would occur has been calculated to be 15m for the roller in steady state operation. This calculation assumes a roller with two drums, 0.4mm amplitude and a drum width of 1.3m (e.g. a small ride on roller). The calculation incorporates a 33% chance of exceeding the criterion.

5.2.2. A 15m buffer around the LLAU of the C2C Scheme is presented in **Plate TR1-5-4** to identify the locations of receptors where it is predicted that a significant vibration effect may occur as a result of the construction works.

Plate TR1-5-4 - Sensitive receptors within significant construction vibration effect buffer



5.2.3. Potentially significant adverse vibration impacts are predicted at 95 receptors as a result of the construction works. However, as the vibratory roller will only be in operation for a few days at most, the duration criteria as set out in paragraph 3.2.7 is not anticipated to be exceeded. Consequently, no significant vibration effects are expected as a result of the construction works.

VIBRATION-SENSITIVE FACILITIES

5.2.4. Similar to the above, in order to determine where a significant effect may occur at potentially vibration-sensitive facilities due to the use of vibratory rollers, calculations in line with BS 5228-2 Table E.1 have been carried out. The distance at which a potentially significant effect (0.1mm/s) would occur for microscopes to 100X and other equipment of high sensitivity has been calculated to be 60m for the roller in steady state operation.

5.2.5. The following facilities, which could contain particularly vibration-sensitive equipment, have been identified within this 60m buffer:

- Department of Materials Science and Metallurgy;
- Mira Building;
- The Cambridge Equine Hospital;
- Department of Chemical Engineering and Biotechnology;
- Maxwell Centre;
- The Nanoscience Centre; and
- Magnetic Resonance Research Centre.

Once the construction programme and methodologies are known, a more detailed assessment should be undertaken to predict the vibration levels at these facilities (and potentially other facilities nearby depending on the sensitivity of equipment contained within), using details of vibration-generating plant that are likely to be used during the construction phase. It is also recommended that consultation is undertaken with the above facilities to ascertain whether there are any vibration-sensitive spaces/items and their location. Using equipment that generates minimal vibration may be required to mitigate any potentially significant impacts.

5.3 CUMULATIVE CONSTRUCTION NOISE AND VIBRATION

5.3.1. Cumulative construction noise and vibration effects can occur at a receptor where works are undertaken simultaneously at two sites close by. Construction noise impacts are more common than vibration, as generally, vibration generating activities occur less often and over shorter durations than noise generating activities. Also, vibration impacts are usually more localised than noise impacts. Cautiously, any committed developments with construction works occurring within 300m of the C2C Scheme have been considered.

5.3.2. **Table TR1-5-2** presents a summary of the committed developments with the potential to result in cumulative adverse effects in combination with the C2C Scheme (i.e. any that are situated within 300m of the C2C Scheme). The consideration of potential cumulative construction noise and vibration effects for each of the committed developments is also included. Committed developments which are located at too great a distance for cumulative significant effects to occur have not been included in the table.

Table TR1-5-2 - On-site construction effects from committed developments

Application name and reference	Closest distance from C2C	Status	On-site construction effects
Bourn Airfield New Village S/3440/18/OL	0m	Post application	From a review of the ES associated with this scheme, no significant adverse construction noise or vibration effects were anticipated with the proposed embedded mitigation. However, if the construction works overlap in terms of programme, there is the potential for cumulative construction phase impacts as a result of C2C and this scheme at receptors to the east close to Broadway.
West Cambridge Development Site 17/1799/FUL 17/1896/FUL	50 – 90m	Under construction	From a review of the ES associated with this scheme, no significant adverse construction noise or vibration effects were anticipated with the proposed embedded mitigation. However, if the construction works overlap in terms of programme, there is the potential for cumulative construction phase impacts as a result of C2C and this scheme at nearby receptors.
New Development at St Chad's 19/1212/FUL	15m	Consented	The location of this development is such that there is the potential for cumulative construction phase impacts at nearby sensitive receptors. The adoption of the mitigation measures in the CoCP will minimise impacts as far as possible.
Grange Lane College Accommodation S/C/U3	5m	Under construction	The location of this development is such that there is the potential for cumulative construction phase impacts at nearby sensitive receptors.

5.4 OPERATIONAL NOISE

3D NOISE MODEL

5.4.1. A detailed acoustic model of the C2C Scheme and the surrounding area has been produced to calculate the level of road traffic noise at sensitive receptors close to the travel hub and along the route once C2C is operational. The model has been produced using CadnaA® noise mapping software.

5.4.2. The base mapping has been established using Ordnance Survey open data, whilst the topography has been based on 1m Digital Terrain Model (DTM) data.

5.4.3. For the Proposed Scheme alignment, topographic data have been extracted from the 3D engineering drawings, including the new retaining walls to the north of Childerley Lodge and the bunds created either side of the C2C Scheme north of Coton.

5.4.4. The following assumptions have been adopted in the acoustic model:

- Ground absorption has been set at 1 (i.e. acoustically absorptive conditions) to approximate the acoustically absorptive ground cover between the travel hub and existing road network, and the nearby dwellings;
- All residential buildings, including those identified as sensitive receptors have an assumed height of 8m; and
- All roads have been assumed to have a hot rolled asphalt surface type, with surface corrections applied in accordance with DMRB LA 111.

5.4.5. Traffic data (flow, speed and proportion of heavy vehicles) have been provided for the following assessment scenarios:

- Do-minimum 2041 – without C2C, and without the Making Connections Scheme;
- Do-something 2041 – with C2C, and without the Making Connections Scheme; and
- Do-something 2041 – with C2C, and with the Making Connections Scheme.

5.4.6. In addition to the above, a Do-minimum 2026 without C2C and without the Making Connections scheme has been modelled. This scenario has been used as a proxy to compare against the measured noise levels to validate the 3D noise model. A comparison of the measured and predicted noise levels is presented in **Table TR1-5-3** below.

Table TR1-5-3 - Comparison of measured and predicted noise levels

Measurement Position	Measured noise levels $L_{A10,18h}$	Predicted noise levels $L_{A10,18h}$	Notes
ML1	44 – 52 dB Average: 50 dB	50 dB	Predicted noise level falls within range of measured noise levels at this position. Good correlation.
ML2	52 – 58 dB Average: 55 dB	52 dB	Predicted noise level falls within range of measured noise levels at this position. Good correlation.
ML3	50 – 59 dB Average: 55 dB	54 dB	Predicted noise level falls within range of measured noise levels at this position. Good correlation.
ML4	50 – 56 dB Average: 53 dB	46 dB	Predicted noise level falls below range of measured noise levels at this position. Noise model under-predicting at this position. This is likely due to existing non-road traffic noise sources influencing the measured noise

Measurement Position	Measured noise levels $L_{A10,18h}$	Predicted noise levels $L_{A10,18h}$	Notes
			levels in this area, including Cambridge Lawn Tennis Club.
ML5	48 – 55 dB Average: 52 dB	46 dB	Predicted noise level falls just below range of measured noise levels at this position. Noise model under-predicting at this position. This is likely due to existing non-road traffic noise sources influencing the measured noise levels in this area, including Passersby and Clare Hall Gym and Pool.

ROAD TRAFFIC NOISE

5.4.7. The short-term noise level changes as a result of C2C have been assessed for the following two comparisons:

- Comparison 1 - Do-minimum 2041 without C2C and without Making Connections vs Do-something 2041 with C2C and without Making Connections; and
- Comparison 2 - Do-minimum 2041 without C2C and without Making Connections vs Do-something 2041 with C2C and with Making Connections.

5.4.8. Noise contour maps have been prepared for the above two comparisons. **Plate T1-5-5** presents the short-term change in noise level as a result of the C2C Scheme only (Comparison 1). **Plate TR1-5-6** presents the short-term change in noise level as a result of the C2C Scheme and the Making Connections Scheme (Comparison 2). For completeness, the travel hub has been included in the noise model and the figures.

