7. Noise and Vibration

7.1 Introduction

7.1.1 This chapter of the Environmental Statement (ES) has been prepared by Bickerdike Allen Partners LLP and assesses the likely significant effects of the Proposed Development with reference to noise and vibration. The chapter should be read in conjunction with **Chapter 2: Description of the Proposed Development**. The chapter considers the noise and vibration associated with the following activities at Bristol Airport:

- Flights into and out of Bristol Airport (air noise and vibration);
- Aircraft operations at Bristol Airport (ground noise);
- Bristol Airport related road traffic movements (road traffic noise); and
- Construction of the infrastructure associated with the Proposed Development (construction noise and vibration).

7.1.2 The operational noise and vibration is assessed for 2017 and for future years, both with and without the Proposed Development.

7.1.3 This chapter commences by describing the noise related planning context against which the Proposed Development will be considered. It goes on to present and discuss the baseline noise environment at Bristol Airport and then considers the likely significant effects of changes to air, ground, road traffic and construction noise and vibration in both the 'with' and 'without the Proposed Development' scenarios. Within these sections the assessment criteria and methodology are presented, the baseline noise conditions discussed where relevant, and assessments are made of any effects (beneficial and adverse) associated with the Proposed Development. Mitigation measures are also described, where appropriate, as are cumulative and residual effects.

7.1.4 The assessment of noise and vibration involves a significant amount of technical detailed work and to seek to maintain this chapter as concise and informative as possible, this chapter is supplemented by a series of appendices which provide further detail on each of the specific topics. These are referenced throughout this chapter to aid an understanding of the topic being described. The appendices supporting this noise chapter are as follows:

- **Appendix 7A** – Glossary;
- **Appendix 7B** – Relevant legislation, policy, technical guidelines and assessment criteria;
- **Appendix 7C** – Baseline Noise and Vibration;
- **Appendix 7D** – Air Noise and Vibration;
- **Appendix 7E** – Ground Noise;
- **Appendix 7F** – Road Traffic Noise; and
- **Appendix 7G** – Construction Noise and Vibration.

Noise indices

7.1.5 The $L_{Aeq,T}$ index is the average noise exposure level that occurs over a time period T. In the case of aircraft noise therefore, it accounts for the sound energy produced both by the number of aircraft

events and the noisiness of each aircraft event, over a defined time period. It is the primary metric for quantifying community effects of aircraft noise in the UK, specifically $L_{Aeq,16h}$ covering the daytime period from 07:00 to 23:00 and $L_{Aeq,8h}$ covering the night-time period from 23:00 to 07:00. The convention is to assess aircraft movements over three summer months, specifically a 92 day period from 16 June to 15 September inclusive. Summer in this chapter refers to this 92-day period unless stated otherwise.

7.1.6 The L_{den} is a unit that considers an average annual day of aircraft traffic (although it can be applied equally to either rail or road traffic) over a 24-hour period, providing greater emphasis, by way of adding noise penalties of 5 dB and 10 dB to noise levels arising from aircraft traffic in the evening (19:00 to 23:00) and night (23:00 to 07:00) periods respectively. For many airports, the L_{den} equates approximately to the $L_{Aeq,16h}$ index by the relationship $L_{den} = L_{Aeq,16h} + 2$ dB. The precise relationship however depends on the distribution of aircraft traffic over the 24-hour period.

7.1.7 The L_{night} equates approximately to the $L_{Aeq,8h}$ index commonly used to rate night noise in the UK with the exception that it is based on an average annual night of aircraft movements rather than an average summer night.

7.1.8 The L_{A90} is a unit that is often used to describe the background noise level at a location. It is defined as the noise level that is exceeded for 90% of the time.

7.1.9 Similarly, the L_{A10} is the noise level that is exceeded for 10% of the time. In the UK, the convention for assessing road traffic noise is in terms of $L_{A10,18h}$, This is the L_{A10} for the 18-hour period between 06:00 and midnight.

7.1.10 The Government, as set out in the Aviation Policy Framework (APF) [1] and supported by SoNA [2], confirms that the current convention in the UK is to assess the effect of daytime aircraft noise in terms of daytime $L_{Aeq,16h}$ noise contours determined from an average summer day of aircraft movements. As a result, emphasis on the assessment of daytime noise in this chapter is placed on the UK methodology and $L_{Aeq,16h}$ unit. This unit has been used historically within the UK over the past 30 years to assess the effects of aircraft noise.

7.1.11 For night-time, the recent publication of the Government's response[3] to the airspace change consultation[4] confirms the use of $L_{Aeq,8h}$ noise exposure contours determined from an average summer night of aircraft movements for assessing aircraft noise effects at night. These contours are also now prepared and published annually for the designated airports such as Heathrow, Stansted and Gatwick, along with daytime $L_{Aeq,16h}$ contours. The L_{night} index is also referenced, alongside the $L_{Aeq,8h}$ index, as both are very similar.

7.1.12 In Europe, noise indicators based on the L_{Aeq} unit, known as the L_{den} and L_{night}, are used to assess environmental noise effects and are used in the UK to prepare Strategic Noise Maps and Noise Action Plans. Noise contours, in terms of L_{den} and L_{night}, are therefore produced on a five-yearly basis for all major airports, including Bristol Airport. The development of criteria by which to judge this European index is in its relative infancy compared to the body of knowledge built around the $L_{Aeq,16h}$ unit, although guidance is continuing to emerge, particularly regarding noise exposure and potential health effects.

[1] Department for Transport (2013). Aviation Policy Framework.
[2] Civil Aviation Authority (2017). Survey of noise attitudes 2014: Aircraft, CAP 1506.
[3] Department for Transport (2017). Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace. [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/653801/consultation-response-on-uk-airspace-policy-web-version.pdf [Checked 7/09/2018].
[4] Department for Transport (2017). UK Airspace Policy: A framework for balanced decisions on the design and use of airspace. [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/588186/uk-airspace-policy-a-framework-for-balanced-decisions-on-the-design-and-use-of-airspace-web-version.pdf

7.1.13 While average exposure noise contours of this type are well established and important at demonstrating trends in total noise around an airport, it is recognised in the APF that people do not always experience aircraft noise in an averaged manner and that the L_{Aeq} indicator does not necessarily reflect all aspects of the perception of aircraft noise. Supplementary indices are therefore considered as part of this air noise assessment which reflect how aircraft noise may be experienced in different localities. The purpose of this is to ensure a better understanding of noise effects and to inform the development of targeted noise mitigation measures.

7.1.14 Night-time aircraft noise can be evaluated in a number of different ways. The common method is to rate night noise in terms of noise exposure, using the $L_{Aeq,8h}$ index and the L_{night} index (for the period 23:00 to 07:00). It is also important however to consider the typical noise levels of individual aircraft, using noise indices such as the Single Event Level (SEL) and/or the L_{ASmax}.

7.1.15 The SEL is a measure of the noise energy produced during a noise event, such as an aircraft passby, averaged over a reference time of a single second. It therefore accounts for both the level and duration of the noise event. This is commonly used in the UK to describe noise produced by single aircraft (and rail) events, particularly at night.

7.1.16 The L_{ASmax} in contrast reflects what a person hears as the maximum noise level during an aircraft passby and is an index that is most understandable to people without the need for technical understanding. Like the SEL, it is used to rate the noise of an individual event, particularly at night.

7.1.17 L_{Amax} is commonly expressed in either "fast" or "slow" time weighting, denoted L_{AFmax} and L_{ASmax} respectively. For aircraft noise, the convention is to use L_{ASmax} whereas for other noise sources, L_{AFmax} is used.

7.1.18 The N index is becoming more commonly used to describe aircraft noise, often using the N70 parameter for daytime and N60 parameter for night-time aircraft noise assessment. This index describes the number of times in a defined period, such as the daytime or night-time, that a receptor will experience a given maximum noise level as a result of an aircraft passby. For example, an N70 of 20 means that a receptor will experience 20 aircraft events producing 70 dB L_{ASmax} or more during the defined period of time. This allows an understanding of how, for a given noise level and above, the number of flights during the daytime might alter when comparing two scenarios, such as with or without an airport development. There are no specific criteria for rating the acceptability of N70 or N60 contours although they further assist a comparison of two different operational scenarios.

7.1.19 Noise annoyance ratings are also a useful way of explaining how a given noise environment is likely to affect the local community, by identifying those likely to be 'highly annoyed' by aircraft noise. The measure considers the general population and it is accepted that some people would be more annoyed or less annoyed for a given daytime noise exposure level. This method of assessment offers some advantages over simply banding a population into "low", "moderate" and "high" annoyance categories since it recognises that even at relatively low levels of aircraft noise, some people can by highly annoyed. It can therefore be usefully used as a means of evaluating differences between scenarios. Similar ratings for sleep disturbance also exist for night-time activities.

7.1.20 While noise exposure contours take account of both the noisiness of aircraft events and the number of operations that occur during a day or night, they only provide an 'average' value. While this is required by Government for planning purposes, it does not reflect the change that occurs over a day. It is therefore also relevant to consider how the noise level might vary at a given receptor in a given day, particularly when comparing two scenarios. This is often represented by considering the following:

- Single mode contours produced assuming either 100% westerly operations or 100% easterly operations. There are no specific criteria available to rate noise levels associated with single mode contours. However, such contours show the noise exposure levels expected for a given day when operations occur from a single runway direction; and
- The variation in noise level at representative locations over a typical day, for example, on an hourly basis.

7.1.21 Consideration is given to both these methods within this noise chapter and accompanying appendices.

7.1.22 In undertaking an assessment for an ES, it is necessary to establish those effects that are considered to be adversely or beneficially significant. The thresholds to be adopted for this purpose are discussed later in the Assessment Criteria (**Section 7.3**) and Significance Criteria (**Section 7.9**) sections of this chapter.

Aircraft movements and scenarios

7.1.23 Three key scenarios have been considered in this chapter:

- Baseline (taken to be 2017);
- 10 million passengers per annum (mppa) Without Proposed Development in 2026. For air noise, a scenario of 10 mppa in 2021 has also been assessed since this is when this passenger capacity is expected to be reached; and
- 12 mppa With Proposed Development in 2026.

7.1.24 If the Proposed Development does not proceed, Bristol Airport would be constrained from 2021 onwards to a limit of 10 mppa. This would constrain Bristol Airport to operating no more aircraft movements in 2026 than occurred in 2021.

7.1.25 To reflect this, a sensitivity scenario for air noise has been included for 10 mppa in 2026 (Without Proposed Development) assuming that fleet modernisation occurs at the same rate as for growth to 12 mppa in 2026. In practice, the likelihood that more modern, quieter aircraft will be allocated to Bristol Airport will be reduced compared to the 12 mppa scenario since no potential for growth will be present for the airlines. Airlines are already securing flights to destinations and associated 'slots' at airports as far ahead as summer 2020 at the time of writing. If an airline can be assured growth at another airport it may seek to deliver a competitive advantage to secure capacity now. As airports are coming under increased pressure to reduce noise impacts, securing more modern aircraft fleets coupled with growth is a key way in which this can occur sustainably. Therefore, the 10 mppa 2026 scenario is a worst-case comparison for the 12 mppa scenario as the expectation of aircraft modernisation is similar.

7.1.26 As a result, in the case of air noise, the noise effects in the 10 mppa in 2021 scenario are likely to reflect the noisiest that will arise at Bristol Airport if it is constrained to 10 mppa. Moving forward in time would not alter the amount of aircraft movements or passenger throughput without additional development but noise levels would be likely to reduce as a result of gradual on-going fleet replacement with more modern and quieter aircraft.

7.1.27 The number of summer aircraft movements associated with each of the key scenarios for the daytime and night-time periods is given in **Table 7.1**, alongside the total number of annual movements.

Table 7.1 Annual aircraft movements for assessment scenarios

Scenario		Number of Aircraft Movements		
		92-day Summer Daytime (07:00-23:00)	92-day Summer Night-time (23:00-07:00)[1]	Annual Total
Key scenarios	**Baseline 2017**	18,924	2,735	73,562
	10 mppa 2021 (Without Proposed Development)	19,294	4,022	86,973
	12 mppa 2026 (With Proposed Development)	22,540	4,639	97,393
Air noise sensitivity scenario	**10 mppa 2026 (Without Proposed Development)**	19,294	4,022	86,973

Note: 1. This period is different to that which has a movement limit restriction, which is based on 23:30 to 06:00.

7.1.28 During the period 23:30 to 06:00, Bristol Airport is currently restricted to 3,000 aircraft movements in the summer season (approximately seven months, defined as the period from late March to late October when British Summer Time is in effect) and 1,000 aircraft movements in the winter season (when Greenwich Mean Time is in effect). The 12 mppa application seeks to keep the annual limit of 4,000 but remove the segregation of summer and winter periods. In this chapter, the assessment of the 12 mppa scenario is on the basis that this change is approved. Therefore the comparisons to the without development scenarios offer a worst case comparison.

7.1.29 The 12 mppa application does not seek any change to the Quota Count (QC) budgets for the summer and winter seasons. Such periods are also based on the same time criterion as the number of aircraft movements as explained above. The QC budgets are to remain at 1,260 in the summer and 900 in the winter.

7.2 Limitations of this assessment

7.2.1 Air noise and ground noise assessments in the future have been based on forecast aircraft movement data, while assessments for 2017 have been based on actual data. The forecasts used in this assessment have been prepared by Bristol Airport Limited (BAL) and verified by Mott McDonald, independent aviation consultants.

7.2.2 The road traffic noise assessment has been based on traffic counts undertaken in 2018 to determine current conditions as 2017 information is not available. It has been assumed that conditions in 2017 were identical. The baseline year has been referred to as 2017 throughout this chapter for consistency with other noise sources.

7.2.3 The assessment of construction noise is based on detailed construction plant schedules and programmes of works provided by BAL, supplemented with additional plant where relevant based on professional judgement.

7.3 Relevant legislation, planning policy and technical guidance

Legislative context

7.3.1 The following legislation is relevant to the assessment of the effects on noise and vibration receptors:

- *EU Regulation 598-2014*[5] sets out, for airports where a noise problem has been identified, the process to be followed for the introduction of noise-related operating restrictions in a consistent manner on an airport-by-airport basis, so as to help improve the noise climate and to limit or reduce the number of people significantly affected by potentially harmful effects of aircraft noise, in accordance with the Balanced Approach[6];
- *Environmental Noise Directive (END) 2002/49/EC 2002*[7] aims to define a common approach across the European Union with the intention of avoiding, preventing or reducing on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise including from aviation;
- *The Control of Pollution Act 1974*[8] provides a means for regulating construction noise and vibration;
- *The Aeroplane Noise Regulations 1999*[9] require that all civil propeller and jet aeroplanes registered in the UK shall have a noise certificate;
- *Aerodrome (Noise Restrictions) (Rules and Procedures) Regulations 2003*[10] apply to larger civil airports in the EU. Where it is proposed to introduce noise-related operating restrictions, the competent authority (currently BAL itself) is required to undertake a detailed assessment of the noise situation in the locality, and the full range of possible measures to address any noise problems identified. An EIA can be used under this legislation for introducing any noise-related changes that occur as a result of infrastructure or significant airport operational changes;
- *The Civil Aviation Act 2006*[11] includes a number of measures aimed at strengthening the powers available to control noise. These included provisions for airport operators to fix charges in respect of an aircraft or a class of aircraft based on the noise or amount of emissions produced by the aircraft. The Act also gave airport operators statutory powers to introduce noise control schemes for the purpose of avoiding, limiting or mitigating the effect of noise connected with the taking off or landing of aircraft;

[5] European Commission (2014). Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC, [online]. Available at: https://publications.europa.eu/en/publication-detail/-/publication/b6947ca7-f1f6-11e3-8cd4-01aa75ed71a1/language-en [Checked 21/08/2018].

[6] 'Balanced Approach' as defined in EU Regulation 598-2014 is the process developed by the International Civil Aviation Organization under which the range of available measures, namely the reduction of aircraft noise at source, land-use planning and management, noise abatement operational procedures and operating restrictions, is considered in a consistent way with a view to addressing the noise problem in the most cost-effective way on an airport-by-airport basis;

[7] European Commission (2002). Directive 2002/49/EC Directive Of The European Parliament and of the Council of 25th June 2002 relating to the assessment and management of environmental noise, [online]. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0049&from=EN [Checked 21/08/2018].

[8] Control of Pollution Act (1974), c.40. [Online]. Available at: http://www.legislation.gov.uk/ukpga/1974/40/pdfs/ukpga_19740040_en.pdf [Checked 21/08/2018].

[9] The Aeroplane Noise Regulations (1999). No. 1452. [online]. Available at: http://www.legislation.gov.uk/uksi/1999/1452/contents/made [Checked 30/08/2018].

[10] The Aerodromes (Noise Restrictions) (Rules and Procedures) Regulations (2003) SI 1986/925. [Online]. Available at: http://www.legislation.gov.uk/uksi/2003/1742/made [Checked 25/09/2018].

[11] Civil Aviation Act (2006), c34. [online]. https://www.legislation.gov.uk/ukpga/2006/34/contents [Checked 30/08/2018].

- *The Civil Aviation Act 2012*[12] placed a new duty on the Civil Aviation Authority (CAA) to make information about the environmental performance of the aviation sector and measures taken to limit adverse environmental effects available to the general public, and;
- *Environmental Noise (England) Regulations 2006 (as amended)*[13] transpose the *European Environmental Noise Directive (Directive 2002/49/EC)*[2] into English law. They require operators of non-designated major civil airports, such as Bristol Airport, to make and submit strategic noise maps to the Secretary of State every five years starting in 2007 which reflect the noise situation in the preceding calendar year. Regulation 18 places a duty on the operators of major airports, as the competent authority, to draw up a Noise Action Plan for places near the airport and submit this to the Secretary of State. There is then a continuing obligation on airport operators to review (and revise, if necessary) the Noise Action Plan every five years or sooner where a major development occurs.
- *The Town and Country Planning (Environmental Impact Assessment) Regulations 2017*[14] set out the process of Environmental Impact Assessments to be carried out in England, in accordance with corresponding European *Directive 2014/52/EU*[15].

7.3.2 Further details of how this legislation relates to noise and vibration is given in **Appendix 7B**.

Planning policy context

7.3.3 There are several policies and guidance at the national and local level that will be relevant to the noise assessment contained in this ES. In addition to policy referenced in **Chapter 5: Legislative and Policy Overview**, policy directly applicable to this noise assessment is listed in **Table 7.2** below.

Table 7.2 Relevant policies and their implications for noise and vibration

Policy reference	Implications
Noise Policy Statement for England (NPSE) 2010[16]	
Paragraph 1.7	Provides the framework for noise management decisions to be made that ensure noise levels do not place an unacceptable burden on society.
Paragraph 2.20	Introduces the concepts of NOEL (No Observed Effect Level), LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level).
National Planning Policy Framework (NPPF) 2018[17]	
Paragraph 180	States that planners should seek to mitigate and minimise potential adverse noise impacts from a new development.

[12] Civil Aviation Act (2012), c19. [Online]. http://www.legislation.gov.uk/ukpga/2012/19/contents/enacted [Checked 30/08/2018].
[13] The Environmental Noise (England) Regulations (2006). No. 2238. [Online]. http://www.legislation.gov.uk/uksi/2006/2238/contents/made [Checked 30/08/2018].
[14] The Town and Country Planning (Environmental Impact Assessment) Regulations 2017. [Online]. Available at: http://www.legislation.gov.uk/uksi/2017/571/pdfs/uksi_20170571_en.pdf [Checked 23/11/2018].
[15] European Commission (2014). Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment. [Online]. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0052&from=EN [Checked 23/11/2018].
[16] Defra (2010). Noise Policy Statement for England, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69533/pb13750-noise-policy.pdf [Checked 10/04/2018].
[17] Ministry of Housing, Communities and Local Government (2018). National Planning Policy Framework, [Online]. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf [Checked 08/10/2018].

Policy reference	Implications
Aviation Policy Framework (APF) 2013[1]	
Paragraph 3.12	Defines the Government's objectives and policies on the impacts of aviation in the UK and states that the Government's overall objective on noise is to "Limit and where possible reduce the number of people in the UK significantly affected by aircraft noise".
Paragraph 3.13	Guidance provided on the noise metric used to rate airborne noise (summer $L_{Aeq,16h}$ and $L_{Aeq,8h}$).
Paragraph 3.17	Interpretation given of the 57 dB $L_{Aeq,16h}$ contour as an average level of summer daytime aircraft noise marking the approximate onset of significant community annoyance.
Paragraph 3.36 to 3.38	Government expectations and guidance with respect to noise levels where airport operators are to provide exposed households assistance with the cost of moving and acoustic insulation.
Paragraph 3.39 to 3.41	Government expectations and guidance where households are exposed to increased noise levels due to new developments.
UK Airspace Policy: A framework for balanced decisions on the design and use of airspace 2017 consultation[3]	
Paragraph 9	States that although the Government's current aviation policy is set out in the APF[1], the policies set out within this document provide an update to some of the policies on aviation noise contained within the APF, and should be viewed as the current government policy.
Paragraph 2.39	Removal of the 3 dB minimum change requirement for financial assistance towards acoustic insulation to residential properties in the 63 dB $L_{Aeq,16h}$ level or above.
Paragraph 2.70	A level of 54 dB $L_{Aeq,16h}$ is acknowledged to correspond to the onset of significant community annoyance and replaces the 57 dB $L_{Aeq,16h}$ level in the APF.
Paragraph 2.72	For assessing and comparing noise impacts of airspace changes, LOAEL is taken as 51 dB $L_{Aeq,16h}$ and 45 dB L_{night}, for daytime and night-time noise respectively. 45 dB $L_{Aeq,8h}$ is considered appropriate as the LOAEL for airspace change assessment.
Airports National Policy Statement (NPS)[18]	
Section 2	Sets out the Government's policy on the need for new airport capacity in the South East of England

Technical guidance

7.3.4 A summary of the technical guidance used to assess the likely significant effects of the Proposed Development with respect to noise and vibration is given in **Table 7.3**. Details of technical guidance are given in **Appendix 7B.**

Table 7.3 Technical guidance relevant to noise and vibration

Technical guidance	Relevance to this assessment
General	
WHO *Guidelines for Community Noise*[19]	Sets out noise targets which represent goals for minimising the adverse effects of noise on health.

[18] Department for Transport (2018). Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England. [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/714106/airports-nps-new-runway-capacity-and-infrastructure-at-airports-in-the-south-east-of-england-web-version.pdf [Checked 30/08/2018].

[19] Berglund, B. et al (1999). Guidelines for community noise. [Online]. Available at: http://apps.who.int/iris/bitstream/handle/10665/66217/a68672.pdf?sequence=1&isAllowed=y [Checked: 30/08/2018].

Technical guidance	Relevance to this assessment
WHO *Night Noise Guidelines*[20]	Effects on health and sleep from transportation sources.
WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep [21]	Reports the latest findings from the WHO concerning night noise from transportation sources and its effects on health and sleep.
BS8233:2014 *Sound insulation and noise reduction for buildings – Code of practice*[22]	Provides guidance on the control of external noise. The standard presents a number of design ranges for indoor noise levels for different types of space.
Department of Education *BB93*[23]	Gives upper limits for indoor ambient noise level for new and refurbished schools, and schools formed by a material change of use.
Department of Health *HTM 08-1*[24]	Guidance on recommended internal noise levels for healthcare facilities.
Air noise	
IEMA *Guidelines on Environmental Noise Impact Assessment*[25]	Significance rating for a change in air noise level.
Civil Aviation Authority *Survey of Noise Attitudes 2014*[26]	Methods to determine noise annoyance.
Report of a Field Study of Aircraft Noise and Sleep Disturbance[27]	Eligibility threshold for a sound insulation scheme due to night time aircraft noise.
Environmental Noise: Valuing impacts on: sleep disturbance, annoyance, hypertension, productivity and quiet[28]	Percentage of those people likely to be highly sleep disturbed.
Airborne aircraft vibration	

[20] World Health Organisation Europe (2009). Night Noise Guidelines for Europe, [Online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf [Checked 7/09/ 2018].
[21] Basner, M. et al. (2018). WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep. Int. J. Environ. Res. Public Health 2018, 15, 519. [Online]. Available at: https://www.mdpi.com/1660-4601/15/3/519 [Checked 25/09/2018].
[22] British Standards Institution (2014). BS 8233:2014 Sound insulation and noise reduction for buildings – Code of practice. [Online]. Available at: https://shop.bsigroup.com/ProductDetail/?pid=000000000302415798_ga=2.85437209.1462736480.1535108011-979344642.1535108011 [Checked: 24 /08/2018].
[23] Department of Education (2015). Acoustic design of schools: performance standards Building bulletin 93, [Online]. Available at: https://www.gov.uk/government/publications/bb93-acoustic-design-of-schools-performance-standards [Checked 24/08/2018].
[24] Department of Health (2013). Specialist Services, Health Technical Memorandum 08-01: Acoustics, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/144248/HTM_08-01.pdf [Checked 24/08/2018].
[25] Institute of Environmental Management and Assessment (2014). Guidelines on Environmental Noise Impact Assessment. London: IEMA.
[26] Civil Aviation Authority (2017). Survey of noise attitudes 2014: Aircraft, CAP 1506, [Online]. Available at: https://publicapps.caa.co.uk/docs/33/CAP%201506%20FEB17.pdf [Checked 30/08/2018].
[27] Ollerhead, J.B. et al (1992). Report of a Field Study of Aircraft Noise and Sleep Disturbance: A Study Commissioned by the Civil Aviation Policy Directorate of the Department of Transport from the Department of Safety, Environment and Engineering, Civil Aviation Authority. London: HMSO.
[28] Department for Environment Food and Rural Affairs (2014). Environmental Noise: Valuing impacts on: sleep disturbance, annoyance, hypertension, productivity and quiet. [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/380852/environmental-noise-valuing-imapcts-PB14227.pdf [Checked 26/09/2018].

Technical guidance	Relevance to this assessment
Aviation Noise Metric – Research on the Potential Noise Impacts on the Historic Environment by Proposals for Airport Expansion in England[29]	Summarises research into vibration effects from aircraft.
Airports and the Environment[30]	Description of potential vortex damage to buildings due to aircraft.
Ground noise	
National Noise Incidence Study[31]	Percentage of population exposed to noise levels which exceed the guideline for 'serious' community annoyance.
Road traffic noise	
Design Manual for Roads and Bridges[32]	Road traffic noise assessment criteria.
Construction noise and vibration	
BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites. Noise*[33]	Provides methods to predict, measure and assess the impact of construction and demolition noise.
BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites. Vibration*[34]	Recommends basic methods to control vibration on construction and open sites with significant vibration levels arising from work activities/operations.

7.4 Data gathering methodology

Study area

7.4.1 The study area is based on the largest extent of likely effects due to noise. This area is different for different noise and vibration sources considered.

7.4.2 The largest ZoI considered for the assessment is for air noise. This zone consists of a rectangle that extends 20km to the east, 25km to the west, 4km to the north and 4km to the south of the Bristol Airport runway and is shown in **Figure 7.7**.

7.4.3 The only properties likely to potentially experience significant levels of vibration from airborne aircraft are those closest to aircraft in flight, which are the dwellings bordering Felton Common.

7.4.4 For ground noise the ZoI considered consists of a 6km square centred on the Bristol Airport runway.

[29] Historic England (2014). Aviation Noise Metric – Research on the Potential Noise Impacts on the Historic Environment by Proposals for Airport Expansion in England, [Online]. Available at: https://research.historicengland.org.uk/Report.aspx?i=15740 [Checked 26/11/2018]
[30] Anne Paylor (1994). Airports and the Environment.
[31] BRE (2002). The National Noise Incidence Study 2000/2001 (United Kingdom): Volume 1 – Noise Levels, Client report number 206344f, [Online]. Available at: http://randd.defra.gov.uk/Document.aspx?Document=10280_NIS1206344f.pdf [Checked 7/09/2018].
[32] Highways England (2018). Design Manual for Roads and Bridges, [Online]. Available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/index.htm [Checked 24/04/ 2018].
[33] British Standards Institution (2008). BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Noise, [Online]. Available at: https://shop.bsigroup.com/ProductDetail?pid=000000000030258086 [Checked 24/08/2018].
[34] British Standards Institution (2008). BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites. Vibration, [Online]. Available at: https://shop.bsigroup.com/ProductDetail/?pid=000000000030258089 [Checked 2/10/2018].

7.4.5 For road traffic noise the ZoI considered consists of a rectangle that extends approximately 1km to the east, 2km to the west, 1km to the north and 2km to the south of the Bristol Airport runway. The receptors considered are shown in **Figure 7F.2**.

7.4.6 For construction noise and vibration, the ZoI considered consists of the immediate vicinity of the construction sites. The receptors considered are shown in **Figure 7.2**.

Desk study

7.4.7 An initial desk top study has been undertaken to review the existing airport including Google Earth™ imagery and Ordnance Survey (OS) mapping of the surrounding environment to determine the context of the proposal. The desk top study identified the main scope of the noise surveys undertaken to assess the existing environment and the location of the closest noise sensitive receptors to the proposed operations for the impact assessment. Dwelling data and data regarding noise sensitive community buildings has been acquired from the sources listed below. A summary of the organisations that have supplied data, together with the dates the data was supplied and the nature of that data is as follows:

- National Air Traffic Services – June 2018:
  - Geographical information about the location and height of the runway have been taken from the latest version of the UK Aeronautical Information Package (AIP) for Bristol Airport.
- OS – May 2018:
  - Local topography based on the OS Landform Panorama Digital Terrain Model (DTM) product processed for use in the air noise modelling software;
  - 1:50,000 base map; and
  - AddressBase Plus product to identify non-residential property types.
- BAL – May to October 2018:
  - Current and future aircraft types and movement information, arrival and departure flight tracks;
  - Current (2017) and forecast (2026) road traffic numbers; and
  - Construction noise information.
- CACI Ltd – October 2017:
  - Dwelling counts and populations.

Survey work

7.4.8 The noise climate around Bristol Airport includes noise from aircraft activity, as well as non-aircraft related activities. The baseline at any given location will depend on its proximity to Bristol Airport and aircraft flight paths as well as to major or minor roads and any other local noise sources. The A38 in particular is a major contributor to the baseline noise environment close to Bristol Airport, with the M5 and A370 also contributing significantly to the noise environment to the west of Bristol Airport. Some noise is also produced by traffic on minor roads, for example Downside Road, alongside departing and arriving aircraft at Bristol Airport and aircraft activity on the ground.

7.4.9 Noise monitoring locations have been selected to obtain representative ambient and background noise levels at those noise sensitive receptor locations close to Bristol Airport, that is, at receptors most at risk of being affected by aircraft operations from the development of Bristol Airport.

7.4.10 Details of the noise survey work is given in **Appendix 7C** and a summary is presented in this section.

Long-term noise monitoring

7.4.11 Day and night-time noise surveys were undertaken at four locations around Bristol Airport to establish the baseline noise environment. The locations are representative of the communities in closest proximity to Bristol Airport, which therefore are likely to experience the greatest noise effect from Bristol Airport operations.

7.4.12 The surveys were carried out during the period 13 March 2018 to 5 April 2018, where each survey lasted at least three weeks. Each noise survey comprised unattended, free-field and continuous monitoring of 5-minute periods. Observations were made at each monitoring location of the noise climate prevailing at the time that measurements were started.

7.4.13 Noise levels have been measured in terms of $L_{Aeq,T}$, which represents the average noise level, and L_{AF90}, which represents the background noise level, for the 16 hour day (07:00 to 23:00), 12 hour day (07:00 to 19:00) and 8 hour night (23:00 – 07:00) periods.

7.4.14 Details of the long-term noise monitoring locations are given in **Table 7.4** and are shown in **Figure 7C.1**.

Table 7.4 Long-term noise monitoring locations

Receptor	Location	Dates of noise survey
A	Cooks Bridle Path, Downside	14 March 2018 to 4 April 2018
B	Downside Road, Lulsgate Bottom	13 March 2018 to 5 April 2018
C	School Lane, Lulsgate Bottom	13 March 2018 to 3 April 2018
D	Red Hill (A38), Redhill	14 March 2018 to 5 April 2018

Ground noise monitoring

7.4.15 A daytime attended noise survey was undertaken at Bristol Airport on 26 July 2018 to measure the ground noise of taxiing arriving and departing aircraft.

7.4.16 Measurements were free-field, of 10 second duration and recorded in terms of $L_{Aeq,T}$, SEL and L_{AFmax}, with observations made of the aircraft type at each time.

7.4.17 The ground noise monitoring location was at the corner of Winters Lane to the north of the runway and is shown in **Figure 7C.2**.

Road traffic noise monitoring

7.4.18 A daytime attended noise survey was undertaken at Bristol Airport on 26 July 2018 to measure road traffic noise at four locations around Bristol Airport. The locations are representative of the communities in closest proximity to the roads affected by Bristol Airport, which therefore are likely to experience the greatest change in road traffic noise from Bristol Airport operations.

7.4.19 The principles of the Department of Transport's *Calculation of Road Traffic Noise*[35] (*CRTN*) shortened measurement method were used, with three measurements of 5-minute duration taken

[35] Department of Transport (1988). Calculation of Road Traffic Noise. Department of Transport Welsh Office. London: HMSO.

in three consecutive hours at each location. Values of $L_{A10,T}$ were obtained at each location, along with other environmental noise indices including $L_{Aeq,T}$, $L_{A90,T}$ and L_{AFmax}.

7.4.20 Details of the road traffic noise monitoring locations are given in **Table 7.5** and are shown in **Figure 7C.2**.

Table 7.5 Road traffic noise monitoring locations

Receptor	Location
R1	Downside Road
R2	A38 / Downside Road intersection
R3	A38 / North Side Road roundabout
R4	A38 / road to Old Barn Lane intersection

7.5 Overall baseline

Noise

7.5.1 The locations at which the baseline noise conditions have been assessed are shown in **Figure 7C.1** and **Figure 7C.2.** The results are summarised in **Table 7.6**, **Table 7.7** and **Table 7.8** for these locations in terms of the ambient noise level (L_{Aeq}), maximum noise level (L_{AFmax}) and background noise level (L_{A90}). Detailed results are given in **Appendix 7C.**

7.5.2 As well as airborne and ground-borne noise from Bristol Airport, the surrounding community is affected by noise from the local road network.

7.5.3 All noise sources affect the L_{Aeq} metric which, commonly used to denote the ambient noise level, signifies the single steady average noise exposure level which is equivalent in energy terms to that produced by the various fluctuating noise levels that occur in the given measurement period. The L_{AFmax} metric is the peak noise level recorded during the measurement period. The L_{A90} metric denotes the level of noise which is exceeded for 90% of the time and represents the prevailing background noise level in the absence of any noise from airborne aircraft.

Table 7.6 Current baseline noise measurements – long -term summary

Location	16-hour day (07:00 to 23:00)		8-hour night (23:00 to 07:00)		Dominant daytime noise source
	L_{Aeq} dB(A)	Average $L_{AF90,5m}$ dB(A)	L_{Aeq} dB(A)	Average $L_{AF90,5m}$ dB(A)	
A Cooks Bridle Path, Downside	53	38	49	37	Aircraft
B Downside Road, Lulsgate Bottom	58	49	54	47	Aircraft
C School Lane, Lulsgate Bottom	59	47	54	42	Aircraft
D Red Hill (A38), Redhill	50	42	47	37	Road traffic

Table 7.7 Current baseline noise measurements – ground noise summary

Location	Average $L_{Aeq,10s}$ dB(A)	Average SEL dB(A)	Average L_{AFmax} dB(A)	Dominant noise source
G1 Winter's Lane (corner N of Runway)	82	92	84	Aircraft taxiing

Table 7.8 Current baseline noise measurements – road traffic noise summary

Location	$L_{Aeq,15m}$ dB(A)	L_{A10} dB(A)	L_{A90} dB(A)	L_{AFmax} dB(A)	Dominant noise source
R1 Downside Road	69	71 – 73	42 – 47	87 – 92	Road traffic
R2 A38 / Downside Road intersection	75	78 – 79	63 – 65	86 – 89	Road traffic
R3 A38 / North Side Road roundabout	69	69 – 71	59 – 60	82 – 89	Road traffic
R4 A38 / road to Old Barn Lane intersection	72	75 – 77	47 – 52	83 – 86	Road traffic

7.5.4 **Table 7.6** indicates that the general ambient noise level around Bristol Airport is in the range of 50 to 59 dB L_{Aeq} during the daytime, with an underlying background noise level in the range 38 to 49 dB L_{A90}. During the night, ambient noise levels are lower and lie in the range 47 to 54 dB L_{Aeq}, with an underlying background noise level in the range 37 to 47 dB L_{A90}.

7.5.5 The noise environment at any given location in the immediate vicinity of Bristol Airport depends on its proximity to Bristol Airport and the A38. The A38 generates a consistent and steady noise around the area and is a contributor to the background noise level. Superimposed on this are departing and arriving aircraft at Bristol Airport, along with noise from aircraft activity on the ground.

Vibration

7.5.6 The baseline vibration conditions for most dwellings in the vicinity of Bristol Airport are generally dictated by local road traffic conditions. For dwellings along major roads, there is potential for perceptible vibration levels to be produced by passing heavy vehicles such as buses and Heavy Goods Vehicles (HGVs). For dwellings located away from busy roads, vibration levels will be low and the occupants are unlikely to be aware of any vibration within their premises from outside sources.

7.5.7 Dwellings that are situated close to Bristol Airport and are in line with the runway have the potential to experience perceptible vibration due to airborne aircraft. Some dwellings bordering Felton Common to the east of the runway fall into this category.

7.6 Consultation

7.6.1 North Somerset Council (NSC) have been consulted regarding the methodology of the assessment. BAL met with NSC on 11 October and 23 October 2018. **Table 7.9** provides a summary of the points raised by NSC and the responses given.