Plate T1-5-5 - Short-term change in noise level as a result of the C2C Scheme only (Comparison 1)

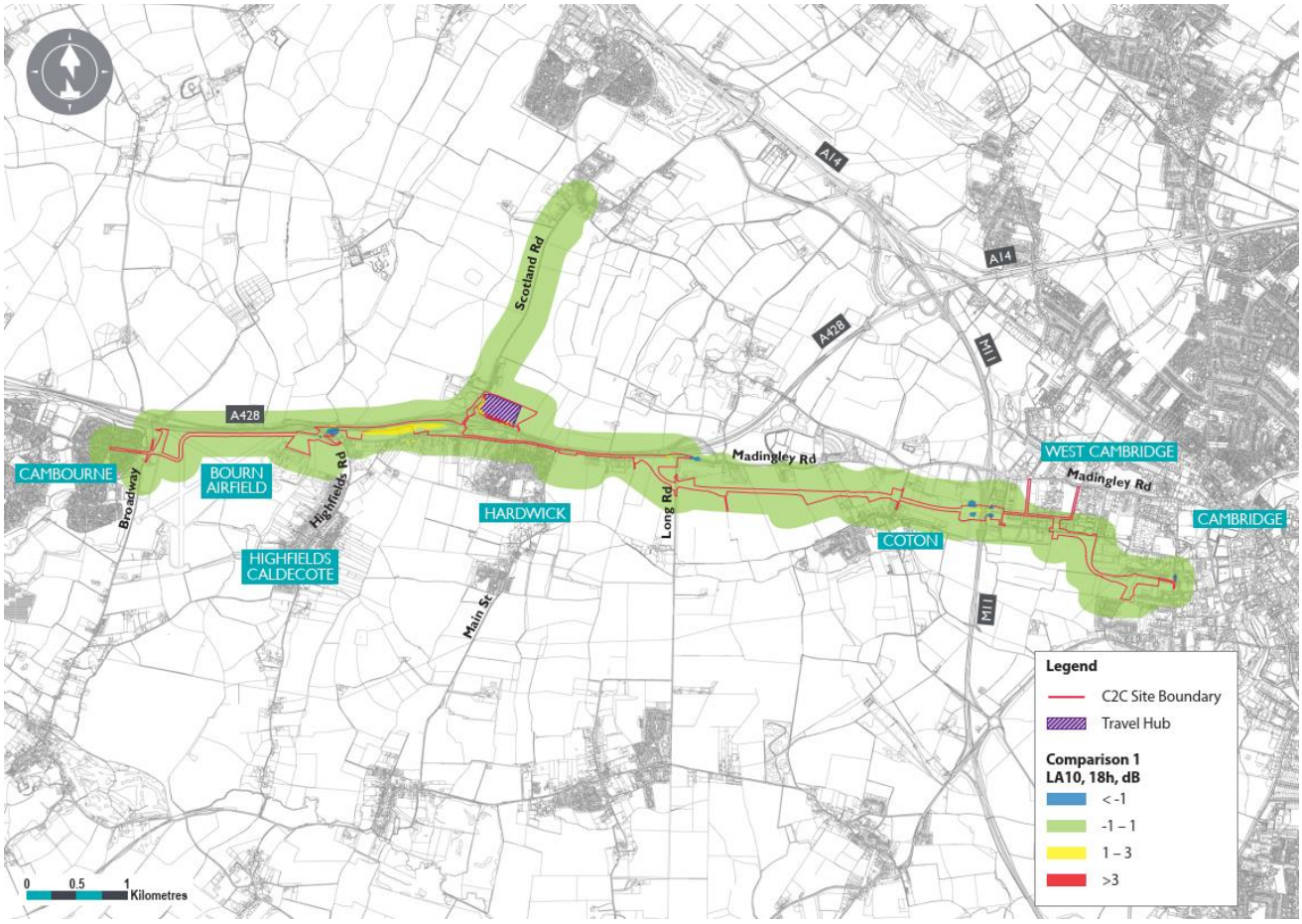
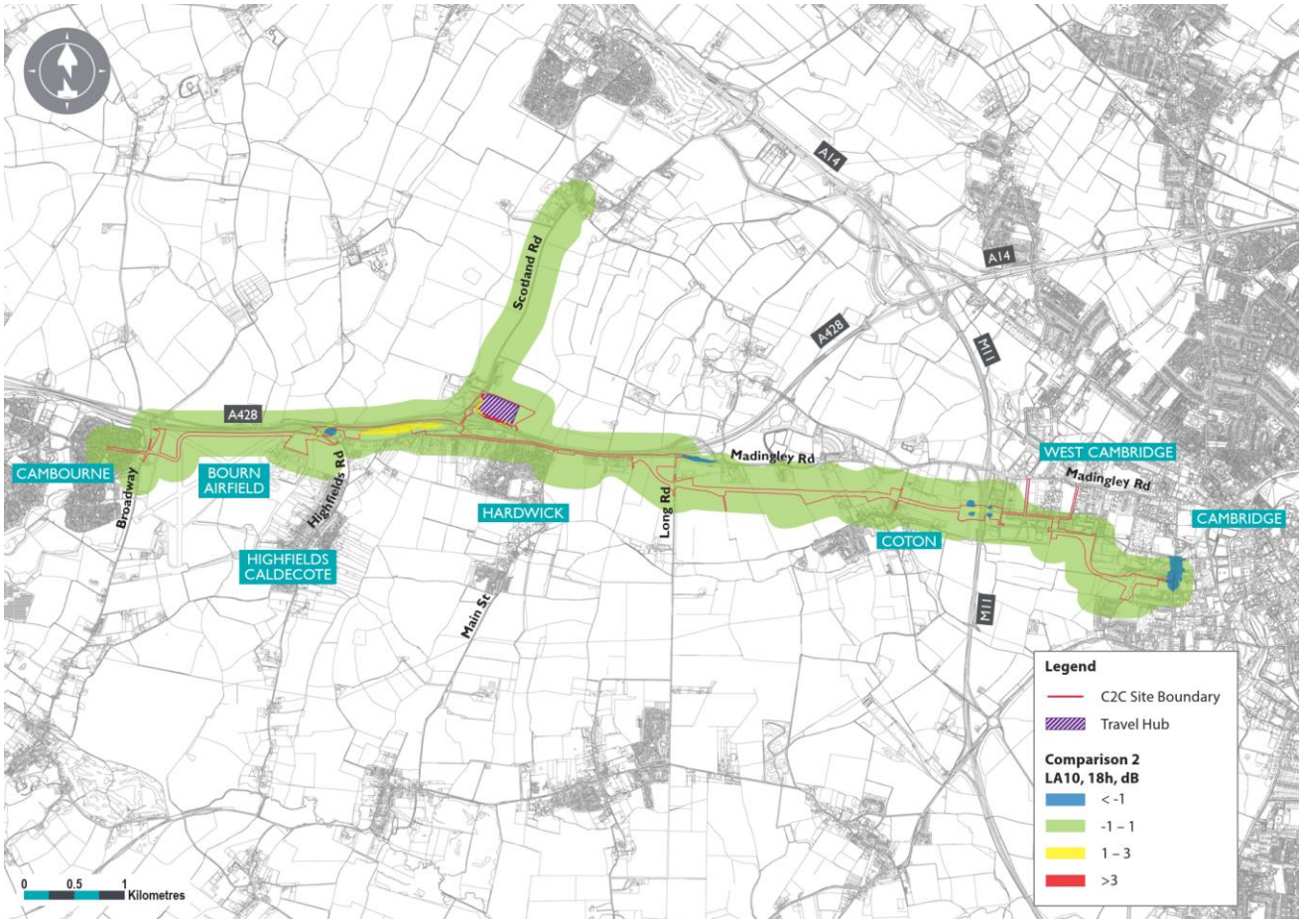


Plate TR1-5-6 - Short-term change in noise level as a result of the C2C and Making Connections Schemes (Comparison 2)



5.4.9. For the vast majority of both comparisons, the short-term changes are negligible (falling within the -1 dB to 1 dB change, shown as light green on the figures). In line with the guidance in the DMRB, it can be concluded that the negligible changes in road traffic noise level will not give rise to a significant effect, as a change of this nature is considered to not be perceptible.

5.4.10. For both comparisons, there is a minor adverse (increase) change in noise level east of Childerley Gate, to the north of St Neots Road, as shown in yellow on the figures. However, there are no properties in the affected area to the north of St Neots Road and therefore this is considered no further.

5.4.11. Similarly, for both comparisons, there is a minor beneficial (decrease) change in noise level due to screening of the M11 road noise by the new overbridge, as shown in darker green on the figures. There are no properties in this area immediately adjacent to the M11 and therefore this is considered no further.

5.4.12. For Comparison 2, there is also a minor beneficial (decrease) change in noise level at the very eastern end of the C2C Scheme along Grange Road. Given this beneficial change is not shown in Comparison 1, this is likely due to the reduction in traffic as a result of the Making Connections Scheme only and therefore this is considered no further.