Table 7.9 Summary of issues raised during consultation regarding noise and vibration

Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
NSC highlighted that while the scoping report referred to most relevant policies at both a local and national level, some were missing	NSC	Additional local and national policies referred to in final ES chapter.	**Section 7.3, Appendix 7B**
NSC noted that BAL 'do not intend to increase the number of 'night-time' flights per annum, which is limited to 4,000, but they do wish to include greater flexibility to their distribution, which is restricted to 3,000 in the summer time and 1,000 in the winter time. If this leads to a higher concentration of night-time flights in the summer season, which is when more residents may choose to sleep with windows open, the potential impacts on sleep disturbance and human health should be examined.'	NSC	The assessment of 12 mppa has assumed that the 3,000-summer restriction is lifted (but 4,000 annual remains). The comparisons to 12 mppa are therefore worst-case comparisons as the combined effect of both the increase in movements and relaxation of summer restriction is assessed.	**Section 7.10 and Section 7.11**
NSC requested a simplified version of the ES chapter on noise be prepared that can be used to engage with local communities	NSC	A summary version of the ES chapter on noise will be prepared following issue of the ES that can be used to engage with local communities. Bristol Airport has prepared a fact sheet for this purpose.	**n/a**
NSC wish to understand changes in aircraft fleet and modernisation between the 10 mppa and 12 mppa scenarios particularly with respect to past aircraft type adoption	NSC	Changes in aircraft fleet and modernisation between the 10 mppa and 12 mppa scenarios particularly with respect to past aircraft type adoption are given explicitly in **Appendix 7D**.	**Appendix 7D**
NSC requested an explanation for Significant Observed Adverse Effect Level (SOAEL) is provided	NSC	Request was based on summary report (Summary Findings of ES Air Noise Assessment 10.10.18) provided to NSC which did not include a definition of SOAEL. SOAEL is defined in this chapter and associated appendices.	**Section 7.9, Appendix 7B**
NSC raised a concern about noise due to car parking activities (such as doors slamming)	NSC	Assessment of noise due to car parking activities is included in **Appendix 7F**.	**Appendix 7F**

Issue raised	Consultee(s)	Response and how considered in this chapter	Section Ref
at unwelcome hours due to increased car parking capacity			
NSC requested that changes in road traffic noise levels at Defra-defined Noise Important Areas are presented	NSC	Changes in noise level at Noise Important Areas have been included in **Appendix 7F**.	**Appendix 7F**

7.7 Scope of the assessment

Assessment activities

Air noise and vibration

7.7.1 Air noise contours have been prepared in terms of the usual UK noise indicator for daytime airborne noise, the $L_{Aeq,16h}$ index, and for night-time airborne noise, the $L_{Aeq,8h}$ index, using the *Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT)*[36].

7.7.2 Consideration has been given to other sources of aircraft performance data, such as those available from the Civil Aviation Authority (CAA) on the performance of future aircraft types, as well as aircraft performance information relating to operations of relevant aircraft types. In this assessment, this has included the Airbus A320neo and A321neo, and also the Boeing B738MAX aircraft.

7.7.3 The likelihood of vibration effects due to airborne aircraft have been assessed for the dwellings bordering Felton Common.

Ground noise

7.7.4 A ground noise assessment has been undertaken for the area around Bristol Airport where aircraft ground operations, such as engine running on stands and at hold positions, taxiing, manoeuvring and the operation of auxiliary power units (APUs) while on stands, will give rise to the greatest potential noise effects.

7.7.5 Ground noise contours have been prepared in terms of the daytime $L_{Aeq,16h}$ index and the night-time $L_{Aeq,8h}$ index using Datakustik CadnaA[37] noise modelling software.

7.7.6 Consideration has been given to survey work of aircraft ground operations, both at Bristol Airport and at other airports where similar aircraft types operate.

Road traffic noise

7.7.7 Road traffic noise calculations at representative noise sensitive receptors have been undertaken using the UK recognised method of assessment set out in CRTN[35].

7.7.8 Road traffic noise contours have been prepared in terms of the $L_{A10,18h}$ index using Datakustik CadnaA[37] noise modelling software.

Construction noise and vibration

7.7.9 The construction plant noise emission details as set out in tables within BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites*[33] (BS 5228-1) along with the associated described methodologies have been used to assess and predict construction noise for different phases of the Proposed Development at key noise sensitive receptors.

7.7.10 For the vibration assessment, information from BS 5228-2:2009+A1:2014[34] (BS 5228-2) has been used where relevant to predict vibration levels at key noise and vibration sensitive receptors.

[36] Federal Aviation Administration (2017). Aviation Environmental Design Tool (AEDT) Version 2d, [Online]. Available at: https://aedt.faa.gov/2d_information.aspx [Checked 28/08/2018].
[37] DataKustik GmbH (2018). CadnaA - State-of-the-art Noise Prediction Software 2017 Version, [Online]. Available at: https://www.datakustik.com/en/products/cadnaa/ [Checked 1/10/2018].

Spatial scope

7.7.11 The spatial scope of the assessment application site together with the Zones of Influence (ZoI) that have formed the basis of the study area is described in **Section 7.4**.

7.7.12 The largest ZoI considered for the assessment is for air noise. This zone consists of a rectangle that extends 20km to the east, 25km to the west, 4km to the north and 4km to the south of the Bristol Airport runway and is shown in **Figure 7.7**.

Temporal scope

7.7.13 The temporal scope of the assessment is consistent with the period over which the Proposed Development would be carried out and therefore covers the construction (2019-2026) and operational periods (2017, 2021 and 2026). The air, ground and road traffic noise assessments consider the following scenarios:

- Baseline year (2017);
- 10 mppa in 2021 (air noise only). This aircraft mix and number of movements corresponds to Bristol Airport reaching its current passenger limit;
- 12 mppa. This aircraft mix and number of movements corresponds to implementation of the Proposed Development in 2026; and
- 10 mppa in 2026. This aircraft mix and number of movements corresponds to the 10 mppa in 2021 scenario but assumes that aircraft modernisation occurs at the same rate as under the 12 mppa scenario. For the air noise assessment this is regarded as a sensitivity case as there is significant uncertainty regarding how much additional aircraft modernisation would occur beyond 2021 in the event that the Proposed Development is not implemented (refer to paragraph 7.1.25). For ground and road traffic noise aircraft modernisation does not affect the assessment.

Potential receptors

7.7.14 Potential noise receptors considered include dwellings as well as non-residential receptors, as follows:

- Residential receptors;
- Schools;
- Hospitals or residential healthcare facilities;
- Places of worship, and;
- Amenity areas.

Residential receptors

7.7.15 For the purposes of dwelling and population counts for air noise, the residential receptors have been identified using a 2017 dataset supplied by CACI Ltd. This data consists of dwelling count and population by postcode. CACI derive this data from the latest available census information and adjust it to account for developments that have been built out since the latest census.

7.7.16 For the purposes of dwelling counts for ground noise, the residential receptors have been identified using the OS AddressBase Plus product, which provides details of individual dwellings.

7.7.17 For the purposes of dwelling counts for road traffic noise, representative residential receptors have been identified from details of the location and layout of buildings around Bristol Airport supplied by BAL, and from the inspection of maps of the area.

7.7.18 Specific residential receptors used for the air noise assessment are given in **Table 7.10**. Similarly, **Table 7.11** gives the specific residential receptors used for the ground noise and construction noise assessments. These are shown in **Figure 7.1** and **Figure 7.2**. These receptors have been chosen as representative of the local communities most sensitive to noise effects from the Proposed Development.

Table 7.10 Specific residential receptors – air noise

Number	Air noise residential receptor
1	Henley Park, Yatton
2	Bishops Road, Cleeve
3	Fountain Treeworks, Brockley
4	Cooks Bridle Path, Downside
5	Downside Road, Downside
6	School Lane, Lulsgate Bottom
7	Hillview Gardens, Felton
8	Market Place, Winford
9	Chew Magna, North Wick
10	Church Road, Norton Malreward
11	Lye Mead, Winford
12	Red Hill, Redhill
13	Wrington Hill, Wrington
14	Southlands Way, Congresbury

Table 7.11 Specific residential receptors – general

Designator	Ground and construction residential receptor
A	Cooks Bridle Path, Downside
B	Downside Road (West), Lulsgate Bottom
C	School Lane, Lulsgate Bottom
D	Red Hill (A38) (North), Redhill
E	Winters Lane (South), Redhill
F	Downside Road (South), Downside
G	Downside Road (North), Downside

Designator	Ground and construction residential receptor
H	Downside Road (East), Lulsgate Bottom
I	Bridgwater Road (A38), Lulsgate Bottom
J	Red Hill (A38) (South), Redhill
K	Winters Lane (North), Redhill

Non-residential receptors

7.7.19 Specific non-residential receptors used for the air noise and ground noise assessments are given in **Table 7.12**, **Table 7.13** and **Table 7.14** for schools, places of worship and amenity areas respectively. These are shown in **Figure 7.3**, **Figure 7.4**, and **Figure 7.5** respectively. No hospitals or residential healthcare facilities were identified within the study area.

Table 7.12 Specific non-residential receptors – schools

Designator	Non-residential receptor - school
S1	Winford Primary, Winford
S2	St. Andrew's Primary, Congresbury
S3	Yatton Junior, Yatton
S4	Marksbury Primary, Marksbury
S5	St. Anne's Primary, Hewish
S6	Chew Magna Primary, Chew Magna
S7	Wrington Primary, Wrington
S8	Court de Wyck Primary, Cleeve
S9	Pensford Primary, Pensford
S10	Dundry Primary, Dundry
S11	Stanton Drew Primary, Stanton Drew
S12	Woodspring School, Weston-Super-Mare

Table 7.13 Specific non-residential receptors – places of worship

Designator	Non-residential receptor place of worship
W1	St. Thomas A Becket's Church, Pensford
W2	Marksbury Methodist Church, Marksbury
W3	St. Barnabas Church, Claverham
W4	St. Dunstan And St Anthony Church, Claverham
W5	Chew Magna Baptist Church, Chew Magna

Designator	Non-residential receptor place of worship
W6	Sacred Heart Church, Chew Magna
W7	All Saints Church, Publow
W8	St. James Church, Regil
W9	Holy Trinity Church, Cleeve
W10	St. Margaret's Church, Queen Charlton
W11	St. Mary and St Peters Church, Winford
W12	St. Mary's Church, Compton Dando
W13	Congresbury Methodist Church, Congresbury
W14	Chewton Keynsham Church, Chewton Keynsham
W15	Dundry Baptist Church, Dundry
W16	St. Nicholas Church, Brockley
W17	St. Andrews Church of England, Hartcliffe
W18	Wrington United Reformed Church, Wrington
W19	Holy Saviour's Church, Hewish
W20	Yatton Methodist Church, Yatton
W21	St. Andrews Church, Congresbury
W22	Holy Trinity Church, Norton Malreward
W23	St. Katherine's Church, Felton
W24	All Saints Church, Wrington
W25	All Saints Church, Kingston Seymour
W26	Claverham Free Church, Claverham
W27	The Church of Saint Mary The Virgin, Yatton
W28	Christ Church, Redhill
W29	St. Michael, Dundry
W30	Gospel Hall - Pensford Gospel Church, Pensford
W31	St. Michael's Church, Burnett
W32	St. Mary's Church, Stanton Drew
W33	St. Andrew's Church, Chew Magna
W34	Winford Baptist Chapel, Winford
W35	Horsecastle Chapel, Yatton

Table 7.14 Specific non-residential receptors – amenity areas

Designator	Non-residential receptor amenity area
A1	The Glebe Field, Wrington
A2	Yatton Village Green, Yatton
A3	Glebelands Gardens, Yatton
A4	Bishport Avenue Open Space, Hartcliffe
A5	Streamcross Playing Field, Claverham
A6	Crosscombe Walk Open Space, Hartcliffe
A7	Court Farm Road Open Space, Whitchurch
A8	Cadbury Hill, Yatton
A9	Vee Lane Play Area, Felton
A10	Manor Road Playing Field, Keynsham
A11	Marksbury Playground, Marksbury
A12	Chew Magna Playing Field, Chew Magna
A13	Orchid Drive Play Area, Keynsham
A14	Publow Lane Recreation Ground, Publow
A15	The Mead Play Area, Keynsham
A16	Hamilton Way Play Area, Whitchurch
A17	Congresbury Millennium Green, Congresbury
A18	Hangstones Playing Field, Yatton
A19	Rock Road Playing Field, Yatton
A20	Land at Saxon Court, St. Georges
A21	Holmoak Road Playing Field, Keynsham
A22	Chalfield Close Play Area, Keynsham
A23	Whitchurch Playground, Whitchurch
A24	Felton Common, Felton

Likely significant effects

7.7.20 The noise and vibration receptors that have been taken forward for assessment are summarised in **Table 7.15,** along with the potential likely significant effects that might arise as a result of the Proposed Development.

Table 7.15 Noise receptors scoped in for further assessment

Receptor	Relevant assessment criteria	Likely significant effects
Air noise		
Residential	NPPF[17], NPSE[16], APF[1], SoNA201420[26], WHO[19 20 21]	People exposed to significant air noise could experience worsening conditions, or new people become similarly exposed.
Schools	BB93[23]	Communication and learning could be affected adversely by any increase in air noise.
Places of Worship	As Residential	Increased risk of disturbance to people and activities.
Amenity Areas	BS 8223[22], WHO[19]	Increased risk of disturbance to people and activities.
Airborne aircraft vibration		
Residential	Historic England[29]	Perceptible vibration e.g. windows rattling.
Ground noise		
Residential	WHO[19]	People exposed to significant ground noise could experience worsening conditions, or new people become similarly exposed.
Schools	BB93[23]	Communication and learning could be affected adversely by any increase in ground noise.
Places of Worship	n/a	Increased risk of disturbance to people and activities.
Amenity Areas	BS 8223[22], WHO[19]	Increased risk of disturbance to people and activities.
Road traffic noise		
All Receptors	*Noise Insulation Regulations*[38 39], BS 8233[22]	People exposed to significant road traffic noise could experience worsening conditions, or new people become similarly exposed.
Construction noise and vibration		
All Receptors	BS 5228[33 34]	People could become exposed to significant construction noise levels, over a relatively prolonged period.

7.8 Environmental measures embedded into the development proposals

7.8.1 A range of environmental measures have been embedded into the development proposals as outlined in **Section 2.3**. **Table 7.16** outlines how these embedded measures will influence the noise and vibration assessment. A detailed account of the embedded mitigation through existing noise controls and mitigation procedures in place at Bristol Airport is also described.

[38] The Noise Insulation Regulations (1975). No. 1736. [online]. Available at: http://www.legislation.gov.uk/uksi/1975/1763/contents/made [Checked 4/10/2018].
[39] The Noise Insulation (Amendment) Regulations (1988). No. 2000. [online]. Available at: https://www.legislation.gov.uk/uksi/1988/2000/contents/made [Checked 4/10/2018].

7.8.2 In general, these controls and procedures are in place and have therefore been accounted for in the assessment. The exception is the noise insulation grants. These grants allow homeowners to reduce the noise levels inside dwellings as they provide funds towards the cost of noise insulation works. However, as the convention for aircraft noise assessment is to assess it in terms of the external noise levels, this mitigation is not accounted for in the assessment.

Table 7.16 Summary of the embedded environmental measures

Receptor	Changes and effects	Embedded measures
Dwellings exposed to ground noise to the north of Bristol Airport	Aircraft movements will increase with potentially a consequential increase in ground noise exposure.	As part of the Proposed Development, a new walkway will be constructed to the north of the existing eastern apron. This will offer screening from ground noise for receptors to the north of this location, in particular those on Downside Road.

Bristol Airport – existing planning controls

7.8.3 Bristol Airport has operated for many years under a number of planning consents and as such is already subject to planning controls and voluntary agreements relating to those consents as well as its own sustainability and noise management policies.

7.8.4 Most recently planning permission was granted in February 2011 for expansion of Bristol Airport to handle 10 mppa[40]. The current Section 106 Agreement includes planning obligations relating to the management and control of air and ground noise through the implementation of a noise control scheme and adoption of operational procedures and practices aimed at achieving ongoing improvements.

7.8.5 These are each briefly described in the following section and are given in detail in Bristol Airport's current *Noise Action Plan*[41].

7.8.6 A planning obligation required the establishment of an Airport Environmental Improvement Fund[42], the purposes of which includes the funding of initiatives to mitigate the impact of aircraft and ground noise in the local community. Bristol Airport paid an initial sum of £100,000 into the fund in 2012 with further annual payments exceeding £100,000 and increasing in line with the annual percentage increase in passenger numbers.

Air noise

7.8.7 Air noise is currently limited by a condition which states that the area enclosed by the 57 dB $L_{Aeq,16h}$ (07:00 to 23:00) summer noise contour shall not exceed 12.42km^2 using the standardised average mode (Planning condition 30).

7.8.8 Residential properties located within this 57 dB $L_{Aeq,16h}$ contour (which did not previously qualify for noise insulation in the A38 Diversion Scheme) are eligible for a grant under the noise insulation grant scheme (Planning condition 31). This grant scheme is on the same basis as the previous A38 Diversion Scheme and is described in more detail in paragraph 7.8.25.

[40] North Somerset Council (2011). Planning permission 09/P/1020/OT2, [Online]. Available at: https://planning.n-somerset.gov.uk/online-applications/ [Checked 6/09/2018].
[41] Bristol Airport (2014). Noise Action Plan 2014 to 2018, [Online]. Available at https://www.bristolairport.co.uk/~/media/files/brs/about-us/nap-14_18.ashx?la=en [Checked 27/04/2018].
[42] Bristol Airport (2018). Airport Environmental Improvement Fund, Guidelines for applying for a grant for noise insulation, [Online]. Available at: https://www.bristolairport.co.uk/~/media/files/brs/about-us/community/guidelines-2018_final.ashx?la=en [Checked 5/10/2018].

Ground noise

7.8.9 Bristol Airport has procedures in place to limit the use of Auxiliary Power Units (APUs).

7.8.10 These include requirements for the installation and availability of Fixed Electrical Ground Power (FEGP) before the use of stands for live aircraft movements (Planning condition 32) and for FEGP to be used in preference to APUs (Planning condition 33) on areas cited in these conditions.

7.8.11 Mobile diesel ground power generators and aircraft APUs cannot be used on stands 38 and 39 (Planning condition 34). As part of the application, a variation to this condition is proposed so that it only applies between the hours of 23:00 and 06:00 as per stands 34 to 37.

7.8.12 APUs cannot be used on stands 34 to 37 between the hours of 23:00 and 06:00 (Planning condition 35).

7.8.13 Planning conditions 4, 5 and 69 require the erection of 3m to 5m high noise attenuation walls around the western and eastern apron extensions, and a timber fence around the northern boundary of the north side car park.

Night flying

7.8.14 A night noise Quota Count (QC) limit is used to restrict night flying (Planning condition 36). This assigns each aircraft operation a QC score based on how loud they are. The noise classification of an aircraft is set out in a formal notice published by NATS on a regular basis.

7.8.15 The current annual quota is 2,160 points, with 1,260 points allocated for the summer season (approximately seven months, defined as the period from late March to late October when British Summer Time is in effect) and 900 points allocated for the winter season.

7.8.16 Bristol Airport reports the use of the quota at the end of every season to the Airport Consultative Committee and publishes it on Bristol Airport's website.

7.8.17 The number of take-offs and landings between 23:30 and 06:00 are limited to 3,000 in the summer season and 1,000 in the winter season (Planning condition 38). As part of the application Bristol Airport is seeking to amend this condition to a limit of 4,000 for two adjoining seasons.

7.8.18 The total number of take-offs and landings between 06:00 and 07:00 and between 23:00 and 23:30 are limited to 10,500 in any calendar year (Planning condition 39).

Noise monitoring

7.8.19 Aircraft noise is continually measured using noise monitors located at each end of the runway, near Felton and Congresbury. These monitors are positioned in accordance with ICAO standards for monitoring noise from aircraft arriving and departing using runway 27.

7.8.20 The Felton monitor is therefore located 2,289m from the touchdown point for arriving aircraft using runway 27 and the Congresbury monitor is 6,500m from the start of roll point for departing aircraft using runway 27.

7.8.21 A further monitor is located at Littleton Hill, 6,500m from the start of roll point for departing aircraft using runway 09.

7.8.22 A portable noise monitor can be used to record noise at specific locations in response to queries from the local community. Mobile noise monitoring has occurred at over 12 sites during 2018 including Felton, Congresbury, Winford, Wrington and Cleeve at the time of writing.

7.8.23 The monitoring system, known as the Aircraft Noise Operation Management System (ANOMS) also takes radar data from air traffic control (ATC) enabling the aircraft track to be recorded and compared with the published routes.

7.8.24 Processed data from the noise monitors are published annually in Bristol Airport's *Operations Monitoring Report* [43] which provides a year by year comparison of noise results.

Noise insulation grants

7.8.25 As part of the Bristol Airport Environmental Improvement Fund, grants are available from Bristol Airport to cover some or all of the costs of new glazing and ventilators for properties most closely overflown and impacted by noise from Bristol Airport flights. Depending on location a property could be eligible for a grant of 100% (up to a maximum of £5,000) or 50% (up to a maximum of £2,500).

7.8.26 Eligible properties are within the 63 dB, 60 dB and 57 dB noise contours. If a property is within the 63 dB contour, the grant can cover 100% of new double glazed windows or ventilators up to a sum of £5,000. If a property is within the 60 dB and 57 dB contours, the grant can cover 50% of new double-glazed windows or ventilators up to a sum of £2,500.

7.8.27 As there is a limit of annual funding grant applications are prioritised according to categories based on the contour the property is in, and whether it has had a grant before. Should the fund be oversubscribed in any one category, priority is given to those living closest to the extended centreline of the runway i.e. those closest to overflying aircraft.

Bristol Airport – noise abatement procedures

7.8.28 Details of opening hours and noise abatement procedures are given in the latest version of the UK Aeronautical Information Package (AIP) for Bristol Airport[44].

7.8.29 Bristol Airport offers a continuous day and night service. Prior permission is required for take offs and landings between 23:00 and 07:00 (22:00 and 06:00 BST). A night surcharge applies to all landings between 22:00 and 07:00 (21:00 to 06:00 BST).

7.8.30 The following procedures are followed to minimise the noise impact of departing and arriving aircraft around Bristol Airport unless otherwise instructed by ATC:

- Operators of all aircraft using Bristol Airport are to ensure that their aircraft conform to the noise abatement techniques laid down for the type of aircraft and that operations are conducted in a manner calculated to cause the least disturbance practicable in areas surrounding Bristol Airport; and
- When operating Instrument Flight Rules (IFR), any aircraft carrying out a visual approach must not join the final approach track at an altitude of less than 2,200ft (QNH[45]).

[43] Bristol Airport (2017). 2017 Operations Monitoring Report, [online]. Available at https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKEwjb-r7GgZDdAhUEElAKHevOC5cQFjAAegQIABAC&url=https%3A%2F%2Fwww.bristolairport.co.uk%2F~%2Fmedia%2Ffiles%2Fbrs%2Fabout-us%2Fenvironment%2F2017-operations-monitoring-report.ashx%3Fla%3Den&usg=AOvVaw08RjZl1qAodXxwf_UpeuOC [Checked 28/08/2018]. (Use the airport website link please: https://www.bristolairport.co.uk/about-us/environment/sustainability

[44] National Air Traffic Services (2017). IAIP Bristol – EGGD Textual data and Charts related to the Airport, [Online]. Available at: http://www.nats-uk.ead-it.com/public/index.php%3Foption=com_content&task=blogcategory&id=36&Itemid=85.html [Checked 28/08/2018].

[45] QNH is a code indicating the atmospheric pressure adjusted to mean sea level. An altitude given in terms of QNH is the altitude above mean sea level, measured using atmospheric pressure.

7.8.31 Aircraft using the Instrument Landing System (ILS) in Instrument or Visual Meteorological Conditions (IMC or VMC) shall not descend below the altitude specified above before intercepting the glide path nor thereafter fly below it. Aircraft approaching without assistance from ILS or radar shall follow a descent path which will not result in its being at any time lower than the approach path which would be followed by an aircraft using the ILS glide path.

7.8.32 The Noise Preferential Routeings (NPR) given in **Table 7.17** are compatible with ATC requirements and shall apply in both VMC and IMC. The tracks are to be flown by all departing aircraft of more than 5,700kg maximum certified weight, unless otherwise instructed by ATC or unless deviations are required in the interests of safety.

7.8.33 The NPRs are incorporated in the ATC Standard Instrument Departure procedures (SIDs).

Table 7.17 Noise Preferential Routeings (NPRs)

Take-off runway	Details
09	Climb straight ahead to I-BON 4.7 nm DME to be no lower than 3000ft QNH at this point before commencing the turn
27	Climb straight ahead to I-BTS 4.5 nm DME to be no lower than 3000ft QNH at this point before commencing the turn.

7.8.34 The obligations of NPRs cease when an altitude of 4,000ft QNH or above has been reached.

7.8.35 Subject to ATC instructions, inbound aircraft are to maintain as high an altitude as practical and adopt a continuous descent profile, when appropriate.

7.8.36 Every aircraft using Bristol Airport shall, after take-off or 'go around' be operated in the quietest possible manner.

7.8.37 Pilots and engineers should restrict the use of Auxiliary Power Units (APU) to the minimum time necessary. Between 23:30 to 05:59 (22:30 to 04:59 BST) except when immediately prior to departure, APUs may only be run subject to approval from Airside Operations.

7.8.38 In order to avoid overflying Felton Village, when departing runway 09 and requiring to turn left, all aircraft shall climb ahead to 1nm DME before commencing the left turn.

7.8.39 Noise abatement procedures for light aircraft are given in

7.8.40 **Table** 7.18.

Table 7.18 Noise abatement procedures for light aircraft

Take-off runway	Details
09	(1) Practice engine failures after take-off by single-engine aircraft are not permitted. (2) Circuit direction is normally right hand only. However, ATC may require non-standard circuit direction for traffic integration.
27	(1) All pilots should arrange their flight so as to minimise noise nuisance. (2) Circuit direction is normally left hand.

7.9 Assessment methodology

7.9.1 The generic project-wide approach to the assessment methodology is set out in **Chapter 4**: **Approach to Preparing the Environmental Statement**, specifically in **Sections 4.5** to **4.7**. However, whilst this has informed the approach that has been used in this noise and vibration assessment, it is necessary to set out how this methodology has been applied, and adapted as appropriate, to address the specific needs of this assessment.

7.9.2 The general assessment methodology involves the following:

- Derivation of assessment criteria for each type of noise source;
- Computation of existing and future noise levels under the various scenarios;
- Assessment of magnitude of impacts (absolute) on residential and non-residential receptors, for each scenario;
- Determination of the change in noise levels, and associated impacts (relative) as a result of the introduction of the Proposed Development;
- Consideration of the likely significant effects of changes in noise levels from Without to With Proposed Development;
- Description of the potential effects (beneficial and adverse) associated with the Proposed Development; and
- Description of any mitigation measures, where appropriate, in relation to the Proposed Development and describe any residual effects.

7.9.3 While the technical assessment methodology adopted for a given source of noise is generally unique (each of which is described in the relevant section later in this chapter), there are some common concepts that apply across all noise topics based on Government guidance through the Noise Policy Statement for England (NPSE)[16].

7.9.4 The Government, through the NPSE, and the introduction of the Significant Observed Adverse Effect Level (SOAEL), has presented the concept of significance thresholds to rate health effects and quality of life. It is generally accepted that "significance" in this context differs from that used in an ES. This is because it refers to the significance of the absolute noise level, whereas an ES assesses the significance of the proposed change. For example, a receptor may be exposed to significant levels of noise regardless of any development, but if the noise level remains the same then the receptor would not be said to be significantly impacted by the development.

7.9.5 The thresholds for assessing health effects and quality of life are important, particularly when considering and comparing different scenarios as well as establishing the need for and extent of

noise mitigation. The NPSE introduces the concept of the NOEL (No Observed Adverse Effect Level), LOAEL (Lowest Observed Adverse Effect Level), and SOAEL. The National Planning Policy Guidance also introduces the concept of the UAEL (Unacceptable Adverse Effect Level). It is appropriate to consider what level of noise at Bristol Airport might be attributed to these levels, in light of emerging guidance on the effects of noise on health and also Government guidance.

7.9.6 The NOEL, LOAEL, SOAEL and UAEL can vary depending on the source, receptor, and time period (e.g. day or night), and in this way the sensitivity of the receptor is embedded into the criteria. For example, the SOAEL for a dwelling at night will be lower than during the day, to reflect the fact that dwellings are more sensitive to noise at night.

7.9.7 The technical guidance, summarised in **Table 7.3** and described in detail in **Appendix 7B**, has been used to develop noise and vibration assessment criteria and also used to derive values of LOAEL, SOAEL and UAEL as given in NPSE[16] and National Planning Practice Guidance (NPPG)[46], where appropriate. The definition of these is as follows:

- 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.
- UAEL – Unacceptable adverse effect level. Noise above this level should be prevented.

7.9.8 Further guidance on how planning authorities should take account of the acoustic environment and the mitigation strategies which should be applied in relation to the above terms is provided in the NPPG[46] .

7.9.9 The advice is that noise above the SOAEL should be avoided using appropriate mitigation while taking into account the guiding principles of sustainable development.

7.9.10 Where noise is between LOAEL and SOAEL, the advice is to take all reasonable steps to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. Noise in this category is described as an observed adverse effect which is noticeable and intrusive.

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

7.9.12 Where any adverse noise effects are predicted, these are identified and if these cannot be avoided, mitigation measures are recommended to ensure no significant residual effects on health and quality of life arise. This approach is considered consistent with the principal aims of the NPSE. It is important to note that findings against the LOAEL and SOAEL are measures of the effect of noise on health and quality of life, and not environmental impact assessment findings.

7.9.13 During the course of this assessment (October 2018), the World Health Organization (WHO) published their updated *Environmental Noise Guidelines*[47]. These guidelines strongly recommend

[46] Defra (2014). National Planning Policy Guidance, Planning Practice Guidance, Noise, [Online] Available at: https://www.gov.uk/guidance/noise--2 [Checked 21/08/2018].
[47] World Health Organization Regional Office for Europe (2018). Environmental Noise Guidelines for the European Region. [Online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf [Checked: 25/10/2018].

that aircraft noise does not exceed 45 dB L_{den} or 40 dB L_{night} outside a dwelling. These recommendations are extremely stringent but can be considered in the context of the noise levels assessed and reported here as occurring now and in the future around Bristol Airport. They are aspirational targets and have not yet been adopted as policy. As a result, this assessment still relies on previous advice from the World Health Organisation as relevant to this assessment as this has informed Government policy that applies today.

7.9.14 The assessment criteria for different noise sources is given in the following sections. Full details of how this assessment criteria is developed is given in **Appendix 7B**.

Air noise and vibration assessment criteria

Air noise

7.9.15 Air noise encompasses that produced by aircraft during their departure and arrival at Bristol Airport. It is produced when an aircraft starts its departure, travels along the runway and climbs into the air as well as when an aircraft approaches Bristol Airport, touches down and slows to taxiing speed on the runway. It therefore includes reverse thrust noise when this takes place.

7.9.16 The assessment methodology for the calculation of air noise is set out in detail in **Appendix 7D**, along with the assumptions used to rate air noise and the results of the assessment.

Residential receptors – absolute levels

7.9.17 The Government, in the APF[1], acknowledges research in recent years which suggests that the balance of probability is that people are now relatively more sensitive to aircraft noise than in the past. At that time, the Government considered there was insufficient evidence to indicate a clear threshold noise level denoting the "onset of significant community annoyance". As a result, they retained within the APF the 57 dB $L_{Aeq,16h}$ contour as the average level of daytime aircraft noise marking the approximate onset of significant public annoyance.

7.9.18 In 2017, following the Government's response to the UK Airspace Change consultation, the Government set out policies that provide an update to some of the policies on aviation noise contained within the APF. They advised that these should be viewed as the current government policy. Specifically, it advised that a level of 54 dB $L_{Aeq,16h}$ is now acknowledged to correspond to the onset of significant community annoyance and replaces the 57 dB $L_{Aeq,16h}$ level in the APF.

7.9.19 The Government also advise that some adverse effects of annoyance can now be seen to occur down to 51 dB $L_{Aeq,16h}$ and that this should be used as the LOAEL when assessing and comparing noise impacts of airspace changes.

7.9.20 Based on Government guidance as described above, the following contour values are relevant in terms of assessing daytime airborne aircraft noise:

- 51 dB $L_{Aeq,16h}$ which provides a threshold below which there are no observed adverse effects from air noise. This represents the LOAEL; negligible effect;
- 54 dB $L_{Aeq,16h}$ which currently provides an indication of the onset of significant community annoyance; minor effect;
- 63 dB $L_{Aeq,16h}$ which denotes moderate levels of community annoyance, commonly used at airports and recommended by the Government as an eligibility criterion for sound insulation grant schemes. As a result, this value is commonly considered to represent the SOAEL; moderate effect; and

- 69 dB $L_{Aeq,16h}$ which denotes high levels of community annoyance where UK Government guidance is for consideration to be given by airports to assist in the costs of re-locating people from exposed dwellings, or, under certain circumstances, to offer to purchase such dwellings. This represents the UAEL; very substantial effect.

7.9.21 Night-time aircraft noise can be evaluated in a number of different ways. The common method is to rate night noise in terms of noise exposure, using the $L_{Aeq,8h}$ index (for the period 23:00 to 07:00). The $L_{Aeq,16h}$ and $L_{Aeq,8h}$ indices are the primary indicators used in this assessment, in line with those recommended by UK Government in the APF and the recent response to the air space change consultation.

7.9.22 Alongside the primary indicators, a number of supplementary indicators as recommended in the APF have been used to better describe the changes in the air noise environment between the different scenarios. These are as follows:

- L_{den}, which is an annual average 24-hour metric that penalises movements occurring in the evening (19:00 to 23:00) and night (23:00 to 07:00) periods by 5 dB and 10 dB respectively;
- L_{night}, which is an annual average 8-hour night (23:00 to 07:00) metric;
- Number of people likely to be highly annoyed;
- Number of people likely to be highly sleep disturbed;
- SEL and L_{ASmax} for the loudest typical (i.e. at least once per night) individual aircraft events in different scenarios;
- N70 (daytime) and N60 (night-time) contours, which demonstrate the areas exposed to a given number of events above the specified L_{ASmax} value;
- Single mode contours, which assume either 100% easterly or westerly operations and show the noise exposure levels expected for a given worst-case day with operations occurring in a single direction; and
- Variation in noise level at representative locations, both between scenarios and over the day.

7.9.23 These supplementary indicators have been provided for information and do not form the primary basis of the assessment of significance. They do however provide context to the significance, helping to show how the noise environment will change between one scenario and another. Further information on how these supplementary indicators can be interpreted is given in **Appendix 7B**.

7.9.24 The WHO[20] sets out night noise guidelines in terms of L_{night} which are commonly used in Europe to rate the acceptability of environmental noise at night. While the guideline value of 40 dB L_{night} is set out as an environmental goal to aspire towards, 55 dB L_{night} has been suggested as an interim target. The UK Government also recognise 45 dB L_{night} as representing the LOAEL while adopting the 45 dB $L_{Aeq,8h}$ index for this purpose for consistency with the $L_{Aeq,16h}$ daytime noise index.

7.9.25 The $L_{Aeq,8h}$ index differs only slightly from the L_{night} index in that it relates to an average summer day of aircraft activity, as opposed to an average annual day. As summer activity is generally higher than at other times of the year, the adoption of the $L_{Aeq,8h}$ unit, in place of the L_{night} unit represents a conservative approach. Similarly, on this basis, 55 dB $L_{Aeq,8h}$ is adopted as the SOAEL in this assessment.

7.9.26 It is also important however to consider the noise of individual aircraft, using noise indices such as the SEL and/or the L_{ASmax}.

7.9.27 The WHO guidelines provide advice that for a good sleep, indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night. Accounting for sleeping with a

bedroom window slightly open (and a reduction from outside to inside of 15 dB), this translates to an outside sound pressure level of 60 dB L_{Amax}. (approx. 70 dB(A) SEL for aircraft noise).

7.9.28 In the UK, where night noise is considered sufficiently high, a value of 90 dB(A) SEL (approx. 80 dB L_{ASmax}) is commonly used as the eligibility threshold for a sound insulation scheme, often based on the noisiest or most common aircraft operation occurring once or more on average per night. This threshold was developed based on research published in 1992 by the Department of Transport[48].

7.9.29 On the basis of the above, the absolute noise values used to assess the impact magnitude of air noise at residential receptors are given in **Table 7.19**.

Table 7.19 Air noise impact assessment criteria (absolute) – residential, outdoors

Subjective description of Impact	Daytime criteria[1] $L_{Aeq,16h}$ dB	Night-time criteria[2] $L_{Aeq,8h}$ dB	L_{ASmax} dB	SEL dB(A)	Description
Negligible	51 (LOAEL)	45 (LOAEL)	60	70	More than 10-15 events per might
Very minor	54	48			
Minor	57	51			
Minor/Moderate	60	54			
Significant - Moderate	63 (SOAEL)	55 (SOAEL)	80	90	More than one event per night
Significant - Substantial	66	60			
Significant – Very Substantial	69 (UEL)	63 (UEL)	90	100	More than one event per night

Note: 1. Equivalent L_{den} criterion value, ≈ $L_{Aeq,16h}$ + 2 dB.
2. Approximately equivalent to L_{night} value.

Non-residential receptors – absolute levels

7.9.30 Absolute noise criteria for non-residential receptors are given in **Table 7.20** and their derivation is explained in **Appendix 7B**.