5.4.13. As only negligible changes are predicted as a result of the C2C Scheme at nearby sensitive receptors, no significant effects are anticipated.

TRAVEL HUB

5.4.14. The current proposals indicate that there will be 2,000 parking spaces. The travel hub will be accessible 24 hours a day, 7 days per week. However, it is understood that the majority of people will be using the travel hub between 06:00 and 19:00. This is based on the project's transport consultant mapping the arrivals and departures from similar park and ride sites in and around Cambridge.

5.4.15. It is anticipated that vehicles will generally manoeuvre within the site at low speeds (<15km/h) and, as such, generate low levels of noise. However, higher noise levels can be generated briefly from doors being slammed and engines starting.

5.4.16. In order to determine the potential impact of noise generated by the travel hub at nearby sensitive receptors, calculations have been undertaken based on typical sound exposure levels (SEL) from vehicle activities and movements that WSP has measured previously, as presented in **Table TR1-5-4**, below.

Table TR1-5-4 - Travel hub source data

Source	SEL
Vehicle pass-by (including engine revving)	71 dBA at 10m
Vehicle door slam	63 dBA at 10m

5.4.17. A SEL is the total sound energy generated by one discrete noise event normalised to a 1 second duration. The approach of using SEL values for discrete events is useful for calculating equivalent noise levels (L_{Aeq}) over a longer period.

5.4.18. An assessment of the potential impact of the travel hub has been undertaken during the daytime (07:00 – 23:00) over a 1-hour period, and during the night-time (23:00 – 07:00) over a 15-minute period, in line with the guidance in BS 4142.

5.4.19. During the daytime, the travel hub will generally be at, or nearing capacity. Between 06:00 and 07:00 (during the night-time period), the hourly traffic profiling shows that approximately 20% of the spaces would be used.

5.4.20. Each time the space is used impacts will arise when vehicles pull in to, and away from, the space.

5.4.21. The equivalent daytime 1-hour L_{Aeq} level and night-time 15-minute L_{Aeq} level has been calculated from the SEL values for each parking space, and taking the above into account as follows:

$$\mathbf{L_{Aeq,1h} = SEL + 10logN – 10logT}$$

where: **N** = movements per space within the relevant time period (taken to be two, reflecting the number of movements associated with each space)

T = time period in seconds (i.e. 3600s for a 1-hour period and 900s for a 15-minute period)

5.4.22. The sound pressure level ($L_{Aeq,T}$ calculated at a reference distance of 10m) for each parking space has been converted to a sound power level by adding 28 dB. The resulting sound power level of

100 dB L_{WA} has been applied across the overall travel hub area within the 3D digital noise model for the daytime, and 99 dB L_{WA} for the night-time.

5.4.23. The nearest sensitive receptors are approximately 40 m from the site boundary of the travel hub. At this distance, the resultant L_{Amax} from door slams at the receptor would be 51 dB. Assuming a 15 dB sound reduction for a partially open window, the resultant L_{Amax} internal level would be 36 dB, which is comfortably below the criterion of 45 dB (as presented in **Table TR1-3-6**). Therefore, the L_{Amax} noise levels arising from individual events are considered no further in this assessment.

5.4.24. With the noise sources described in **Table TR1-5-4** included in the noise model, the predicted noise level from the operation of the travel hub at the nearest sensitive receptors is 29 dB $L_{Aeq,1h}$ during the day (predicted at a height of 1.5m, representative of a ground floor living room) and 32 dB $L_{Aeq,15min}$ during the night (predicted at a height of 4m, representative of a 1st floor bedroom window).

5.4.25. The typical background sound level at ML2 (very close to the location of the proposed travel hub) is 44 dB $L_{A90,T}$ during the day and 32 dB $L_{A90,T}$ during the night. It can be seen that the predicted noise levels from the operation of the travel hub do not exceed the existing background sound level at the nearest receptor. Consequently, and in line with the scale of effect in **Table TR1-3-5**, no significant adverse effects are anticipated.

5.4.26. BS 4142 requires that all assessments also consider all pertinent contextual factors. Therefore, the resultant internal noise levels within habitable rooms (living rooms and bedrooms) have also been considered. Assuming a 15 dB sound reduction for a partially open window, the predicted noise level in internal spaces of nearby receptors would be 14 dB during the day and 17 dB during the night. As such, the predicted noise level falls comfortably below the daytime and night-time criteria (as presented in **Table TR1-3-6**) for habitable rooms of sensitive receptors with windows open.

5.4.27. The corrections which may be applied to account for the acoustic character of the noise source, as set out in BS 4142. Any characteristics associated with a noise level of 29-32 dB would be unlikely to attract attention. Furthermore, the proposed sources of noise are similar in character to the existing dominant source of noise (i.e. road traffic) in proximity to the nearby sensitive receptors. Therefore, no corrections have been applied.

5.4.28. Given the particularly low predicted noise level levels, in comparison to the guideline criteria, no significant noise effects are anticipated from the travel hub.

BUSES

5.4.29. It is understood that the C2C Scheme will use single decker buses, 12m long, and containing, as a minimum, a Euro VI compliant engine, with an aspiration for electric vehicles to be introduced at the earliest opportunity.

5.4.30. In order to determine the potential impact of the buses at nearby sensitive receptors, calculations have been undertaken based on typical sound exposure levels (SEL) from bus movements that WSP has measured previously.

Table TR1-5-5 - Bus source data

Source	SEL
Bus pass-by	72 dBA at 10m

5.4.31. An assessment of the potential impact of the bus movements has been undertaken during the daytime (07:00 – 23:00) and night-time (23:00 – 07:00) over a 1-hour period.

5.4.32. It is understood there will be 8 movements each way every hour from Cambourne to Caldercote, and 10 movements each way every hour from Hardwick to West Cambridge fringe (Newnham). This is based on following assumed routing:

- Huntingdon – Papworth – Cambourne – Cambridge City Centre (2 buses per hour);
- St Neots – Cambourne – Cambridge City Centre (2 buses per hour);
- Cambourne – Cambridge City Centre (2 buses per hour);
- Cambourne – Cambridge Biomedical Campus (2 buses per hour); and
- Scotland Farm Travel Hub – CBC (2 buses per hour).

5.4.33. The equivalent daytime 1-hour L_{Aeq} level has been calculated for the bus pass-bys, and taking the above into account:

$$\mathbf{L_{Aeq,1h} = SEL + 10logN – 10logT}$$

where: **N** = movements per hour (16 Cambourne – Caldercote, and 20 in Hardwick - Newnham)

T = time period in seconds (i.e. 3600s for a 1-hour period)

Cambourne

5.4.34. The closest sensitive receptors are approximately 10m from the C2C in this area. At this distance, the resultant sound pressure level, based on 8 buses per hour each way, is 48 dB $L_{Aeq,1h}$.

5.4.35. This predicted noise level from the operation of the busway falls within the range of measured noise levels during the day at ML1 (44 – 56 dB $L_{Aeq,16h}$), and during the one hour night-time period between 06:00 – 07:00 (36 – 48 dB $L_{Aeq,1h}$). However, the predicted noise level from the operation of the busway exceeds the range of measured noise levels during the one hour night-time period between 23:00 – 00:00 (38 – 44 dB $L_{Aeq,1h}$). This noise level difference of 4 – 10 dB, a moderate to major magnitude of impact in line with the scale of effect in **Table TR1-3-3**, should be seen in context, and this is explored in more detail below. Further contextual considerations are also provided for the daytime noise levels as well.

5.4.36. The predicted noise level from the bus movements is comfortably below the target external noise criterion in gardens of 55 dB (as presented in **Table TR1-3-6**), as well as the daytime and night-time SOAEL (as presented in **Table TR1-3-4**).

5.4.37. Furthermore, and assuming a 15 dB sound reduction for a partially open window, the resultant internal level would be 33 dB. This is below the daytime criterion of 35 dB (as presented in **Table TR1-3-6**). It exceeds the night-time criterion of 30 dB (as presented in **Table TR1-3-6**), but it falls within the 5 dB relaxation to achieve reasonable internal conditions (see paragraph 3.2.18 for further details). The buses only operate during the night-time period (23:00 – 07:00) during the first and last hour (i.e. between 23:00 – 00:00, and 06:00 – 07:00). Internal noise levels during the day and night would be comfortably achieved with windows closed.