[48] Ollerhead, J.B. et al (1992). Report of a Field Study of Aircraft Noise and Sleep Disturbance: A Study Commissioned by the Civil Aviation Policy Directorate of the Department of Transport from the Department of Safety, Environment and Engineering, Civil Aviation Authority. London: HMSO.

Table 7.20 Air noise impact assessment criteria (absolute) – non-residential, outdoors

Receptor	External noise level threshold
Schools[23]	55 dB $L_{Aeq,30min}$ (daytime)
Places of worship[22]	As per daytime residential – see **Table 7.19**.
Amenity areas[22]	55 dB $L_{Aeq,T}$

Relative levels

7.9.31 In addition to the absolute noise level, the relative change in noise level between operational scenarios is used to assess air noise. A potential impact rating for a change in level is given in **Table 7.21**. A semantic scale of this type, based on the *Institute of Environmental Management and Assessment noise impact guidelines*[49], has been accepted in various airport Public Inquiries.

Table 7.21 Air noise impact ratings - change in noise level, outdoors

Change in noise level dB	Subjective impression	Potential Impact classification
0 to 2	Imperceptible change	Negligible
2 to 3	Barely perceptible change	Minor
3 to 6	Perceptible change	Moderate
6 to 9	Up to a halving or a doubling of loudness	Substantial
> 9	Equal to or more than a halving or doubling of loudness	Very substantial

Magnitude of effect and significance

7.9.32 The magnitude of an effect from changing from one scenario to another, such as from without to with the Proposed Development, is established from a consideration of both the absolute noise level after the change along with the magnitude of the change in noise level that occurs at a receptor.

7.9.33 The effect of a change in noise level tends to increase with the absolute level of noise experienced at a receptor. If, for example, the daytime noise level at a dwelling were to change from 45 dB to 50 dB $L_{Aeq,16h}$, (below the LOAEL) the overall effect for the occupants would be less than if the daytime noise level were to increase by the same amount from 63 dB to 68 dB $L_{Aeq,16h}$ (above the SOAEL).

7.9.34 There is no clearly accepted method of how to rate the magnitude of the effect of a change in the absolute air noise level and the associated change in noise level. Some guidance has however been provided in the NPPG[46] which states among "What factors influence whether noise could be a concern?" the following:

> *"In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little or no change in behaviour would be likely to occur."*

[49] Guidelines for Environmental Noise Impact Assessment, Institute of Environmental Management & Assessment, October 2014

7.9.35 **Table 7.22** shows how the primary air noise indicators are interpreted into magnitude of effect. This is based on the information presented in this chapter and professional judgement.

Table 7.22 Summary of magnitude of effect – air noise

Receptor Type	Outdoor noise level, dB	Magnitude of effect				
		Very low	Low	Medium	High	Very High
		Change in noise level, dB(A)				
Residential Day (07:00-23:00)	$51 \leq L_{Aeq,16h} < 63$	0-2	2-3	3-6	6-9	>9
	$L_{Aeq,16h} \geq 63$	0-1	1-2	2-4	4-7	>7
Residential Night (23:00-07:00)	$45 \leq L_{Aeq,8h} < 55$	0-2	2-3	3-6	6-9	>9
	$L_{Aeq,8h} \geq 55$	0-1	1-2	2-4	4-7	>7
Schools	$L_{Aeq,30min} \geq 55$	0-2	2-3	3-6	6-9	>9
Places of worship	$51 \leq L_{Aeq,16h} < 63$	0-2	2-3	3-6	6-9	>9
	$L_{Aeq,16h} \geq 63$	0-1	1-2	2-6	6-9	>9
Amenity Areas	$L_{Aeq,T} \geq 55$	0-2	2-3	3-6	6-9	>9

7.9.36 A potential significant effect (adverse or beneficial) is considered to arise if in **Table 7.22** the magnitude of the effect is rated as medium or higher. Additionally, a change in the number of dwellings exposed to 90 dB(A) or higher at least once per night is a potential significant effect. Whether a significant effect arises will depend on context, such as the number of noise sensitive receptors affected and how often it occurs.

Airborne aircraft vibration

7.9.37 Low frequency noise from airborne aircraft has the potential to cause perceptible vibration levels within dwellings. For this reason, the most appropriate noise metric to assess the likelihood of these effects is the maximum C-weighted noise level, denoted L_{Cmax}. C-weighting gives more weight to low frequency noise rather than the more commonly used A-weighting, which approximates the average human hearing response to different frequencies of noise.

7.9.38 This vibration effect is most obviously characterised by effects such as windows rattling. As discussed in the Historic England report[29], aircraft passbys that produce a maximum noise level above 97 dB L_{Cmax} are likely to produce an audible rattle of windows. While it is appreciated that low frequency noise from aircraft can induce perceptible vibration levels in lightweight structures and loose-fitting components, the levels are below those at which even minor cosmetic damage would be likely to occur.

7.9.39 Vibration effects due to airborne aircraft can vary depending on the specific details of the building, for example, the room dimensions which can cause resonance effects at certain frequencies. Resonances increase the sound level in parts of the room and decrease it in others which can influence the any consequential vibration.

7.9.40 The noise level of 97 dB L_{Cmax} has been taken as a threshold for potential significance of vibration effects due to airborne aircraft events. Whether a significant effect occurs between scenarios will depend on the number of dwellings affects and the frequency of the events.

7.9.41 The other potential effect from airborne aircraft vibration is vortex damage to buildings. This is best explained by an extract from the *Airports and the Environment*[30] report:

"Less of an environmental problem, but one that affects community relations, is that of vortex damage to properties within neighbouring communities. Vortices, which are circulating currents of air created by the passage of aircraft, are generally dispersed by wind and air turbulence before they reach the ground. However, in certain weather conditions they can reach ground level and can dislodge unsecured roofing tiles."

7.9.42 This effect is both rare and unpredictable as specific conditions are required for it to occur. It has been known to occur recently at a property in the vicinity of Bristol Airport. In this case the damage was rectified by Bristol Airport. As the strength of vortices is influenced by the size of aircraft, and the Proposed Development does not affect which aircraft are able to use Bristol Airport, it is not expected that there will be any significant effect on the occurrence of vortex damage.

Ground noise assessment criteria

7.9.43 Ground noise encompasses that produced by aircraft activities on the ground, such as during taxiing, manoeuvring, holding on the runway prior to departure, and running engines on the stand. Noise from engine running for test and maintenance purposes is also considered as ground noise.

7.9.44 The assessment methodology for ground noise is set out in detail in **Appendix 7E**, along with the assumptions used to rate ground noise and the results of the assessment.

7.9.45 There is no definitive agreement on the method of assessment of aircraft ground noise. Various methods have been adopted in the past, and these have led to the assessment of ground noise in terms of the equivalent continuous sound level, $L_{Aeq,T}$, for various time periods. As is convention, consideration is given in this assessment to the $L_{Aeq,16h}$ metric for the daytime period of 07:00 to 23:00 and the $L_{Aeq,8h}$ metric for the night-time period of 23:00 to 07:00.

7.9.46 The ground noise level assessed at various receptors can be compared to the existing ambient environmental noise and published guidelines for the assessment of environmental noise. The WHO have previously recommended a guideline value of 50 dB $L_{Aeq,16h}$ to prevent 'moderate' community annoyance and 55 dB $L_{Aeq,16h}$ for 'serious' community annoyance[19].

7.9.47 To put these guidance criteria into context over half of the population is exposed to levels which exceed the 55 dB L_{Aeq} guideline for 'serious' community annoyance. This was confirmed by the results of the Defra funded 2000/2001 National Noise Incidence Study[50].

7.9.48 The ambient noise levels in the area around Bristol Airport have been measured to lie in the range 50 dB(A) to 60 dB(A) $L_{Aeq,16h}$ during the daytime with an underlying background noise level in the range 35 dB(A) to 50 dB(A) L_{AF90} (refer to **Section 7.5**). During the night-time, ambient noise levels

[50] BRE (2002). The National Noise Incidence Study 2000/2001 (United Kingdom): Volume 1 – Noise Levels, Client report number 206344f, [online]. Available at: http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwi-t-mQ16jdAhVJUlAKHTMiD-kQFjAAegQIABAC&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3D10280_NIS1206344f.pdf&usg=AOvVaw2R14Uu8gQF3HgMnuM0z5ui [Checked 7/09/2018].

have been measured to lie in the range 45 dB(A) to 55 dB(A) with underlying background noise levels in the range 35 dB(A) to 45 dB(A) L_{AF90}. The background noise levels better reflect the noise environment in the absence of aircraft noise and other intermittent environmental noise sources.

7.9.49 Based on the standards in BS 8233 for dwellings, the WHO levels would ensure that the recommended indoor noise levels of 35 dB $L_{Aeq,16h}$ within living rooms and 30 dB $L_{Aeq,8h}$ within bedrooms, would be achieved with windows partly open.

7.9.50 If windows are closed, an additional protection of around 10 dB can be expected. If ground noise were to rise above these levels, some form of additional mitigation, such as sound insulation treatment to the dwelling, would be required to protect people inside dwellings from the effects of ground noise.

7.9.51 Sound insulation can only provide so much protection to a dwelling, typically around 35 dB, and once the noise level outside a dwelling rises beyond a certain value, mitigation in itself will not provide sufficient protection.

Residential receptors – absolute levels

7.9.52 The absolute noise values used to assess ground noise at residential receptors are given in **Table 7.23**. These $L_{Aeq,T}$ levels are based on the BS8233 and WHO guidance and professional judgement.

Table 7.23 Ground noise assessment criteria – absolute, daytime and night-time

Action	Effect Level	Daytime external noise level, dB $L_{Aeq,16h}$	Night-time external noise level, dB $L_{Aeq,8h}$
Mitigate and reduce to a minimum	Lowest Observed Adverse Effect Level (LOAEL)	50	45
Avoid	Significant Observed Adverse Effect Level (SOAEL)	60	55
Prevent	Unacceptable Adverse Effect Level (UAEL)	70	65

Non-residential receptors – absolute levels

7.9.53 Absolute noise criteria for non-residential receptors are given in **Table 7.24**.

Table 7.24 Ground noise assessment criteria – non-residential – absolute

Receptor	External noise level threshold
Schools[23]	55 dB $L_{Aeq,30min}$ (daytime)
Places of worship[22]	As per daytime residential – see **Table 7.23**
Amenity areas[22]	55 dB $L_{Aeq,T}$

Relative levels

7.9.54 In addition to the absolute noise level, the relative change in noise level between operational scenarios is used to assess air noise. A potential impact rating for a change in level is given in

Table 7.25. A semantic scale of this type, based on the *Institute of Environmental Management and Assessment noise impact guidelines*[51], has been accepted in various airport Public Inquiries.

Table 7.25 Ground noise impact ratings - change in noise level, outdoors

Change in noise level dB	Subjective impression	Potential Impact classification
0 to 2	Imperceptible change	Negligible
2 to 3	Barely perceptible change	Minor
3 to 6	Perceptible change	Moderate
6 to 9	Up to a halving or a doubling of loudness	Substantial
> 9	Equal to or more than a halving or doubling of loudness	Very substantial

Magnitude of effect and significance

7.9.55 **Table 7.26** shows how this is interpreted into magnitude of effect. This is based on the IEMA *Guidelines on Environmental Noise Impact Assessment*[25] and professional judgement.

Table 7.26 Summary of magnitude of effect – ground noise

Receptor Type	Outdoor noise level, dB	Magnitude of effect				
		Very low	Low	Medium	High	Very High
		Change in noise level, dB(A)				
Residential Day (07:00-23:00)	$50 \leq L_{Aeq,16h} < 60$	0-2	2-3	3-6	6-9	>9
	$L_{Aeq,16h} \geq 60$	0-1	1-2	2-4	4-7	>7
Residential Night (23:00-07:00)	$45 \leq L_{Aeq,8h} < 55$	0-2	2-3	3-6	6-9	>9
	$L_{Aeq,8h} \geq 55$	0-1	1-2	2-4	4-7	>7
Schools	$L_{Aeq,30min} \geq 55$	0-2	2-3	3-6	6-9	>9
Places of worship	$50 \leq L_{Aeq,16h} < 60$	0-2	2-3	3-6	6-9	>9
	$L_{Aeq,16h} \geq 60$	0-1	1-2	2-6	6-9	>9
Amenity Areas	$L_{Aeq,T} \geq 55$	0-2	2-3	3-6	6-9	>9

[51] Guidelines for Environmental Noise Impact Assessment, Institute of Environmental Management & Assessment, October 2014

7.9.56 A potential significant effect (adverse or beneficial) is considered to arise in the above table if the magnitude of the effect is rated as medium or higher. Whether a significant effect arises will depend on context, such as the number of noise sensitive receptors affected and the how often it occurs.

Road traffic noise assessment criteria

7.9.57 Road traffic noise includes noise from road vehicles accessing Bristol Airport as well as that from other road vehicles, not related to Bristol Airport, using the surrounding roads.

7.9.58 The assessment methodology for road traffic noise is set out in detail in **Appendix 7F**, along with the assumptions used to rate road traffic noise and the results of the assessment.

7.9.59 The criteria used in the road traffic noise assessment considers the noise criteria within the *Noise Insulation Regulations 1975 (as amended 1988)* and the *Design Manual for Roads and Bridges* (DMRB)[32].

7.9.60 Road traffic noise is commonly measured and assessed in the UK in terms of the L_{A10} index over the 18-hour period from 06:00 to 24:00. This index, known as $L_{A10,18h}$, is used to rate the potential impacts of road traffic noise arising for example from a change in a highway. Legislation exists in the form of the Noise Insulation Regulations to offer sound insulation to people who are significantly affected by the introduction of a new highway or changes to a highways scheme where the noise level rises above a certain value as a result of the change in traffic flow. Under this legislation, the trigger level for introducing a noise insulation scheme is expressed as a façade level of 68 dB $L_{A10,18h}$. This can be approximately converted back to an $L_{Aeq,16h}$ index by applying a correction of -3 dB(A) to convert from the façade level to a free-field level, and by applying a further correction of -2 dB(A) to convert from $L_{A10,18h}$ to $L_{Aeq,16h}$ for road traffic noise. The resulting trigger level in this case is 63 dB $L_{Aeq,16h}$. This is 5 dB lower than the equivalent $L_{A10,18h}$ value.

7.9.61 The absolute values for impact assessment, and for establishing the LOAEL, SOAEL and UAEL can therefore be determined based on the same principles as described for ground noise above, using the guideline standards for noise levels within dwellings recommended in BS 8233.

Absolute levels

7.9.62 The absolute noise values used to assess road traffic noise between operational scenarios at all receptors are given in **Table 7.27**.

Table 7.27 Road traffic noise assessment criteria – absolute, daytime and night-time

Action	Effect Level	Daytime facade noise level, dB $L_{A10,18h}$
Mitigate and reduce to a minimum	Lowest Observed Adverse Effect Level (LOAEL)	55
Avoid	Significant Observed Adverse Effect Level (SOAEL)	68
Prevent	Unacceptable Adverse Effect Level (UAEL)	75

Relative levels

7.9.63 The subjective importance of changes in road traffic noise level on people relates to the magnitude of the change and, to some extent, when it occurs. A significance rating for a change in level is taken from the DMRB[32].

7.9.64 DMRB provides objective assessment criteria in terms of changes in noise for both the 'short-term' and the 'long-term'. Evidence suggests that residents are much more likely to perceive very small changes in average daytime noise level (1 to 3 dB(A)) following the opening of a major road infrastructure project. Over time, people become accustomed to the change and respond to any changes in traffic flow and associated change in noise conditions with reduced sensitivity.

7.9.65 The only new roads being built as part of the Proposed Development are within Bristol Airport. The receptors affected by these roads will be affected to a greater extent by road traffic on Downside Road. Therefore, the long-term changes in noise level are the only changes relevant to this assessment. These are indicative as the impact of a relative change in level also depends on the absolute level associated with it and the noise conditions prior to the change.

Magnitude of effect and significance

7.9.66 **Table 7.28** shows how this is interpreted into magnitude of effect. This is based on DMRB.

Table 7.28 Summary of magnitude of effect – road traffic noise

Receptor Type	Outdoor noise level, dB	Magnitude of effect				
		Very low	Low	Medium	High	Very High
		Change in noise level, dB(A)				
Residential	$L_{A10,18h} \geq 55$	0-2	2-3	3-5	5-10	>10

7.9.67 A potential significant effect (adverse or beneficial) is considered to arise in **Table 7.28** if the magnitude of the effect is rated as medium or higher. Whether a significant effect arises will depend on context, such as the number of noise sensitive receptors affected and the how often it occurs.

Construction noise and vibration assessment criteria

7.9.68 Construction noise and vibration relates to that produced by construction traffic accessing and departing from the construction sites as well as that produced by demolition, piling and

construction plant operating at the construction sites during each phase of the construction project. The effects of construction noise and vibration have been assessed taking account of their magnitude and also the likely sequence period and daily duration over which they will occur for the affected receptors.

7.9.69 The assessment methodology for construction noise and vibration is set out in detail in **Appendix 7G**, along with the assumptions used to rate construction noise and vibration and the results of the assessment.

7.9.70 In the UK, BS 5228-1[33] is the current guidance and approved code of practice document for the control of construction noise. This provides guidance on methods of controlling noise and provides methods to predict, measure and assess the impact of construction and demolition noise. The guidance in the document can be considered to present recommendations for best practical means to control noise on site.

7.9.71 An informative Annex is included in BS 5228-1 that provides guidance on objectively assessing the significance of construction noise. It advises that a pragmatic approach needs to be taken when assessing the noise effects of any construction project and suggests the guidance provided in the annex would generally only apply to projects of significant size, and lesser projects might not need to be assessed or might only require general consideration of noise effects and mitigation. For large infrastructure projects for example, it highlights historically the procedure that has developed in the UK based on the use of fixed noise limits and also additionally introduces alternative methods used to rate the potential significance of construction noise, based on prevailing ambient noise conditions.

7.9.72 There are no universally recognised or mandatory UK standards or guidelines that set out limits for construction noise. The historical use of fixed noise limits for projects of significant size is described in BS 5228-1 which sets out a subjective principle as follows:

"Noise from construction and demolition sites should not exceed the level at which conversation in the nearest building would be difficult with the windows shut."

7.9.73 It also goes on to describe external noise limits as:

"Noise levels, between say 07:00 and 19:00 hours, outside the nearest window of the occupied room closest to the site boundary should not exceed:

- *70 decibels (dBA) in rural, suburban and urban areas away from main road traffic and industrial noise;*
- *75 decibels (dBA) in urban areas near main roads in heavy industrial areas."*

7.9.74 BS 5228-1 also provides details of alternative methods of assessment to determine the potential for a significant noise effect, reproduced in **Table 7.29**, by testing the construction noise level against the prevailing baseline noise level (that is, the noise level in the absence of construction noise). If the site noise level exceeds the appropriate category value, then a potential significant effect is indicated. The assessor then needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.