5.4.38. It is acknowledged that, in this area, the busway is 'offline' (i.e. not on or alongside an existing road). However, the receptors are located near to other local roads (including Sterling Way and Broadway) and therefore will be exposed to existing transport noise to some degree.

5.4.39. Based on the above, and the current information at the time of writing, for this offline section, significant adverse effects are possible as a result of the number of bus movements during the night-time period.

5.4.40. However, based on a timetable adopted in line with the current guided busway services, the number of buses during the night-time period, both between 06:00 – 07:00 and 23:00 – 00:00, may be lower than the assumed eight movements each way. If a similar profile to the existing services was adopted for the C2C scheme, there would likely be only five movements each way between 06:00 – 07:00 and three movements each way during 23:00 – 00:00. Using these movements, the predicted noise levels from the busway reduces to 46 dB $L_{Aeq,1h}$ between 06:00 – 07:00 and 44 dB $L_{Aeq,1h}$ between 23:00 – 00:00. In absolute terms, these are low noise levels. Consequently, once the detail on the timetable is known as well as the exact bus specification, the significant adverse effects on receptors in this area could be expected to be downgraded, especially on the assumption that electric buses will be deployed.

Bourn Airfield

5.4.41. The Bourn Airfield site, located immediately east of Upper Cambourne, is allocated for the development of a new village of approximately 3,500 dwellings in the South Cambridgeshire Local Plan 2018. The nearest sensitive receptors may be approximately 10m from the C2C in this area (the final building layout is not yet confirmed). At this distance, the resultant sound pressure level based on 8 buses per hour each way, is 48 dB $L_{Aeq,1h}$.

5.4.42. A secure long-term noise monitoring position was not available in the vicinity of Bourn Airfield. However, based on the acoustic reports prepared to support the outline planning application for Bourn Airfield New Village, the daytime noise levels close to the A428 are reported to be 64 dB $L_{Aeq,16h}$ during the day and 55 dB $L_{Aeq,8h}$ during the night. The predicted noise levels from the busway are below these baseline noise levels.

5.4.43. The predicted noise level from the bus movements is also comfortably below the target external noise criterion in gardens of 55 dB, as well as the daytime and night-time SOAEL.

5.4.44. Furthermore, and assuming a 15 dB sound reduction for a partially open window, the resultant internal level would be 33 dB. This meets the daytime criterion of 35 dB, and whilst it exceeds the night-time criterion of 30 dB it falls within the 5 dB relaxation to achieve reasonable internal conditions. The buses only operate during the night-time period (23:00 – 07:00) during the first and last hour (i.e. between 23:00 – 00:00, and 06:00 – 07:00). Internal noise levels during the day and night would be comfortably achieved with windows closed.

5.4.45. It is acknowledged that, in this area, the busway is 'offline'. However, the busway runs parallel to the busy A428 and this is likely to be the dominant noise source in the area.

5.4.46. Based on the above, and the current information at the time of writing, for this offline section which runs parallel to the A428, no significant adverse effects are anticipated.

Childerly Gate and Highfields Caldecote

5.4.47. The closest sensitive receptors are approximately 10m from the C2C in this area. At this distance, the resultant sound pressure level based on 8 buses per hour each way, is 48 dB $L_{Aeq,1h}$.

5.4.48. A secure long-term noise monitoring position was not available in the vicinity of Childerley Gate and Highfields Caldecote. However, the noise levels are likely to be similar to that near Bourn Airfield given the A428 will be the dominant noise source. Consequently, daytime noise levels in this area are likely to be in the region of 64 dB $L_{Aeq,16h}$ during the day and 55 dB $L_{Aeq,8h}$ during the night. The predicted noise levels from the busway are below these baseline noise levels.

5.4.49. The predicted noise level from the bus movements is also comfortably below the target external noise criterion in gardens of 55 dB, as well as the daytime and night-time SOAEL.

5.4.50. Furthermore, and assuming a 15 dB sound reduction for a partially open window, the resultant internal level would be 33 dB. This meets the daytime criterion of 35 dB, and whilst it exceeds the night-time criterion of 30 dB it falls within the 5 dB relaxation to achieve reasonable internal conditions. The buses only operate during the night-time period (23:00 – 07:00) during the first and last hour (i.e. between 23:00 – 00:00, and 06:00 – 07:00). Internal noise levels during the day and night would be comfortably achieved with windows closed.

5.4.51. It is acknowledged that, in this area, the busway is 'offline'. However, the busway runs parallel to the busy A428 and this is likely to be the dominant noise source in the area.

5.4.52. Based on the above, and the current information at the time of writing, for this offline section which runs parallel to the A428, no significant adverse effects are anticipated.

Hardwick

5.4.53. The closest sensitive receptors are approximately 15m from the C2C in this area. At this distance, the resultant sound pressure level based on 10 buses per hour each way, is 48 dB $L_{Aeq,1h}$.

5.4.54. A secure long-term noise monitoring position was not available in the vicinity of Hardwick. The measured noise levels at ML2 have been used as a proxy, and are considered worst-case as the measurement position was located further from the A428 than the existing receptors in Hardwick. The predicted noise level from the operation of the busway falls below the range of measured noise levels during the day at ML2 (50 – 55 dB $L_{Aeq,16h}$), and within the range of measured noise levels during the one hour night-time period between 06:00 – 07:00 (43 – 57 dB $L_{Aeq,1h}$) and the one hour night-time period between 23:00 – 00:00 (43 – 50 dB $L_{Aeq,1h}$).

5.4.55. The predicted noise level from the bus movements is comfortably below the target external noise criterion in gardens of 55 dB in this area, as well as the daytime and night-time SOAEL.

5.4.56. Furthermore, and assuming a 15 dB sound reduction for a partially open window, the resultant internal level would be 33 dB. This meets the daytime criterion of 35 dB and whilst it exceeds the night-time criterion of 30 dB, it falls within the 5 dB relaxation to achieve reasonable internal conditions. As before, internal noise levels during the day and night would be comfortably achieved with windows closed.

5.4.57. Further to the above, in this area, the busway is 'online' and therefore the buses will use the existing road. Consequently, nearby residents will already be exposed to existing transportation noise.

5.4.58. Based on the above, and the current information at the time of writing, for this online section, no significant adverse effects are anticipated.

Coton

5.4.59. The closest sensitive receptors are approximately 40m from the C2C in this area. At this distance, the resultant sound pressure level based on 10 buses per hour each way, is 42 dB $L_{Aeq,1h}$.

5.4.60. This predicted noise level from the operation of the busway falls below the range of measured noise levels during the day at ML3 (48 – 55 dB $L_{Aeq,16h}$), during the one hour night-time period between 06:00 – 07:00 (45 – 57 dB $L_{Aeq,1h}$), and the one hour night-time period between 23:00 – 00:00 (43 – 48 dB $L_{Aeq,1h}$).

5.4.61. The predicted noise level from the bus movements is comfortably below the target external noise criterion in gardens of 55 dB in this area, as well as the daytime and night-time SOAEL.

5.4.62. Furthermore, and assuming a 15 dB sound reduction for a partially open window, the resultant internal level would be 27 dB. This meets the daytime criterion of 35 dB and night-time criterion of 30 dB.

5.4.63. It is acknowledged that, in this area, the busway is 'offline'. However, the receptors are located near to other local roads (including Cambridge Road and the M11) and therefore will be exposed to existing transport noise to some degree.

5.4.64. Based on the above, and the current information at the time of writing, for this offline section which is at least 40m from the nearest receptors, no significant adverse effects are anticipated.

West Cambridge

5.4.65. The closest sensitive receptors are approximately 10m from the C2C in this area. At this distance, the resultant sound pressure level based on 10 buses per hour each way, is 49 dB $L_{Aeq,1h}$.

5.4.66. This predicted noise level from the operation of the busway falls below the range of measured noise levels during the day at ML4 (51 – 56 dB $L_{Aeq,16h}$), and within the range of measured noise levels during the one hour night-time period between 06:00 – 07:00 (45 – 54 dB $L_{Aeq,1h}$), and the one hour night-time period between 23:00 – 00:00 (46 – 52 dB $L_{Aeq,1h}$).

5.4.67. The predicted noise level from the bus movements is comfortably below the target external noise criterion in communal gardens of 55 dB, as well as the daytime and night-time SOAEL.

5.4.68. Furthermore, and assuming a 15 dB sound reduction for a partially open window, the resultant internal level would be 34 dB. This meets the daytime criterion of 35 dB, and whilst it exceeds the night-time criterion of 30 dB it falls within the 5 dB relaxation to achieve reasonable internal conditions. Internal noise levels during the day and night would be comfortably achieved with windows closed.