Table 7.29 Example threshold of potential significant effect at dwelling

Assessment category and threshold value period	$L_{Aeq,T}$ Threshold value dB(A)		
	Category A[1]	Category B[2]	Category C[3]
Daytime (07:00–19:00) and Saturdays (07:00–13:00)	65	70	75
Night-time (23:00 – 07:00)	45	50	55

1. Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
2. Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
3. Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.

7.9.75 A further alternative method is available where 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 a significant effect.

7.9.76 BS 5228-1 also provides examples of noise thresholds used for the introduction of both sound insulation treatment (or the reasonable costs thereof) and temporary re-location. It is stated in BS 5228-1 that:

"If the contractor has applied best practicable means to the provision of mitigation, i.e. all reasonable measures have been taken to reduce the noise levels, but levels are still such that widespread community disturbance or interference with activities or sleep is likely to occur, there are two further provisions that can be made if the construction activities are likely to continue for a significant period of time either continuously or sporadically."

7.9.77 The first provision is noise insulation. For eligibility for sound insulation the daytime Monday to Friday (08:00-18:00) and Saturday morning (08:00-13:00) threshold is 75 dB $L_{Aeq,10h/5h}$ at 1 metre outside the most exposed window or door of the façade of any eligible dwelling. This level also needs to be exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months.

7.9.78 The second provision is temporary or permanent re-housing. For eligibility for temporary rehousing the daytime Monday to Friday (08:00-18:00) and Saturday morning (08:00-13:00) threshold is at least 85 dB $L_{Aeq,10h/5h}$. This level also needs to be exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months.

7.9.79 Typical daytime ambient noise levels around Bristol Airport lie between 50 dB $L_{Aeq,16h}$ and 60 dB $L_{Aeq,16h}$ during the daytime and 45 dB $L_{Aeq,8h}$ and 55 dB $L_{Aeq,8h}$ during the night-time (see **Appendix 7C**). On this basis, based on the ABC method in BS 5228-1, a value of 65 dB $L_{Aeq,12h}$ would be appropriate as a threshold for potentially significant effects to be indicated for the Proposed Development construction works during the daytime and 55 dB $L_{Aeq,8h}$ during the night-time. These criteria should be considered a target not normally to be exceeded at 1m from the façade of any noise sensitive residential or business receptors.

7.9.80 Based on the above and taking account of the ambient noise levels around Bristol Airport, the criteria adopted to assess the impact of construction noise are given in **Table 7.30**.

Table 7.30 Construction noise assessment criteria – absolute

Action	Effect Level	Daytime outdoor noise level, dB $L_{Aeq,12h}$	Night-time outdoor noise level, dB $L_{Aeq,8h}$
Mitigate and reduce to a minimum	Lowest Observed Adverse Effect Level (LOAEL)	55	45
Avoid	Significant Observed Adverse Effect Level (SOAEL)	65	55
Prevent	Unacceptable Adverse Effect Level (UAEL)	85	75

7.9.81 In summary, the threshold for a potentially significant effect from construction noise adopted in this assessment is 65 dB $L_{Aeq,12h}$ for the daytime (07:00-19:00) and 55 dB $L_{Aeq,8h}$ for the night-time (23:00-07:00).

Construction vibration

7.9.82 Vibration levels due to construction works associated with the Proposed Development have been assessed using the significance criteria given in BS5228-2[34] in terms of peak particle velocity (PPV).

7.9.83 Vibration criteria are given for both human and building response, where human response criteria are more stringent. **Table 7.31** contains the assessment criteria used, which are based on the absolute values given in BS 5228-2.

Table 7.31 Vibration limits for human response and building damage

Vibration limit, PPV mms^{-1}	Effect	Effect
< 0.14	Vibration unlikely to be perceptible.	None
0.14	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.	Negligible
0.3	Vibration might be just perceptible in residential environments.	Minor
1.0	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.	Moderate
7.5	Guide value for cosmetic damage of residential buildings where dynamic loading may lead to resonance.	Significant
10.0	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.	Very Significant

7.9.84 On the basis of the above table, the threshold for a potentially significant effect from construction vibration adopted in this assessment is 1.0 mms^{-1} PPV during the daytime (07:00-23:00) and 0.3 mms^{-1} during the night-time.

7.10 Assessment of effects – air noise and vibration

7.10.1 **Section 7D.5** of **Appendix 7D** provides the detailed results of the air noise and vibration assessment. Air noise contours are presented for the primary and secondary or supplementary parameters, along with contour areas, dwelling and population counts within each contour band for residential receptors. Noise exposure values are also presented for noise sensitive non-residential receptors. The likelihood of vibration effects is also assessed. Key results are presented in this section. Note that the significance ratings arising from the effects described here are described in the section titled "Predicted air noise effects and their significance" at the end of **Section 7.10**.

7.10.2 For all tables in this section, areas are rounded to the nearest 0.1km^2. Dwelling and population counts are rounded to the nearest 50 above 100 and to the nearest 10 below 100. Below 10, the actual number is given. Where percentage changes are given, these are based on unrounded values. The counts include all those dwellings or people within a specified contour band and any higher value bands so, for example, any dwellings within a 63 dB contour would also be counted as being within a 63 dB contour as well.

Residential receptors – primary indicators

$L_{Aeq,16h}$ daytime

7.10.3 The dwelling counts within key daytime air noise contours are presented in **Table 7.32.** These contours are presented in **Figure 7D.1** to **Figure 7D.3** and **Figure 7D.26**.

Table 7.32 Air noise dwelling counts, $L_{Aeq,16h}$ average mode summer day

Contour $L_{Aeq,16h}$ dB(A)	**Number of Dwellings**			
	Baseline 2017	**10 mppa 2021**	**12 mppa 2026**	**10 mppa 2026**
51	3,250	3,150	3,100	2,200
63	20	10	10	10

7.10.4 **Table 7.32** shows that in 2017, around 3,250 dwellings are adversely affected by air noise as a result of daytime aircraft operations at Bristol Airport. This total is expected to remain much the same, although marginally reduce going forward to the 10 mppa in 2021 and the 12 mppa scenarios. The sensitivity scenario (first discussed in paragraph 7.1.25) of 10 mppa in 2026 shows a reduction of 30% compared to the 12 mppa scenario. This is due to the conservative assumption that from 2021 onwards, there is no growth in passenger numbers from 10 mppa but fleet replacement occurs as per the 12 mppa 2026 forecast.

7.10.5 Currently and in the future under any scenario, the number of residential receptors experiencing air noise at or above the SOAEL of 63 dB is very small, around 20 now reducing to around 10 in the future.

$L_{Aeq,8h}$ night-time

7.10.6 Turning to the night-time effects, **Table 7.33** shows the dwelling counts within key night-time air noise contours. These contours are presented in **Figure 7D.4** to **Figure 7D.6** and **Figure 7D.27**.

Table 7.33 Air noise dwelling counts, $L_{Aeq,8h}$ average mode summer night

Contour $L_{Aeq,8h}$ dB(A)	Number of Dwellings			
	Baseline 2017	10 mppa 2021	12 mppa 2026	10 mppa 2026
45	3,750	5,150	5,050	4,150
55	150	300	350	250

7.10.7 **Table 7.33** shows that in 2017, around 3,750 dwellings are adversely affected by air noise as a result of night-time aircraft operations at Bristol Airport. This total is expected to increase by 38% going forward to the 10 mppa in 2021 scenario. The 12 mppa scenario gives rise to a similar, albeit slightly lower, number of dwellings compared to the 10 mppa in 2021 scenario. The sensitivity scenario of 10 mppa in 2026 shows a reduction of 18% compared to the 12 mppa scenario. This is due to the conservative assumption that from 2021 onwards, there is no growth in passenger numbers from 10 mppa but fleet replacement occurs as per the 12 mppa 2026 forecast.

7.10.8 Currently, there are around 150 properties exposed to the SOAEL of 55 dB $L_{Aeq,8h}$ or more. This is predicted to increase to around 300 under the 10 mppa in 2021 scenario, with a 5% increase to around 350 under the 12 mppa scenario. The sensitivity scenario of 10 mppa in 2026 shows a reduction of 21% compared to the 12 mppa scenario. This is due to the conservative assumption that from 2021 onwards, there is no growth in passenger numbers from 10 mppa but fleet replacement occurs as per the 12 mppa 2026 forecast.

Residential receptors – supplementary indicators

L_{den} and L_{night}

7.10.9 These parameters show broadly similar results to the $L_{Aeq,16h}$ and $L_{Aeq,8h}$ metrics. The results are given in detail in **Appendix 7D**.

Annoyance

7.10.10 **Table 7.34** shows the number of people likely to be highly annoyed by air noise around Bristol Airport. This does not take account of any improved insulation for dwellings which have benefitted from the noise insulation grant scheme.

Table 7.34 Highly annoyed population count, $L_{Aeq,16h}$ average mode summer day

Metric	Baseline 2017	10 mppa 2021	12 mppa 2026	10 mppa 2026
Population Highly Annoyed	750	750	750	550

7.10.11 This shows that in the future, levels of annoyance will remain as now under the 10 mppa 2021 scenario and 12 mppa 2026 scenarios, reducing only under the sensitivity case of 10 mppa 2026.

Sleep Disturbance

7.10.12 **Table 7.35** shows the number of people likely to be highly sleep disturbed by air noise around Bristol Airport. This does not take account of any improved insulation for dwellings which have benefitted from the noise insulation grant scheme.

Table 7.35 Highly sleep disturbed population count, L_{night} average mode annual night

Metric	Baseline 2017	10 mppa 2021	12 mppa 2026	10 mppa 2026
Population Highly Sleep Disturbed	450	850	800	650

7.10.13 This shows that the number of people highly sleep disturbed will rise by around 90% from 2017 to the 10 mppa in 2021 scenario before reducing slightly, by around 5% under the 12 mppa in 2026 scenario and by around 25% under the 10 mppa in 2026 scenario. Further information on the methodology can be located in **Appendix 7B**, specifically paragraph 7B.1.139, with the detailed results presented in **Appendix 7D**, in Table 7D.28.

N70 and N60

7.10.14 These parameters help to provide context to how the aircraft noise environment might alter between scenarios. People experience aircraft noise as a series of individual events over a day, rather than as a single average noise exposure level. The N70 parameter helps to illustrate how this might change between scenarios. Further explanation on these metrics is given in paragraph 7.1.18. There are no specific criteria for rating the acceptability of N70 or N60 contours.

7.10.15 The number of dwellings exposed to various N70 and N60 contours do not vary in a consistent manner between scenarios, for example comparing the 10 mppa 2021 scenario with 12 mppa 2026 scenario shows that for both N70 and N60 the number of dwellings increase for some contour values and decrease for others. The results and further explanation of these contours are presented in detail in **Appendix 7D**.

SEL and L_{ASmax}

7.10.16 The number of dwellings exposed to individual events of at least 90 dB SEL or 80 dB L_{ASmax} at least once per night is given in **Table 7.36** for each scenario.

Table 7.36 Air noise dwelling counts, $L_{Aeq,16h}$ average mode summer day

Contour, dB(A)	Number of Dwellings			
	Baseline 2017	10 mppa 2021	12 mppa 2026	10 mppa 2026
90 SEL	250	600	100	100
80 L_{ASmax}	250	650	100	100

7.10.17 **Table 7.36** demonstrates that from 2017 to the 10 mppa 2021 scenario, the number of dwellings exposed to potentially significant noise levels of individual aircraft at least once per night will increase from around 250 to around 650. Going forward to 2026, under both the 12 mppa scenario and the sensitivity scenario, this will reduce to around 100.

Single mode

7.10.18 Single mode L_{Aeq} noise contours have been produced which show how, under westerly and easterly conditions, noise exposure levels will vary during the day and night between scenarios. These represent a worst-case day for each scenario.

7.10.19 The number of dwellings exposed between scenarios varies in a similar manner to the average mode L_{Aeq} contours. The results are presented in detail in **Appendix 7D**.

Variation in noise level over the day

7.10.20 The air noise received at a receptor over a single day will vary according to the scenario being considered and also the mode of operations at Bristol Airport. In addition, the noise level will vary by the hour as a result of variations in the hourly timetabling of aircraft over a 24-hour period. **Appendix 7D** provides this detailed information, in terms of $L_{Aeq,1h}$ over the day for 14 representative residential receptors. The receptors assessed are shown in **Figure 7.1** and details are given in **Table 7.10**.

7.10.21 This analysis shows how the noise levels at a given receptor are vary over a typical day, and how this might change under the future scenarios. A description of this is given in **Appendix 7D**.

Non-residential receptors

7.10.22 **Appendix 7D** sets out the $L_{Aeq,16h}$ and, where relevant, the $L_{Aeq,8h}$ noise exposure levels for schools, places of worship and amenity areas within the zone of influence of air noise around Bristol Airport.

Schools

7.10.23 **Appendix 7D** identifies only one school, Winford Primary School, as being exposed to 55 dB $L_{Aeq,16h}$ or more, under all scenarios.

7.10.24 Strictly, the criteria relating to schools is required to be met over a 30-minute period, not over 16 hours. For a reasonable approximation, a one hourly value is appropriate to use for this purpose. It can be deduced that during the school hours, a one hourly L_{Aeq} value could be around 3 dB higher than the 16-hour average. Even however allowing for this fact, only this one school is exposed to noise levels above 55 dB $L_{Aeq,1h}$ under the 2017 baseline and in the future. The noise level over the day at Winford Primary School in 2017 is 58 dB $L_{Aeq,16h}$ and will remain so in 2021 and under the 12 mppa 2026 scenario as well as the sensitivity test.

Places of worship

7.10.25 There are 35 places of worship identified within the zone of influence of air noise around Bristol Airport. Nine of these are currently exposed to air noise at or above 51 dB $L_{Aeq,16h}$. The situation will remain broadly unchanged in both future scenarios, including the sensitivity test. None are currently exposed to a level of 63 dB $L_{Aeq,16h}$, either now or in the future.

Amenity areas

7.10.26 There are 23 amenity areas identified within the ZoI of air noise around Bristol Airport. These vary in nature from playgrounds and parks, to open spaces. Eight of these are currently exposed to a daytime noise exposure level of 50 dB $L_{Aeq,16h}$ or more. Only three amenity areas are exposed to a significant level of 55 dB $L_{Aeq,16h}$ or more currently, these being Cadbury Hill in Yatton, Vee Lane Play Area in Felton, and Felton Common.

7.10.27 This situation will remain broadly the same under the 10 mppa 2021 scenario and also the 12 mppa 2026 scenario. A reduction in the number of those exposed to 50 dB and 55 dB occurs under the sensitivity test, reducing to six and two (Vee Lane Play Area and Felton Common) respectively.

Airborne aircraft vibration

7.10.28 The assessment finds that in 2017, six dwellings which border Felton Common are exposed to maximum noise levels of 97 dB L_{Cmax} or greater. This reduces to two dwellings in all future scenarios due to the introduction of more modern, quieter aircraft types. The maximum noise level instances occur less than once per day on average in all scenarios.

7.10.29 In practice, it is appreciated that there is some variation depending on the specific characteristics of individual dwellings, and therefore it is possible that lower levels of noise may induce perceptible vibration effects. The typical aircraft operations which produce the highest L_{Cmax} noise levels currently at dwellings bordering Felton Common are departures by the Airbus A321 and Boeing 737-800 using runway 09. These two aircraft types combined carried out four runway 09 departures on an average day in 2017. Under the 10 mppa in 2021 scenario, this increases to seven, before reducing to four under the 12 mppa in 2026 scenario and three under the sensitivity scenario of 10 mppa in 2026.

7.10.30 Therefore, vibration due to airborne aircraft is expected to currently affect a small number of dwellings and this is not expected to vary significantly in the future scenarios.

Predicted air noise and vibration effects and their significance

7.10.31 This section sets out the air noise effects arising from operations at Bristol Airport by comparing the following key scenarios:

- Baseline year (2017) vs future (10 mppa in 2021);
- Future (10 mppa in 2021) vs future (12 mppa in 2026) with Proposed Development; and
- Future (10 mppa in 2026) vs future (12 mppa in 2026) with Proposed Development.

7.10.32 This section concentrates primarily on a comparison of the change from without to with the Proposed Development since this is the key comparison required as part of the ES. A subjective account of how noise conditions will change between the baseline year and 2021 has however been included to provide context, should Bristol Airport reaches its permissible capacity and the Proposed Development not proceed.

7.10.33 This section commences by presenting, for key receptors, an account of how noise levels will change under each scenario during the daytime and night-time. It then compares and discusses specific pairs of scenarios separately.

7.10.34 The assessments have all been carried out on the basis of external noise levels, as this is what the main criteria relate to. Therefore, mitigation in the form of improved sound insulation is not accounted for. This will reduce the internal noise levels for dwellings where works have been carried out, and therefore the absolute effects will be lower than assessed for those properties.

Variation in noise levels at representative residential receptors

7.10.35 To explore by how much noise exposure levels over the day and night are expected to change between different scenarios, noise predictions have been undertaken comparing various scenarios and the change expected at a series of representative residential receptors around Bristol Airport. The receptors assessed are shown in **Figure 7.1** and details are given in **Table 7.10**.

7.10.36 **Table 7.37** shows the daytime air noise exposure levels for 10 mppa 2021 (in brackets) and the relative change in noise level for the baseline (2017) and the 12 mppa 2026 scenario, at representative residential receptors. The sensitivity scenario of 10 mppa 2026 without the Proposed Development is also included.

Table 7.37 10 mppa in 2021 air noise exposure levels, $L_{Aeq,16h}$ average mode summer day, and relative change

	Residential receptor	Absolute level ($L_{Aeq,16h}$) dB(A) or change re: 10 mppa 2021			
		Baseline 2017	10 mppa 2021	12 mppa 2026	10 mppa 2026
1	Henley Park, Yatton	0	(53)	0	-1
2	Bishops Road, Cleeve	+1	(53)	0	-1
3	Fountain Treeworks, Brockley	0	(62)	-1	-2
4	Cooks Bridle Path, Downside	+1	(60)	0	-1
5	Downside Road, Downside	0	(60)	-1	-2
6	School Lane, Lulsgate Bottom	0	(62)	-1	-2
7	Hillview Gardens, Felton	0	(55)	0	-1
8	Market Place, Winford	0	(59)	+1	0
9	Chew Magna, North Wick	0	(54)	+1	0
10	Church Road, Norton Malreward	0	(50)	0	-1
11	Lye Mead, Winford	-1	(54)	0	-1
12	Red Hill, Redhill	0	(51)	0	-2
13	Wrington Hill, Wrington	+1	(53)	0	-1
14	Southlands Way, Congresbury	0	(53)	0	-2

7.10.37 For all 14 locations, the absolute noise levels for 10 mppa 2021 lie below the SOAEL of 63 dB. This is the case now and will remain the case for 12 mppa in 2026 with the Proposed Development.

7.10.38 The results show that the change in daytime noise level between the baseline (2017) conditions and those likely to arise for the 10 mppa in 2021 scenario is negligible at all locations. Three locations are 1 dB louder in 2017, one location is 1 dB quieter, and 10 locations have the same noise level, when compared to 10 mppa in 2021.

7.10.39 Considering the 12 mppa scenario, there is also a negligible change in noise levels from those expected for the 10 mppa in 2021 scenario. Two locations are 1 dB louder in the 12 mppa scenario, three locations are 1 dB quieter, and nine locations have the same noise level, when compared to 10 mppa in 2021.

7.10.40 For the sensitivity scenario of 10 mppa in 2026, this shows a negligible reduction in noise against 10 mppa in 2021, with 12 locations being 1-2 dB quieter under the 10 mppa in 2026 scenario, and two locations having the same noise level, when compared to 10 mppa in 2021.

7.10.41 The differences in daytime air noise between the 12 mppa 2026 and 10 mppa 2026 scenarios are also small, with increases in the range 0 to 1 dB generally occurring with the Proposed Development.

7.10.42 **Table 7.38** shows the night-time air noise exposure levels for 10 mppa 2021 (in brackets) and the relative change in noise level against the baseline (2017) and the 12 mppa 2026 scenarios, at

representative residential receptors. The sensitivity scenario of 10 mppa 2026 without the Proposed Development is also included.

Table 7.38 10 mppa in 2021 air noise exposure levels, $L_{Aeq,8h}$ average mode summer night, and relative change

	Residential receptor	Absolute level ($L_{Aeq,8h}$) dB(A) or change re: 10 mppa 2021			
		Baseline 2017	10 mppa 2021	12 mppa 2026	10 mppa 2026
1	Henley Park, Yatton	-2	(50)	0	-1
2	Bishops Road, Cleeve	-2	(50)	0	-1
3	Fountain Treeworks, Brockley	-1	(58)	0	-1
4	Cooks Bridle Path, Downside	-1	(57)	0	-1
5	Downside Road, Downside	-2	(56)	0	-1
6	School Lane, Lulsgate Bottom	-1	(58)	0	-1
7	Hillview Gardens, Felton	-2	(52)	0	-1
8	Market Place, Winford	-1	(56)	+1	0
9	Chew Magna, North Wick	-1	(51)	+1	0
10	Church Road, Norton Malreward	-1	(47)	0	0
11	Lye Mead, Winford	-2	(51)	0	-1
12	Red Hill, Redhill	-2	(48)	0	-2
13	Wrington Hill, Wrington	-2	(55)	0	-1
14	Southlands Way, Congresbury	-2	(49)	0	-1

7.10.43 For six of the fourteen locations, the absolute noise levels for 10 mppa 2021 all lie at or just above the SOAEL of 55 dB, with the remainder lying below. This is also the case for the 12 mppa 2026 scenario. This is similar to the case now with four of the fourteen receptors experiencing night noise at or above the SOAEL.

7.10.44 The results show negligible increases in noise of 1 to 2 dB at all locations, from the baseline (2017) conditions during the night and those likely to arise for 10 mppa 2021, as currently permitted.

7.10.45 Noise levels during the night will also see little variation under 12 mppa 2026 from those expected for 10 mppa 2021, with two locations experiencing a negligible increase of 1 dB and 12 locations where the noise level remains the same.

7.10.46 For the sensitivity case, this shows a reduction in noise against 10 mppa 2021, with 11 locations experiencing a negligible decrease in noise level of 1 to 2 dB and three locations where the noise level remains the same.

7.10.47 The differences in night-time air noise between the 12 mppa 2026 and 10 mppa 2026 scenarios are similar, with the majority of locations experiencing a negligible increase of 1 dB in the 12 mppa scenario.

Baseline year (2017) vs Future (10 mppa in 2021)

7.10.48 Bristol Airport is forecast to grow to its permitted passenger limit of 10 mppa by 2021, irrespective of whether the Proposed Development is permitted. This section summarises the noise effects expected (compared to 2017) as a result of this growth to Bristol Airport's permitted passenger throughput of 10 mppa and the resulting effects on the local community.

7.10.49 Annual aircraft movements are forecast to increase from 73,562 in 2017 to 86,973 in 2021. This increase will be accompanied by the replacement of some of the most common aircraft at Bristol Airport with their more modern equivalents.

7.10.50 Under the 10 mppa in 2021 scenario, while aircraft movements will increase, noise exposure levels during the day are predicted to reduce slightly due to the modernisation of the aircraft fleet, leading to a slight reduction in the number of people adversely affected by air noise. For example, the number of dwellings exposed to noise levels at or above the LOAEL reduces slightly from 3,250 to 3,150. The associated change in noise level at these receptors is negligible, with most experiencing a decrease of less than 1 dB, with some experiencing an increase of less than 1 dB. This is considered to be a very low effect. The small number of dwellings exposed to noise levels at or above the SOAEL, around 20 dwellings in 2017 falling to around 10 in 2021, experience similar changes in noise level and therefore also a very low effect.

7.10.51 As air traffic increases in the future at night, the number of dwellings that are exposed to noise levels at or above the LOAEL will rise, from 3,750 in 2017 to 5,150 in 2021. The number of dwellings exposed to noise levels at or above the SOAEL increases from 150 in 2017 to 300 in 2021. Of these dwellings, 15 will experience an increase in noise level of 2 to 3 dB and an absolute level above the SOAEL. This constitutes a moderate adverse effect for these dwellings. The remaining dwellings experience either lower absolute noise levels or lower changes in noise level, which constitutes a low or very low adverse effect.

7.10.52 In summary, the air noise effects during the day are not expected to materially change between the 2017 and 10 mppa in 2021 scenarios. Approximately 150 dwellings are exposed to significant levels of night-time air noise under the 2017 scenario. This number will increase to around 300 by 2021. Most of these dwellings, however, will experience only a low or very low effect due to negligible changes in noise level. 15 dwellings will experience a moderate adverse effect, located in the Lulsgate Bottom area close to the eastern end of the runway. All of the dwellings exposed to significant levels of external air noise, both now and in 2021, are eligible under Bristol Airport's current sound insulation scheme and therefore have the option to improve the sound insulation to reduce the internal noise levels. To date, the number of properties that have been insulated are as follows:

- 2000 – 2001: circa 261 properties;
- 2015: 14 properties;
- 2016: 40 properties;
- 2017: 8 properties; and
- 2018: 5 properties.

7.10.53 The number of dwellings exposed to a significant level of noise due to individual aircraft events at least once per night increases from 250 in 2017 to 650 under the 10 mppa in 2021 scenario. This is a potentially significant adverse effect.

Future (10 mppa in 2021) to Future (12 mppa in 2026) With Development

7.10.54 This section summarises the noise effects expected (compared to those currently permitted) as a result of growth from 10 mppa to 12 mppa by 2026. It describes and compares the effects of the two key scenarios assessed in this ES.

7.10.55 Annual aircraft movements are forecast to increase from the 86,973 in 2021, based on the permitted passenger throughput of 10 mppa, to 97,393 in 2026, relating to 12 mppa. This increase will be accompanied by a further replacement of some of the most common aircraft types at Bristol Airport with their more modern equivalents.

7.10.56 **Table 7.39** and **Table 7.40** summarise for the daytime and night-time how this change will affect residential dwellings based on the absolute levels arising under the 12 mppa in 2026 scenario and the change in noise level from the 10 mppa in 2021 scenario that is experienced. The beneficial change category includes the small number of dwellings experiencing no change in noise level.

7.10.57 Based on the criteria set out in **Table 7.22**, the number of residential and non-residential receptors experiencing a given air noise effect due to the change between the 10 mppa in 2021 and 12 mppa in 2026 scenarios is then set out in **Table 7.41**.

7.10.58 A potential significant effect (adverse or beneficial) is considered to arise in **Table 7.39** if the magnitude of the effect is rated as medium or higher. Whether a significant effect arises will depend on context, such as the number of noise sensitive receptors affected and how often it occurs.

Table 7.39 Dwellings exposed to absolute air noise and change in air noise, 10 mppa 2021 to 12 mppa 2026, daytime

Subjective description of impact	Contour band, dB $L_{Aeq,16h}$	Number of dwellings in band, 12 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Moderate	Substantial	Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Negligible	**51 (LOAEL)**	1,550	Beneficial	1,550	0	0	0	0
		650	Adverse	650	0	0	0	0
Very minor	**54**	250	Beneficial	250	0	0	0	0
		200	Adverse	200	0	0	0	0
Minor	**57**	90	Beneficial	90	0	0	0	0
		250	Adverse	250	0	0	0	0
Minor/ Moderate	**60**	40	Beneficial	40	0	0	0	0
		80	Adverse	80	0	0	0	0
Significant Moderate	**63 (SOAEL)**	0	Beneficial	0	0	0	0	0
		10	Adverse	10	0	0	0	0

Subjective description of impact	Contour band, dB $L_{Aeq,16h}$	Number of dwellings in band, 12 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Moderate	Substantial	Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Significant Substantial	**66**	1	Beneficial	1	0	0	0	0
		0	Adverse	0	0	0	0	0
Significant Very Substantial	**69 (UAEL)**	0	Beneficial	0	0	0	0	0
		0	Adverse	0	0	0	0	0
Total		1,950	Beneficial	1,950	0	0	0	0
		1,150	Adverse	1,150	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

Table 7.40 Dwellings exposed to absolute air noise and change in air noise, 10 mppa 2021 to 12 mppa 2026, night-time

Subjective description of impact	Contour band, dB $L_{Aeq,8h}$	Number of dwellings in band, 12 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Moderate	Substantial	Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Negligible	**45 (LOAEL)**	1,700	Beneficial	1,700	0	0	0	0
		350	Adverse	350	0	0	0	0
Very minor	**48**	600	Beneficial	600	0	0	0	0
		1,500	Adverse	1,500	0	0	0	0
Minor	**51**	200	Beneficial	200	0	0	0	0
		250	Adverse	250	0	0	0	0
Minor/ Moderate	**54**	30	Beneficial	30	0	0	0	0
		90	Adverse	90	0	0	0	0
Significant Moderate	**SOAEL (55)**	80	Beneficial	80	0	0	0	0
		250	Adverse	250	0	0	0	0

Subjective description of impact	Contour band, dB $L_{Aeq,8h}$	Number of dwellings in band, 12 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Moderate	Substantial	Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Significant Substantial	**60**	0	Beneficial	0	0	0	0	0
		10	Adverse	10	0	0	0	0
Significant Very Substantial	**63**	1	Beneficial	1	0	0	0	0
		0	Adverse	0	0	0	0	0
Total		2,600	Beneficial	2,600	0	0	0	0
		2,450	Adverse	2,450	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

Table 7.41 Air noise effect on number of dwellings and non-residential receptors – 10 mppa 2021 to 12 mppa 2026

Receptor Type	12 mppa outdoor noise level, dB	Beneficial[1] or adverse change	Magnitude of effect				
			Very low	Low	Medium	High	Very High
			Change in noise level, dB(A)				
Residential Day (07:00-23:00)	$51 \leq L_{Aeq,16h} < 63$	Beneficial	1,950	0	0	0	0
		Adverse	1,150	0	0	0	0
	$L_{Aeq,16h} \geq 63$	Beneficial	1	0	0	0	0
		Adverse	10	0	0	0	0
Residential Night (23:00-07:00)	$45 \leq L_{Aeq,8h} < 55$	Beneficial	2,500	0	0	0	0
		Adverse	2,200	0	0	0	0
	$L_{Aeq,8h} \geq 55$	Beneficial	80	0	0	0	0
		Adverse	250	0	0	0	0
Schools	$L_{Aeq,30min} \geq 55$	Beneficial	1	0	0	0	0

Receptor Type	12 mppa outdoor noise level, dB	Beneficial[1] or adverse change	Magnitude of effect				
			Very low	Low	Medium	High	Very High
			Change in noise level, dB(A)				
		Adverse	1	0	0	0	0
Places of worship	$51 \leq L_{Aeq,16h} < 63$	Beneficial	1	0	0	0	0
		Adverse	5	0	0	0	0
	$L_{Aeq,16h} \geq 63$	Beneficial	0	0	0	0	0
		Adverse	0	0	0	0	0
Amenity Areas	$L_{Aeq,T} \geq 55$	Beneficial	0	0	0	0	0
		Adverse	3	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

7.10.59 While aircraft movements will increase under the 12 mppa 2026 scenario, this is largely offset by the predicted modernisation of the aircraft fleet. Therefore, noise exposure levels are predicted to remain broadly the same, leading to no material change in the number of those people adversely affected by air noise.

7.10.60 The number of dwellings exposed to daytime noise levels at or above the LOAEL reduces slightly from 3,150 to 3,100. The associated change in noise level at these receptors is negligible, with most experiencing a decrease of less than 1 dB, and some experiencing an increase of less than 1 dB. This constitutes a very low effect. The small number of dwellings exposed to noise levels at or above the SOAEL, around 10 dwellings in both scenarios, experience similar changes in noise level and therefore also a very low effect.

7.10.61 The number of dwellings that are exposed to night-time noise levels at or above the LOAEL will decrease slightly under the 12 mppa scenario, reducing from 5,150 to 5,050. Around 2,600 will experience either no change or a negligible reduction in night noise exposure of 0 to 1 dB, and around 2,450 will experience a negligible increase of 0 to 2 dB in 2026 as compared to 2021. This constitutes a low or very low effect for these dwellings.

7.10.62 In summary, the air noise effects are not expected to materially change between the 10 mppa in 2021 and 12 mppa in 2026 scenarios. Approximately 300 dwellings are exposed to significant levels of night-time air noise under the 10 mppa 2021 scenario. This number will increase to around 350 under the 12mppa 2026 scenario. All of these dwellings, however, will experience only a low or very low effect due to negligible changes in noise level. All of the dwellings exposed to significant levels of external air noise, both in 2021 and 2026, are eligible under Bristol Airport's current sound insulation scheme and therefore have the option to improve the sound insulation to reduce the internal noise levels. All properties can also benefit from the Enhanced Sound Insulation Scheme as well.

7.10.63 The number of dwellings exposed to a significant level of noise due to individual aircraft events at least once per night decreases from 650 under the 10 mppa in 2021 scenario to 100 under the 12 mppa in 2026 scenario. This is a potentially significant adverse effect.

7.10.64 A summary of these noise effects with an overall significance finding is set out in **Table 7.42**.

Table 7.42 Summary of air noise effects, 10 mppa 2021 to 12 mppa 2026

Receptor type	$L_{Aeq,T}$ noise criterion	No Change/Beneficial or Adverse[1]	Receptor Nos. in $L_{Aeq,T}$[2]	Change in noise level	% Change in Highly Annoyed/ Sleep Disturbed[3]	Change in dwellings SEL/L_{ASmax} (night)	Significance of Effect
Residential – Day					-1% A.		**Negligible beneficial, not significant**
LOAEL	51 dB $L_{Aeq,16h}$	No change/Benef.	1,950	Negligible			
		Adverse	650	Negligible			
SOAEL	63 dB $L_{Aeq,16h}$	No change/Benef.	1	Negligible			
		Adverse	10	Negligible			
Residential – Night					-6% S.D.		**Negligible adverse, not significant**
LOAEL	45 dB $L_{Aeq,8h}$	No change/Benef.	2,500	Negligible		70 SEL/60 L_{ASmax} (min 10 events) +1,200 (+23%)	
		Adverse	2,200	Negligible			
SOAEL	55 dB $L_{Aeq,8h}$	No change/Benef.	80	Negligible		90 SEL/80 L_{ASmax} (min 1 event) -550 (-85%)	
		Adverse	250	Negligible			
Schools	55 dB $L_{Aeq,30m}$	No change/Benef.	1	Negligible			**Negligible adverse, not significant**
		Adverse	1	Negligible			
Places of Worship	As residential, day	No change/Benef.	1	Negligible			**Negligible adverse, not significant**
		Adverse	5	Negligible			
Amenity Areas	55 dB $L_{Aeq,T}$	No change/Benef.	0	Negligible			**Negligible adverse,**

Receptor type	$L_{Aeq,T}$ noise criterion	No Change/Beneficial or Adverse[1]	Receptor Nos. in $L_{Aeq,T}$[2]	Change in noise level	% Change in Highly Annoyed/ Sleep Disturbed[3]	Change in dwellings SEL/L_{ASmax} (night)	Significance of Effect
							not significant
		Adverse	3	Negligible			

1. States whether noise change is zero or a reduction (No change/beneficial) or an increase (adverse) moving from scenario A to scenario B.
2. The receptor numbers for LOAEL are those exposed to a noise level equal to or greater than LOAEL (assessed in terms of $L_{Aeq,16h}$ daytime, $L_{Aeq,8h}$ night-time) but less than SOAEL, following a move from scenario A to scenario B. Those for SOAEL, relate to receptors exposed to a noise level equal to or greater than SOAEL. For non-residential receptors, it shows the change in the number of those exposed to the specified criterion level.
3. Percentage changes based on unrounded data.

Future (10 mppa in 2026) to Future (12 mppa in 2026) With Development

7.10.65 The effect of air noise on residential receptors in 2026 without the Proposed Development has been assessed assuming that Bristol Airport is limited to a throughput of 10 mppa in 2026. This is compared in this section to the 12 mppa 2026 scenario with the Proposed Development.

7.10.66 If the Proposed Development does not proceed, Bristol Airport would be constrained from 2021 onwards to 10 mppa. The number of aircraft movements in the 10 mppa in 2026 scenario is assumed to therefore remain at 86,973, as would occur in the 10 mppa in 2021 scenario. If the Proposed Development does proceed, annual aircraft movements are forecast to increase to 97,393 in the 12 mppa in 2026 scenario.

7.10.67 It has been assumed that the same proportion of the aircraft fleet has been modernised in both 2026 scenarios. In practice it is likely that modernisation would occur at a slower rate if passenger throughput were constrained to 10 mppa. This is because the likelihood that more modern, quieter aircraft will be allocated to Bristol Airport is reduced since no potential of growth for the airline will be present. Airlines are already securing flights to destinations and associated 'slots' at airports as far ahead as summer 2020 at the time of writing. If an airline can be assured growth at another airport it may seek to deliver a competitive advantage to secure capacity now. As airports are coming under increased pressure to reduce noise impacts, securing more modern aircraft fleets coupled with growth is a key way in which this can occur sustainably. Therefore, the 10 mppa 2026 scenario is a worst-case comparison for the 12 mppa scenario as the expectation of aircraft modernisation is similar.

7.10.68 **Table 7.43** and **Table 7.44** summarise for the daytime and night-time how this change will affect residential dwellings based on the absolute levels arising under 12 mppa in 2026 scenario and the change in noise level from the 10 mppa in 2026 scenario that is experienced. The beneficial change category includes those dwellings experiencing no change in noise level.

7.10.69 Based on the criteria set out in **Table 7.22**, the number of residential and non-residential receptors experiencing a given air noise effect due to the change between the 10 mppa in 2026 and 12 mppa in 2026 scenarios is then set out in **Table 7.45**.

7.10.70 A potential significant effect (adverse or beneficial) is considered to arise in **Table 7.43** if the magnitude of the effect is rated as medium or higher. Whether a significant effect arises will depend on context, such as the number of noise sensitive receptors affected and how often it occurs.