5.4.69. Further to the above, in this area, the busway is 'online' and therefore the buses will use the existing road. Consequently, nearby residents will already be exposed to existing transportation noise to some degree.

5.4.70. Based on the above, and the current information at the time of writing, for this online section, no significant adverse effects are anticipated.

West Cambridge fringe (Newnham)

5.4.71. The closest sensitive receptors are approximately 8m from the C2C in this area. At this distance, the resultant sound pressure level based on 10 buses per hour each way, is 50 dB $L_{Aeq,1h}$.

5.4.72. This predicted noise level from the operation of the busway falls within the range of measured noise levels during the day at ML5 (46 – 51 dB $L_{Aeq,16h}$) and during the one-hour night-time period between 06:00 – 07:00 (47 – 53 dB $L_{Aeq,1h}$). However, the predicted noise level from the operation of the busway exceeds the range of measured noise levels during the one-hour night-time period between 23:00 – 00:00 (41 – 47 dB dB $L_{Aeq,1h}$). This noise level difference of 3 – 9 dB, a moderate to major magnitude of impact in line with the scale of effect in **Table TR1-3-3**, should be seen in context, and this is explored in more detail below. Further contextual considerations are also provided for the daytime noise levels as well.

5.4.73. The predicted noise level from the bus movements is comfortably below the target external noise criterion in gardens of 55 dB, as well as the daytime and night-time SOAEL.

5.4.74. Furthermore, and assuming a 15 dB sound reduction for a partially open window, the resultant internal level would be 35 dB. This meets the daytime criterion of 35 dB, and whilst it exceeds the night-time criterion of 30 dB it falls within the 5 dB relaxation to achieve reasonable internal conditions. The buses only operate during the night-time period (23:00 – 07:00) during the first and last hour (i.e. between 23:00 – 00:00, and 06:00 – 07:00). Internal noise levels during the day and night would be comfortably achieved with windows closed.

5.4.75. It is acknowledged that, in this area, the busway is 'offline'. Whilst the route connects to an existing access track, this is not regularly used by vehicles currently. However, the receptors are located near to other local roads (including Grange Road) and therefore will be exposed to existing transportation noise to some degree.

5.4.76. Based on the above, and the current information at the time of writing, for this offline section, significant adverse effects are possible as a result of the number of bus movements during the night-time period.

5.4.77. However, based on a timetable adopted in line with the current guided busway services, the number of buses during the night-time period, both between 06:00 – 07:00 and 23:00 – 00:00, may be lower than the assumed 10 movements each way. If a similar profile to the existing services was adopted for the C2C scheme, there would likely be only five movements each way between 06:00 – 07:00 and three movements each way during 23:00 – 00:00. Using these movements, the predicted noise levels from the busway reduces to 47 dB $L_{Aeq,1h}$ between 06:00 – 07:00 and 45 dB $L_{Aeq,1h}$ between 23:00 – 00:00. In absolute terms, these are low noise levels. Consequently, once the detail on the timetable is known as well as the exact bus specification, the significant adverse effects on receptors in this area could be downgraded.

Summary

5.4.78. With the exception of receptors close to the offline section of the C2C in Cambourne and Newnham, the proposed buses are similar in character to the existing dominant source of noise (i.e. road traffic) in proximity to the nearby sensitive receptors, and given that the target external noise criterion will be comfortably achieved in gardens and reasonable internal noise levels achieved even with windows open, no significant noise effects are anticipated from the future bus movements. This

conclusion is further supported as the predicted noise levels from the operation of the busway do not exceed the SOAEL during the day or night-time periods.

5.4.79. For receptors close to the offline section of the C2C in Cambourne and Newnham, significant adverse effects are possible as a result of the number of bus movements during the night-time period. However, in reality, fewer movements than assumed are likely during the night-time period based on the timetable profile of existing guided busway services. Consequently, once the detail on the timetable is known as well as the exact bus specification, the significant adverse effects on receptors in this area could be downgraded.

6 SUMMARY OF LIKELY SIGNIFICANT EFFECTS

6.1.1. The assessment has considered locations which could be exposed to noise and/or vibration during the construction phase. Mitigation measures have been identified and included in the environmental commitments for the C2C Scheme (set out in the CoCP) which will be a mandatory requirement under the contracts for implementation of the works. These include measures focused on the control of noise and vibration, and channels for registering concern should there be periods when noise and/or vibration is perceived as a nuisance by receptors in the vicinity of the working area.

6.1.2. It has been concluded that only six properties in proximity to the travel hub, the retaining walls north of St Neots Road and Bin Brook Bridge are predicted to experience significant adverse effects as a result of the construction works.

6.1.3. No significant vibration effects are expected at nearby residential receptors as a result of the construction works due to the short duration of the operation of the vibration roller in any particular location. However, significant adverse vibration effects could occur at seven facilities within 60m of the C2C Scheme, which have been identified as potentially having particularly vibration-sensitive equipment. A more detailed assessment is recommended once the construction programme and methodologies are known. It is also recommended that consultation is undertaken with the identified facilities to ascertain whether there are any vibration-sensitive spaces/items and their location. Using equipment that generates minimal vibration may be required to mitigate any potentially significant impacts.

6.1.4. An assessment has been undertaken for three aspects of the operational scheme; changes in road traffic noise level, noise associated with the operation of the travel hub, and noise associated with the operation of the busway.

6.1.5. As only negligible road traffic noise level changes are predicted as a result of the C2C Scheme at nearby sensitive receptors, no significant effects are anticipated.

6.1.6. The predicted noise levels as a result of the operation of the travel hub are below the typical background sound level during the day and night. Furthermore, the absolute noise levels are low and fall below the target criteria within gardens and within habitable rooms, even with windows open. Consequently, no significant noise effects are anticipated from the travel hub.

6.1.7. Finally, the predicted noise levels as a result of the operation of the busway comfortably achieve the target external noise criterion in gardens and reasonable internal noise levels are achieved, even with windows open. With the exception of receptors close to the offline section of the C2C in Cambourne and Newnham, no significant noise effects are anticipated from the future bus movements. This conclusion is further supported as the predicted noise levels from the operation of the busway do not exceed the SOAEL during the day or night-time periods. For receptors close to the offline section of the C2C in Cambourne and Newnham, significant adverse effects are possible as a result of the number of bus movements during the night-time period. However, in reality, fewer movements than assumed are likely during the night-time period based on the timetable profile of existing guided busway services. Consequently, once the detail on the timetable is known as well as the exact bus specification, the significant adverse effects on receptors in this area could be downgraded.

Appendix A

GLOSSARY OF ACOUSTIC TERMINOLOGY

Table TR1-A-1 - Acoustic glossary

Terminology	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa ($20x10^{-6}$ Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. Generally used to describe road traffic noise.
Free-field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m.
Façade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Ambient noise	The composite of airborne sound from many sources near and far associated with a given environment. No particular sound is singled out for interest.
Residual sound	Ambient sound remaining at the assessment location when the specific sound source is suppressed (or absent) to such a degree that it does not contribute to the ambient sound.
Specific sound	Specific sound source being assessed.
Sound Exposure Level (SEL)	Level of a sound, of one second duration, that has the same sound energy as the actual sound event considered.

$L_{night,\ outside}$	In terms of assessments of night-time road traffic noise based on the DMRB, the $L_{night,outside}$ index is the equivalent continuous sound level $L_{Aeq,8h}$ for the period 23:00 to 07:00 hours assessed outside a dwelling and is free-field.

Appendix B

DETAILS OF NOISE MONITORING POSITIONS

Table TR1-B-1 - Details of noise monitoring positions

Noise monitoring position	Description	Photo
ML1	ML1 was located within the south facing side garden of 61 Bristol Drive, approximately 270m south of the A428. Noise measurements were undertaken over a five day period between 17:00 on 18th January 2022 and 15:00 on 24th January 2022.	
ML2	ML2 was located within the southeast facing garden of 4 Scotland Road, adjacent to the carpark area. Noise measurements were undertaken over a five day period between 13:00 on 12th January 2022 and 09:00 on 18th January 2022.	
ML3	ML3 was located on an adjacent fence line along the north side of a building, bound by a field to the north, approximately 43m south east of Cambridge Road. Noise measurements were undertaken over a five day period between 16:00 on 12th January 2022 and 09:00 on 18th January 2022.	

Noise monitoring position	Description	Photo
ML4	ML4 was located within the south facing garden of 12 Perry Court, bound to the east by Cambridge Lawn Tennis Club. Noise measurements were undertaken over a five day period between 16:00 on 12th January 2022 and 12:00 on 18th January 2022.	
ML5	ML5 was located within the south facing garden of 9 Herschel Road, to the east of Bin Brook. Noise measurements were undertaken over a four day period between 15:00 on 12th January 2022 and 17:00 on 16th January 2022.	
RTN1	RTN1 was located on the corner of St Neots Road where it meets the driveway of Cozy Pets Hotel, approximately 148m south of the A428. Noise measurements were undertaken over a four hour period between 11:00 and 15:00 on 18th January 2022.	

Noise monitoring position	Description	Photo
RTN2	RTN2 was located approximately 14m south of the A428, immediately west of the footbridge which leads to St Neots Road. Noise measurements were undertaken over a five hour period between 11:00 and16:00 on 18th January 2022.	
RTN3	RTN3 was located to the south of the Madingley Road, adjacent to the American Cemetery bus stop, approximately 165m east of the Woodfield House Hotel. Noise measurements were undertaken over a five hour period between 11:55 and 16:55 on 18th January 2022.	

Table TR1-B-2 - Noise measurement equipment

Monitoring position	Item	Make and model	Serial number
ML1	Sound level analyser	01dB-Stell Duo 'Datalogging Integrating Sound Level Meter'	10617
	Preamplifier	01dB-Stell PRE 22 Preamplifier	10324
	Microphone	G.R.A.S Type 40CD Condenser Microphone	162071
	Handheld acoustic calibrator	01dB Cal 21	34924010
ML2	Sound level analyser	01dB-Stell Duo 'Datalogging Integrating Sound Level Meter'	10617
	Preamplifier	01dB-Stell PRE 21 S Preamplifier	10324

Monitoring position	Item	Make and model	Serial number
	Microphone	G.R.A.S Type 40CD Condenser Microphone	162071
	Handheld acoustic calibrator	01dB Cal 21	34924010
ML3	Sound level analyser	01dB-Stell Duo 'Datalogging Integrating Sound Level Meter'	10330
	Preamplifier	01dB-Stell PRE 21 S Preamplifier	10335
	Microphone	G.R.A.S Type 40CD Condenser Microphone	141182
	Handheld acoustic calibrator	01dB Cal 21	50441999
ML4	Sound level analyser	01 dB CUBE 'Integrating-Averaging Sound Level Meter'	10748
	Preamplifier	Acoem PRE 22 Preamplifier	11102
	Microphone	GRAS Type 40CD Condenser Microphone	224197
	Handheld acoustic calibrator	01dB-Stell Cal 21	35054825
ML5	Sound level analyser	01dB-METRAVIB Black Solo 'Datalogging Integrating Sound Level Meter'	60531
	Preamplifier	01dB-Metravib PRE 21 S	16422
	Microphone	01dB Metravib MCE 212 Microphone	166401
	Handheld acoustic calibrator	01dB-Stell Cal 21	1558662
RTN1	Sound level analyser	01dB-Stell Duo 'Datalogging Integrating Sound Level Meter'	10330
	Preamplifier	01dB-Stell PRE 21 S Preamplifier	10335
	Microphone	G.R.A.S Type 40CD Condenser Microphone	141182
	Handheld acoustic calibrator	01dB Cal 21	50441999
RTN2	Sound level analyser	01dB-Stell Duo 'Datalogging Integrating Sound Level Meter'	10617
	Preamplifier	01dB-Stell PRE 21 S Preamplifier	10324

Monitoring position	Item	Make and model	Serial number
	Microphone	G.R.A.S Type 40CD Condenser Microphone	162071
	Handheld acoustic calibrator	01dB Cal 21	34924010
RTN3	Sound level analyser	01 dB CUBE 'Integrating-Averaging Sound Level Meter'	10748
	Preamplifier	Acoem PRE 22 Preamplifier	11102
	Microphone	GRAS Type 40CD Condenser Microphone	224197
	Handheld acoustic calibrator	01dB-Stell Cal 21	35054825

Appendix C

LEGISLATION, POLICY AND GUIDANCE

LEGISLATION

CONTROL OF POLLUTION ACT, 1974

The principal legislation covering demolition and construction noise is the Control of Pollution Act 1974, Part III. Sections 60 and 61 of the Act give the local authority special powers for controlling noise arising from construction and demolition works, regardless of whether a statutory nuisance has been caused or is likely to be caused. Works within the scope of these provisions include repair and maintenance work and road works. These powers may be exercised either before works start or after they have started.

Section 60 enables a local authority in whose area work is going to be carried out, or is being carried out, to serve a notice of its requirements for the control of site noise on the person who appears to the local authority to be carrying out the works. Such a notice may also be served on others appearing to the local authority to be responsible for, or to have control over, the carrying out of the works.

This notice can:

- Specify the plant or machinery that is or is not to be used;
- Specify the hours during which the construction work can be carried out;
- Specify the level of noise that can be emitted; and
- Provide for any changes of circumstances.

Section 61 of the Act provides a mechanism for the main contractor or developer to take the initiative and approach the local authority to ascertain its noise requirements before construction work starts. If a formal application for "prior consent" is received by the local authority it is obliged to give a decision within 28 days; failure to do so or the attachment of unnecessary or unreasonable conditions are grounds for appeal by the applicant.

In cases where the local authority determines that the proposals for minimising the noise of the construction activities are adequate it will issue a consent although this may be subject to conditions limiting certain aspects of the consent such as hours of work, noise levels for particular activities, etc. Provided that the applicant takes all reasonable steps to operate within the terms of the consent, even if the local authority subsequently decides to take proceedings under section 60(8), the applicant should be able to rely on the defence provided in the Act and prove that the alleged contravention amounted to the carrying out of works in accordance with a consent given under section 61.

THE ENVIRONMENTAL PROTECTION ACT (EPA) 1990 (AS AMENDED)

Section 79 of the Environmental Protection Act 1990, Part III requires the local authority to periodically inspect its area to detect any nuisance and, where a complaint of a statutory nuisance is made by a person living within its area, to take such steps as are reasonably practicable to investigate the complaint.

Currently statutory nuisance encompasses a range of matters that has broadened to include topics such as noise and vibration where there may be no obvious potential health effects. Section 79 of the Environmental Protection Act 1990, Part III declares the following to be statutory nuisances in relation to noise:

“(g) noise emitted from premises so as to be prejudicial to health or a nuisance;

(ga) noise that is prejudicial to health or a nuisance and is emitted from or caused by a vehicle, machinery or equipment in a street or in Scotland, road;

…

Subsection (1)(ga) above does not apply to noise made—

(a) by traffic"

If as a result of investigations, the local authority is satisfied of the existence of a statutory nuisance it is obliged to serve an abatement notice. This may require various measures including cessation of the noise, its attenuation or restriction to certain times. At its discretion the local authority can delay the service of a notice for up to seven days if it is pursuing alternative means of securing abatement of the nuisance.

The Environmental Protection Act provides a number of exemptions for certain matters, groups and activities.

NOISE INSULATION REGULATIONS (NIR), 1975 AS AMENDED 1988

The NIR were made under powers inferred by Section 20 of Part II of the Land Compensation Act. Regulation 3 imposes a duty on authorities to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings, subject to meeting certain criteria given in the Regulation, for new roads or carriageways.

Regulation 4 provides authorities with discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings for an altered road. Regulation 5 provides authorities with discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings during construction works for a substantial period of time, but in respect of which building no duty under Regulation 3 or power under Regulation 4 has arisen.

With respect to residential properties affected by noise from new or altered highways, to qualify for such an offer, four criteria must all be fulfilled at 1m in front of the most exposed door or window of an eligible room in the façade of a property:

- Level - The highest total traffic noise level expected within the first fifteen years use of the road (the 'Relevant Noise Level') must be not less than the Specified Level of 68 dB $L_{A10,18h}$. Predicted noise levels of 67.5 dB $L_{A10,18h}$ and above are rounded up to 68 dB $L_{A10,18h}$;
- Increase - The Relevant Noise Level in the design year, or within any other year between the year before the highway construction works commenced and the design year, must be at least 1 dB(A) greater than that immediately before construction commenced (the 'Prevailing Noise Level');
- Contribution - Noise from traffic on the road for which the Regulations apply must contribute at least 1.0 dB $L_{A10,18h}$ to the Relevant Noise Level; and
- Locality - The property under consideration must be within 300m of the Scheme.

The Regulations apply only to qualifying eligible rooms, which include living rooms and bedrooms affected by road traffic noise.

The NIR requires application of the road traffic noise level calculation method detailed within the Calculation of Road Traffic Noise memorandum 1988 (CRTN).

LAND COMPENSATION ACT, 1973

The Land Compensation Act 1973 (Part 1) provides a right to landowners with a qualifying legal interest to seek compensation where the value of their interest is deemed to be depreciated by defined physical factors, including noise, as a consequence of public works.

POLICY

NATIONAL PLANNING POLICY FRAMEWORK (NPPF), 2021

First published in 2012 and most recently updated in July 2021, the NPPF sets out the Government's planning policies for England and how these are expected to be applied. Noise is referenced within the document as follows:

"174. Planning policies and decisions should contribute to and enhance the natural and local environments by:…[a number of points including]…

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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans";

and

"185. 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 the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development - and avoid noise giving rise to significant adverse impacts on health and the quality of life[65]; and

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…."

and

"187. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

Reference number 65 within NPPF paragraph 185(a) points to the Explanatory Note to the Noise Policy Statement for England (NPSE).

NOISE POLICY STATEMENT FOR ENGLAND (NPSE), 2010

This provides more detail than the NPPF setting out the long-term vision of the Government noise policy and applying to all forms of noise excluding occupational noise. The NPSE repeatedly refers

to the management and control of noise within the context of Government Policy on sustainable development.

The NPSE also stresses that noise impact should not be treated in isolation from other related factors. At paragraph 2.7 for example it states:

'…the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight when assessing the noise implications.'

The NPSE introduces and describes three categories, or levels, describing the presence or absence of noise effects but does not quantify those categories, stating that the corresponding objective levels are likely to be different for different noise sources, receptors and times of the day or night. These categories are:

- **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.

The NPSE recognised that, at the time of publication, further research was needed into how these categories might be quantified for different scenarios. There is still no robust, universally accepted method of deriving suitable values and a variety of approaches are adopted in different circumstances.

The three aims of the NPSE are:

1 Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

2 Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

3 Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

PLANNING PRACTICE GUIDANCE, ADOPTED IN 2019

This web-based resource was issued for use by the Department for Communities and Local Government (DCLG). The purpose of the guidance is to complement the NPPF and provide advice on how to deliver its policies.

The section on noise was published in 2014 and last updated in July 2019. It includes a table that summarises "*the noise exposure hierarchy based on the likely average response of those affected*" and offers "*examples of outcomes*" relevant to the NOEL, LOAEL and SOAEL effect levels described in the NPSE. The term Unacceptable Adverse Effect (UAE) level is introduced which

equates to noise perceived as "*present and very disruptive*". It is stated that UAEs should be prevented.

These outcomes are in descriptive form and there is no numerical definition of the NOEL, LOAEL and SOAEL (or UAE), or detailed advice regarding methodologies for their determination. There is also no reference to the further research that is identified as necessary in the NPSE. The noise exposure hierarchy table is duplicated in **Table TR1-C-1** below.

Table TR1-C-1 - Noise exposure hierarchy based on the likely average response

Perception	Examples of outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

SOUTH CAMBRIDGESHIRE LOCAL PLAN, ADOPTED IN 2018

The South Cambridgeshire Local Plan (2018) sets out policies which should be applied within the South Cambridgeshire area. Relevant to noise is Policy SC/10 – Noise Pollution which states:

"1. Planning permission will not be granted for development which:

a. Has an unacceptable adverse impact on the indoor and outdoor acoustic environment of existing or planned development;

b. Has an unacceptable adverse impact on countryside areas of tranquillity which are important for wildlife and countryside recreation;

c. Would be subject to unacceptable noise levels from existing noise sources, both ambient levels and having regard to noise characteristics such as impulses whether irregular or tonal.

2. Conditions may be attached to any planning permission to ensure adequate attenuation of noise emissions or to control the noise at source. Consideration will be given to the increase in road traffic that may arise due to development and conditions or Section 106 agreements may be used to minimise such noise.

3. Where a planning application for residential development is near an existing noise source, the applicant will be required to demonstrate that the proposal would not be subject to an unacceptable noise levels both internally and externally.

4. The Council will seek to ensure that noise from proposed commercial, industrial, recreational or transport use does not cause any significant increase in the background noise level at nearby existing noise sensitive premises which includes dwellings, hospitals, residential institutions, nursing homes, hotels, guesthouses, and schools and other educational establishments."

CITY OF CAMBRIDGE LOCAL PLAN, ADOPTED IN 2018

The City of Cambridgeshire Local Plan (2018) sets out policies which should be applied within the City of Cambridgeshire authority area. Relevant to noise is Policy 35 – Protection of human health and quality of life from noise and vibration which states:

"Development will be permitted where it is demonstrated that:

a. it will not lead to significant adverse effects and impacts, including cumulative effects and construction phase impacts wherever applicable, on health and quality of life/amenity from noise and vibration; and

b. adverse noise effects/impacts can be minimised by appropriate reduction and/or mitigation measures secured through the use of conditions or planning obligations, as appropriate (prevention through high quality acoustic design is preferable to mitigation).

People's health and quality of life needs be protected from unacceptable noise impacts by effectively and appropriately managing the relationship between noise sensitive development and noise sources through land use planning. Noise must be carefully considered when new development might create additional noise and when development would be sensitive to existing or future noise.

Residential and other noise sensitive development will be permitted where it can be demonstrated that future users of the development will not be exposed internally and externally to unacceptable levels of noise pollution/disturbance from existing or planned uses. This would include proposed

noise sensitive development that may experience adverse impacts as a result of exposure to noise from existing or planned/future (i) transport sources (air, road, rail and mixed sources) or (ii) industrial, trade or business / commercial sources.

Noise generating development including industrial, trade or business/commercial uses with associated transport noise sources will be permitted where it can be demonstrated that any nearby noise sensitive uses (as existing or planned) will not be exposed to noise that will have an unacceptable adverse impact on health and quality of life both internally and externally.

A Noise Impact Assessment will be required to support applications for noise sensitive and noise generating development as detailed above including consideration of any noise impacts during the construction phase wherever applicable, when noise sensitive uses are likely to be exposed to significant or unacceptable noise exposure and impacts."

GREATER CAMBRIDGE SUSTAINABLE DESIGN AND CONSTRUCTION SUPPLEMENTARY PLANNING DOCUMENT, ADOPTED IN 2020

The Greater Cambridge Sustainable Design and Construction Supplementary Planning Document (SPD) provides additional technical guidance on the implementation of South Cambridgeshire Local Plan (2018) and City of Cambridge Local Plan (2018) policies.

Appendix 8, Annex A provides a summary of instances and types of development that would likely require an acoustic assessment/ report. Appendix 8, Annex B summarises the general requirements for acoustic reports and assessments.

There are four possible planning recommendations regarding the acoustic acceptability of the development proposal:

"A. Planning consent may be granted without any need for noise conditions - where a potential residential development site poses no or a negligible risk from a noise perspective, the GCPS will typically not require any specific measures ("Grant Consent - No Objection on Noise Grounds");

B. Planning consent may be granted subject to the inclusion of suitable noise conditions in order to mitigate and reduce to a minimum the adverse effects of noise for example to address specific acoustic design aspects of a particular site or require a noise insulation scheme ("Grant Consent - No Objection – Minimise Noise");

C. Planning consent should be refused on noise grounds in order to avoid significant adverse effects of noise ("Refusal / Object - Avoid on Noise Grounds");

D. Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects of noise ("Refusal / Object - Prevent on Noise Grounds")."

GUIDANCE

BS 5228:2009+A1:2014 CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES, PART 1 NOISE

This Standard provides the latest recommendations for basic methods of noise control where there is a need for the protection of persons living and working in the vicinity of, and those working on, construction and open sites.

The Standard includes guidance on assessing the significance of noise effects. In particular, Annex E provides a discussion on the different approaches to the assessment of construction noise, in doing so giving consideration to absolute noise levels (in BS 5228-1 section E2) and to two different approaches to setting criteria based on the ambient noise level ($L_{Aeq,T}$) in the absence of construction noise (in BS 5228-1 section E3).

Firstly, the Standard describes the 'older and more simplistic' approach based on the advice in AL 72, noting that the original advice "*has been expanded over time to include a suite of noise levels covering the whole day/week period taking into account the varying sensitivities through these periods*."

Table TR1-C-2 (Table E.2 in sub-clause E.4 of the BS 5228-1) illustrates the approach – the levels are also stated as being often used as limits above which noise insulation would be provided, subject to the temporal conditions described following the table.

Table TR1-C-2 - Examples of time periods, averaging times and noise levels associated with the determination of eligibility for noise insulation

Time	Relevant time period	Averaging time, 'T'	Noise insulation trigger level dB $L_{Aeq,T}$ (A)
Monday to Friday	07.00 – 08.00	1 h	70
	08.00 – 18.00	10 h	75
	18.00 – 19.00	1 h	70
	19.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Saturday	07.00 – 08.00	1 h	70
	08.00 – 13.00	5 h	75
	13.00 – 14.00	1 h	70
	14.00 – 22.00	3 h	65
	22.00 – 07.00	1 h	55
Sunday and Public Holidays	07.00 – 21.00	1 h	65
	21.00 – 07.00	1 h	55

Note:
(A) All noise levels are predicted or measured at a point 1 m in front of the most exposed of any windows and doors in any façade of any eligible dwelling.

The Standard suggests that where, in spite of the mitigation measures applied, the combined construction and baseline noise levels exceed 75 dB(A) (for a period of ten or more days of working in any fifteen consecutive days or for a total of days exceeding 40 in any six month period), a scheme for the installation of noise insulation or the reasonable costs thereof will be implemented by the developer or promoter.

In BS 5228-1 sub-clause E.3 an alternative approach is described using criteria based on the ambient noise level. This approach is used commonly in environmental impact assessments. Two methods are described.

The first is the ABC method, which is set out in **Table TR1-C-3** below (Table E.1 in BS 5228-1). Three categories, A, B and C, are described in terms of threshold values for a daytime (07:00 to 19:00 weekdays, 07:00 to 13:00 Saturday), evening and weekend, and finally a night-time period (23:00 to 07:00). If the construction site noise level exceeds the relevant threshold value this is deemed a 'significant effect'.

Table TR1-C-3 - Example threshold of potential significant effect at dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB $L_{Aeq,T}$)		
	Category A (A)	Category B (B)	Category C (C)
Night-time (23:00 − 07:00)	45	50	55
Evenings and weekends (D)	55	60	65
Daytime (07:00 − 19:00) and Saturdays (07:00 − 13:00)	65	70	75

Notes:
[1] A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.
[2] If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.
[3] Applied to residential receptors only.

(A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
(B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
(C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.
(D) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

The second method states that "Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut off values of 65 dB, 55 dB and 45 dB $L_{Aeq,T}$ from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant impact."

These criteria may be applied not just to residential buildings, but also to hotels and hostels and buildings in religious, educational and health/community use.

The +5 dB criterion for a period of one month or more, might also be deemed to cause significant effects in public open space. However, the extent of the area impacted relative to the total available area also needs to be taken into account.

Annex F of the Standard provides guidance on estimating noise from construction sites. The estimation procedures described in this Annex take into account the more significant factors:

- the sound power outputs of processes and plant;
- the periods of operation of processes and plant;
- the distances from source to receiver;
- the presence of screening by barriers;
- the reflections of sound; and

- attenuation from absorbent ground.

Four discrete prediction methods are described, two for stationary plant – the activity $L_{Aeq,T}$ method and the plant sound power method – and two for mobile plant – the method for mobile plant in a defined area and the method for haul roads.

BS 5228:2009+A1:2014 CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES, PART 2 VIBRATION

The Standard provides the latest recommendations for basic methods of vibration control where there is a need for the protection of persons living and working in the vicinity of, and those working on, construction and open sites.

With respect to human exposure to building vibration, Table B1 of Annex B to BS 5228-2 provides guidance on the effects of vibration levels on human beings, and it is these (as reproduced in **Table TR1-C-4**) that the construction vibration effects have been based upon.

Table TR1-C-4 - Guidance on effects of vibration levels

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

Notes:
[1] The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.
[2] A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.
[3] Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

CALCULATION OF ROAD TRAFFIC NOISE, 1988

The former Department of Transport/Welsh Office technical memorandum Calculation of Road Traffic Noise (CRTN) methodologies have been adopted.

The factors which may influence road traffic noise levels at source can be divided into two groups:

- Road related factors - gradient and surface type; and
- Traffic related factors - flow, speed and the proportion of heavy-duty vehicles.

The propagation of noise is also covered in CRTN and can influence the noise levels at receptor locations.

HIGHWAYS ENGLAND, TRANSPORT SCOTLAND, WELSH GOVERNMENT AND THE DEPARTMENT FOR INFRASTRUCTURE (NORTHERN IRELAND) DESIGN MANUAL FOR ROADS AND BRIDGES. SUSTAINABILITY & ENVIRONMENT APPRAISAL. LA 111 NOISE AND VIBRATION

The DMRB LA 111 *Noise and Vibration* provides guidance on the assessment of road traffic noise and vibration from new road projects.

For the assessment of permanent noise impacts, consideration is given to the noise level changes at nearby sensitive receptors as a result of a proposed development. The short-term impacts are the starting point for determining the potential for significant effects. Short-term impacts are defined by comparing the 'Do Minimum' scenario (i.e. without the proposed development), with the 'Do Something' scenario (i.e. with the proposed development) in the opening year.

The DMRB presents criteria for determining the magnitude of operational road traffic noise change, which are reproduced below.

Table TR1-C-5 - DMRB LA 111 criteria for magnitude of operational road traffic noise change in the short-term

Short-term magnitude	Noise change ($L_{A10,18h}$ or L_{night}), dB
Major	≥ 5.0
Moderate	3.0 – 4.9
Minor	1.0 – 2.9
Negligible	< 1.0

The DMRB notes that short-term changes in noise level which are negligible would not be considered significant, and that changes of a minor magnitude are unlikely to give rise to a significant effect. However, other contextual factors including the absolute noise level, the location noise sensitive parts of a receptor that are affected, the acoustic character of the area, and the likely perception of change by residents should all be considered in determining the significance of effect.

BS 4142: 2014+ A1:2019 METHODS FOR RATING AND ASSESSING INDUSTRIAL AND COMMERCIAL SOUND.

BS 4142 is the standard most commonly used in assessments of the impacts of industrial and commercial type noise.

A summary of the BS 4142 approach is set out below.

- Establish the specific sound level of the source(s);
- Establish the representative background sound level(s);
- Correct the specific sound level(s) for on-time if necessary;
- Apply feature corrections to the specific sound level, to account for any distinguishing characteristics, to derive the rating level;
- Determine the initial estimate of the impact by subtracting the representative background sound level from the rating level for a given assessment scenario; and
- Consider and modify the initial estimate of impact, as determined above, in the context of the noise and its environs.

Individual elements of this process are explained in greater detail below.

Where the sound source is not yet present, the specific sound level can be established by calculation using source data.

The representative background sound level can be established by measurement at the receptor location or at suitably justified proxy locations.

If the source under investigation is non-continuous the specific sound level can be corrected for the amount of time it is on or active during the reference period. The reference period is one hour during the daytime and 15-mintues during the night-time. The character of noise can be rated using the penalties below:

- Tonality up to 6 dB
- Impulsivity up to 9 dB
- Other sound characteristics 3 dB
- Intermittency 3 dB

An initial estimate of the noise impact is obtained by subtracting the adopted background sound level from the rating level. The results of this comparison are assessed on the basis of the following guidance as described in section 11 of BS 4142:

- Typically, the greater the difference, the greater the magnitude of the impact;
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

All pertinent factors should be taken into account in the consideration of context including the following:

- The absolute level of the sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

Appendix D

LIST OF CONSTRUCTION PHASES AND PLANT LIST

Table TR1-D-1 - Construction Phase Plant and Assumptions

Construction Phase	Plant Item	Number of Plant	Assumed On-time (%)	Source Noise Level at 10 metres/item (L_{Aeq} dB)
Site clearance	Tracked excavator	2	50	76
	Dozer	2	50	78
	Dump truck	1	25	79
	Road sweeper	1	25	76
Road / structure construction	Dump truck	1	25	79
	Asphalt paver	1	50	75
	Vibratory roller	1	50	75
	Excavator with hydraulic breaker	1	10	83
	Road planer	1	25	82

62-64 Hills Road
Cambridge
CB2 1LA

wsp.com