Table 7.43 Dwellings exposed to absolute air noise and change in air noise, 10 mppa 2026 to 12 mppa 2026, daytime

Subjective description of impact	Contour band, dB $L_{Aeq,16h}$	Number of dwellings in band, 12 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Moderate	Substantial	Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Negligible	**51 (LOAEL)**	0	Beneficial	0	0	0	0	0
		2,200	Adverse	2,200	0	0	0	0
Very minor	**54**	0	Beneficial	0	0	0	0	0
		400	Adverse	400	0	0	0	0
Minor	**57**	0	Beneficial	0	0	0	0	0
		350	Adverse	350	0	0	0	0
Minor/ Moderate	**60**	0	Beneficial	0	0	0	0	0
		100	Adverse	100	0	0	0	0
Significant Moderate	**63 (SOAEL)**	0	Beneficial	0	0	0	0	0
		10	Adverse	10	0	0	0	0
Significant Substantial	**66**	0	Beneficial	0	0	0	0	0
		1	Adverse	1	0	0	0	0
Significant Very Substantial	**69 (UAEL)**	0	Beneficial	0	0	0	0	0
		0	Adverse	0	0	0	0	0
Total		0	Beneficial	0	0	0	0	0
		3,100	Adverse	3,100	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

Table 7.44 Dwellings exposed to absolute air noise and change in air noise, 10 mppa 2026 to 12 mppa 2026, night-time

Subjective description of impact	Contour band, dB $L_{Aeq,8h}$	Number of dwellings in band, 12 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Moderate	Substantial	Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Negligible	**45 (LOAEL)**	0	Beneficial	0	0	0	0	0
		2,050	Adverse	2,050	0	0	0	0
Very minor	**48**	0	Beneficial	0	0	0	0	0
		2,100	Adverse	2,100	0	0	0	0
Minor	**51**	0	Beneficial	0	0	0	0	0
		450	Adverse	450	0	0	0	0
Minor/ Moderate	**54**	0	Beneficial	0	0	0	0	0
		100	Adverse	100	0	0	0	0
Significant Moderate	**SOAEL (55)**	0	Beneficial	0	0	0	0	0
		300	Adverse	300	0	0	0	0
Significant Substantial	**60**	0	Beneficial	0	0	0	0	0
		10	Adverse	10	0	0	0	0
Significant Very Substantial	**63**	0	Beneficial	0	0	0	0	0
		1	Adverse	1	0	0	0	0
Total		0	Beneficial	0	0	0	0	0
		5,050	Adverse	5,050	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

Table 7.45 Air noise effect on number of dwellings and non-residential receptors – 10 mppa 2026 to 12 mppa 2026

Receptor Type	12 mppa outdoor noise level, dB	Beneficial[1] or adverse change	Magnitude of effect				
			Very low	Low	Medium	High	Very High
			Change in noise level, dB(A)				
Residential Day (07:00-23:00)	51 ≤ $L_{Aeq,16h}$ < 63	Beneficial	0	0	0	0	0
		Adverse	3,100	0	0	0	0
	$L_{Aeq,16h}$ ≥ 63	Beneficial	0	0	0	0	0
		Adverse	10	1	0	0	0
Residential Night (23:00-07:00)	45 ≤ $L_{Aeq,8h}$ < 55	Beneficial	0	0	0	0	0
		Adverse	4,700	0	0	0	0
	$L_{Aeq,8h}$ ≥ 55	Beneficial	0	0	0	0	0
		Adverse	250	70	0	0	0
Schools	$L_{Aeq,30min}$ ≥ 55	Beneficial	0	0	0	0	0
		Adverse	2	0	0	0	0
Places of worship	51 ≤ $L_{Aeq,16h}$ < 63	Beneficial	0	0	0	0	0
		Adverse	6	0	0	0	0
	$L_{Aeq,16h}$ ≥ 63	Beneficial	0	0	0	0	0
		Adverse	0	0	0	0	0
Amenity Areas	$L_{Aeq,T}$ ≥ 55	Beneficial	0	0	0	0	0
		Adverse	3	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

7.10.71 As aircraft movements will increase under the 12 mppa 2026 scenario, as compared to the 10 mppa 2026 scenario, with little difference in fleet mix, noise exposure levels are predicted to rise slightly.

7.10.72 The differences in daytime air noise between the 12 mppa 2026 and 10 mppa 2026 scenarios are small, with increases in the range 0 to 2 dB occurring with the Proposed Development.

7.10.73 The number of dwellings that are exposed to daytime noise levels at or above the LOAEL will rise from 2,200 to 3,100, from 10 mppa to 12 mppa, with these receptors experiencing a negligible increase of generally around 1 dB, a very low effect.

7.10.74 There are very few dwellings exposed to the SOAEL or above during the daytime, around 10 dwellings both under the 10 mppa and 12 mppa scenarios. Under the 12 mppa scenario, these properties, in the Lulsgate Bottom area, would experience a negligible increase in noise exposure level giving rise to a low or very low effect of no significance.

7.10.75 Around 4,150 dwellings are exposed to night-time air noise at or above the LOAEL under 10 mppa in 2026 and this will increase to 5,050 under 12 mppa with the Proposed Development. The change in noise for these receptors under 12 mppa would be negligible, around 1 dB, a very low effect.

7.10.76 Around 250 dwellings are exposed to night-time air noise at or above the SOAEL under 10 mppa in 2026, increasing to around 350 under 12 mppa. Again, the change in noise for these receptors under 12 mppa would be negligible, around 1 dB, a low or very low effect.

7.10.77 In summary, the air noise effects are expected to increase by a low or very low amount under the 12 mppa in 2026 scenario when compared to the 10 mppa in 2026 scenario. Around 10 dwellings are exposed to significant levels of daytime air noise under both scenarios. At night, the number exposed to significant levels of air noise increases from 250 under the 10 mppa in 2026 scenario to 350 under the 12 mppa in 2026 scenario.

7.10.78 A summary of these noise effects with an overall significance finding is set out in **Table 7.46**.

Table 7.46 Summary of air noise effects, 10 mppa 2026 to 12 mppa 2026

Receptor type	$L_{Aeq,T}$ noise criterion	No Change/Beneficial or Adverse[1]	Receptor Nos. in $L_{Aeq,T}$[2]	Change in noise exposure	% Change in Highly Annoyed/ Sleep Disturbed[3]	Change in dwellings SEL/L_{ASmax} (night)	Significance of Effect
Residential – Day					+37% A.		**Negligible adverse, not significant**
LOAEL	51 dB $L_{Aeq,16h}$	No change/Benef.	0	Negligible			
		Adverse	3,100	Negligible			
SOAEL	63 dB $L_{Aeq,16h}$	No change/Benef.	0	Negligible			
		Adverse	10	Negligible			
Residential – Night					+18% S.D.		**Negligible adverse, not significant**
LOAEL	45 dB $L_{Aeq,8h}$	No change/Benef.	0	Negligible		70 SEL/60 L_{ASmax} (min 10 events) +1,950 (+44%)	

Receptor type	$L_{Aeq,T}$ noise criterion	No Change/Beneficial or Adverse[1]	Receptor Nos. in $L_{Aeq,T}$[2]	Change in noise exposure	% Change in Highly Annoyed/ Sleep Disturbed[3]	Change in dwellings SEL/L_{ASmax} (night)	Significance of Effect
		Adverse	4,700	Negligible			
SOAEL	55 dB $L_{Aeq,8h}$	No change/Benef.	0	Negligible		90 SEL/80 L_{ASmax} (min 1 event) No change	
		Adverse	350	Negligible			
Schools	55 dB $L_{Aeq,30m}$	No change/Benef.	0	Negligible			**Negligible adverse, not significant**
		Adverse	2	Negligible			
Places of Worship	As residential, day	No change/Benef.	0	Negligible			**Negligible adverse, not significant**
		Adverse	6	Negligible			
Amenity Areas	55 dB $L_{Aeq,T}$	No change/Benef.	0	Negligible			**Negligible adverse, not significant**
		Adverse	3	Negligible			

1. States whether noise change is zero or a reduction (No change/beneficial) or an increase (adverse) moving from scenario A to scenario B.
2. The receptor numbers for LOAEL are those exposed to a noise level equal to or greater than LOAEL (assessed in terms of $L_{Aeq,16h}$ daytime, $L_{Aeq,8h}$ night-time) but less than SOAEL, following a move from scenario A to scenario B. Those for SOAEL, relate to receptors exposed to a noise level equal to or greater than SOAEL. For non-residential receptors, it shows the change in the number of those exposed to the specified criterion level.
3. Percentage changes based on unrounded data.

7.10.79 In summary, when considering the noise impacts likely to arise as a result of moving from a 10 mppa scenario under 2021 or 2026 to a 12 mppa scenario with the Proposed Development, these are predicted to be low or very low with no significant effects.

7.11 Assessment of effects – ground noise

7.11.1 **Section 7E.5** of **Appendix 7E** provides the detailed results of the ground noise assessment. Ground noise contours are presented, along with contour areas and dwelling counts within each contour band for residential receptors. Noise exposure values are also presented for noise sensitive non-residential receptors. Key results are presented in this section. Note that the significance ratings arising from the effects described here are described in the next section titled "Predicted ground noise effects and their significance". Where percentage changes are given, these are based on unrounded values.

7.11.2 For all tables in this section, areas are rounded to the nearest 0.1km^2. Dwelling and population counts are rounded to the nearest 50 above 100 and to the nearest 10 below 100. Below 10, the

actual number is given. The counts include all those dwellings or people within a specified contour band and any higher value bands so, for example, any dwellings within a 60 dB contour would also be counted as being within a 50 dB contour as well.

Residential receptors

$L_{Aeq,16h}$ daytime

7.11.3 The dwelling counts within key daytime ground noise contours are presented in **Table 7.47**. These contours are presented in **Figure 7E.3** to **Figure 7E.5**.

Table 7.47 Ground noise dwelling counts, $L_{Aeq,16h}$ average summer day

Contour $L_{Aeq,16h}$ dB(A)	Number of Dwellings		
	Baseline 2017	10 mppa 2026	12 mppa 2026
50	70	80	70
60	1	1	1
70	0	0	0

7.11.4 **Table 7.47** shows that in 2017, around 70 dwellings are adversely affected by ground noise as a result of daytime aircraft operations at Bristol Airport. This total is expected to remain much the same, although marginally increase to around 80 in the 10 mppa scenario.

7.11.5 Currently, and in the future under any scenario, only one residential receptor is predicted to experience ground noise above the SOAEL of 65 dB $L_{Aeq,16h}$, which is Core Hill, on Cooks Bridle Path to the north-west of the western stands at Bristol Airport. Core Hill was previously provided a grant of almost £9,000 as part of the 2000-2001 insulation scheme.

7.11.6 No residential receptors are exposed to unacceptable levels of daytime ground noise currently, nor will they be in the future.

$L_{Aeq,8h}$ night-time

7.11.7 Turning to the night-time effects, **Table 7.48** show the dwelling counts within key night-time ground noise contours. These contours are presented in **Figure 7E.6** to **Figure 7E.8**.

Table 7.48 Ground noise dwelling counts, $L_{Aeq,8h}$ average summer night

Contour $L_{Aeq,8h}$ dB(A)	Number of Dwellings		
	Baseline 2017	10 mppa 2026	12 mppa 2026
45	70	100	100
55	1	2	3
65	0	0	0

7.11.8 **Table 7.48** shows that in 2017, around 70 dwellings are adversely affected by ground noise as a result of night-time aircraft operations at Bristol Airport. This total is expected to increase to around 100 under both future scenarios.

7.11.9 Currently, only one residential receptor is predicted to experience ground noise above the SOAEL of 60 dB $L_{Aeq,8h}$, which is the same property as is exposed to the SOAEL in the daytime. This is predicted to increase to two dwellings under the 10 mppa scenario and increase to three dwellings under the 12 mppa scenario. The additional dwellings are The Lodge in the 10 mppa scenario and North Hill House in the 12 mppa scenario. Both of these are also on Cooks Bridle Path.

7.11.10 No residential receptors are exposed to unacceptable levels of night-time ground noise currently, nor will they be in the future.

Variation in noise levels at representative residential receptors

7.11.11 To explore by how much noise exposure levels in the day and night periods are expected to change between different scenarios, noise predictions have been undertaken comparing various scenarios and the change expected for all residential receptors, considered in different noise exposure bands. These tables depict, for each noise exposure band, the number of receptors that will experience either no change/a beneficial change in noise or an adverse change in noise. These tables are presented in **Appendix 7E**. To further demonstrate these effects, an assessment of the expected noise change between various scenarios is also provided at a series of representative residential receptors around Bristol Airport. The receptors assessed are shown in **Figure 7.2**.

7.11.12 **Table 7.49** shows the daytime and night-time ground noise exposure levels for 10 mppa 2026 (in brackets) and the relative change in noise level for the baseline (2017) and the 12 mppa 2026 scenario, at representative residential receptors.

Table 7.49 10 mppa 2026 air noise exposure levels, average summer day and night, and relative change

Receptor	Location	Daytime $L_{Aeq,16h}$ (dB)			Night-time $L_{Aeq,8h}$ (dB)		
		2017	10 mppa 2026	12 mppa 2026	2017	10 mppa 2026	12 mppa 2026
A	Cooks Bridle Path, Downside	0	(61)	+2	-3	(59)	+2
B	Downside Road, Lulsgate Bottom	0	(58)	-6	-2	(54)	-7
C	School Lane, Lulsgate Bottom	0	(52)	0	-4	(50)	-1
D	Red Hill (A38), Redhill	0	(45)	+1	-2	(41)	0
E	Winters Lane, Redhill	0	(47)	+1	-2	(44)	0
F	Downside Road, Downside	0	(53)	+1	-1	(50)	+1
G	Downside Road, Downside	0	(50)	-1	-2	(47)	-1
H	Downside Road, Lulsgate Bottom	+2	(56)	-5	-3	(53)	-6
I	Bridgwater Road (A38), Lulsgate Bottom	0	(50)	-1	-3	(47)	-1
J	Red Hill (A38), Redhill	0	(43)	0	-2	(39)	0
K	Winters Lane, Redhill	0	(50)	+1	-2	(46)	+1

7.11.13 In both the daytime and night-time periods for the 10 mppa scenario, one of the 11 locations lies at or above the SOAEL, which is Cooks Bridle Path. This is also the situation both in 2017 and under the 12 mppa scenario.

7.11.14 **Table 7.49** shows that in the daytime period, there is in general little change between the 2017 and 10 mppa scenarios, with no change for 10 of the 11 locations, and a negligible decrease of 2 dB for the 10 mppa scenario at one location. In the night-time period, there are increases from 2017 to the 10 mppa scenario. For eight of these locations this is a negligible increase of 2 dB, but for four locations this is a moderate increase of 3 to 4 dB.

7.11.15 Considering the 12 mppa scenario, in the daytime there are generally negligible changes from the 10 mppa scenario; five locations experience an increase of 1 to 2 dB, two locations experience no change, and two locations experience a decrease of 1 dB. Some locations, in particular those in Lulsgate Bottom, benefit from the additional screening resulting from the Proposed Development being built out and therefore two locations experience moderate reductions in noise level of 5-6 dB under the 12 mppa 2026 scenario. This situation is similar in the night-time period, with one location experiencing a negligible increase of 1 dB, five locations experiencing no change, and three locations experiencing a negligible decrease of 1 dB. The same two locations benefit from the additional screening, experiencing moderate or substantial decreases of 6 or 7 dB under the 12 mppa scenario.

Non-residential receptors

7.11.16 **Appendix 7E** sets out the $L_{Aeq,16h}$ and $L_{Aeq,8h}$ noise exposure levels for schools, places of worship and amenity areas within the ZoI of ground noise around Bristol Airport.

Schools

7.11.17 **Appendix 7E** identifies no schools, as being within the ZoI of ground noise around Bristol Airport.

Places of worship

7.11.18 There are two places of worship identified within the ZoI of air noise around Bristol Airport, which are St. Katharine's Church, Felton, and Christ Church, Redhill. Neither of these are exposed to ground noise at or above the LOAEL under any of the three scenarios.

Amenity areas

7.11.19 There are two amenity areas identified within the ZoI of ground noise around Bristol Airport. These are Vee Lane Play Area in Felton and Felton Common. Neither of these areas are exposed to ground noise levels at or above the threshold level of 55 dB $L_{Aeq,16h}$ under any of the three scenarios.

Predicted ground noise effects and their significance

7.11.20 This section sets out the ground noise effects arising from operations at Bristol Airport by comparing the following key scenarios:

- Baseline year (2017) vs future (10 mppa in 2026); and
- Future (10 mppa in 2026) vs future (12 mppa in 2026) With Proposed Development

7.11.21 Note that in the future, as the modernisation of the fleet will have little influence on the ground noise levels produced by aircraft, it is not necessary to consider a future 10 mppa 2021 scenario as this would be expected to give rise to the same noise effects as those under 10 mppa in 2026.

Baseline year (2017) vs Future (10 mppa in 2026)

7.11.22 Bristol Airport is forecast to grow irrespective of whether the Proposed Development proceeds. This section summarises the noise effects expected (compared to 2017) as a result of this growth to Bristol Airport's permitted passenger throughput of 10 mppa and the resulting effects on the local community.

7.11.23 Annual aircraft movements are forecast to increase from 73,562 in 2017 to 86,973 in the 10 mppa scenario.

7.11.24 Under the 10 mppa scenario, aircraft movements will remain similar in the daytime, increasing by 2% compared to 2017. Additionally, there is a reduction in the proportion of movements by propeller aircraft, which are the loudest aircraft category for ground noise. Therefore, daytime ground noise exposure levels are predicted to remain similar to now.

7.11.25 The number of dwellings exposed to noise levels at or above the LOAEL in the daytime increases slightly from 70 to 80. The associated change in noise level at these 80 receptors is negligible, with around half experiencing an increase of 1 dB or less, and the other half experiencing no change or a decrease of 1 dB or less. This is considered to be a very low effect. The one dwelling exposed to noise levels at or above the SOAEL experiences similar changes in noise level and therefore is also a very low effect.

7.11.26 At night, aircraft movements increase by around 50% compared to 2017, and are primarily made up of medium size jets both now and under the 10 mppa 2026 scenario. This results in around 100 dwellings exposed to the LOAEL or above under the 10 mppa 2026 scenario, compared to around 70 in 2017. Of these dwellings, 25 will experience a moderate increase in noise level of 3 to 4 dB. This constitutes a moderate adverse effect for these dwellings. The remainder experience an increase of 1 to 3 dB, which is considered to be a low or very low effect. One dwelling is exposed to the SOAEL under the 2017 scenario, which is Core Hill, on Cooks Bridle Path. A second dwelling becomes exposed to the SOAEL under the 10 mppa scenario, which is The Lodge, also on Cooks Bridle Path. These dwellings experience a change in noise level of 2 to 4 dB which constitutes a medium effect.

7.11.27 In summary, only one dwelling is currently experiencing significant levels of ground noise, which is expected to increase to two in the 10 mppa scenario. These dwellings also experience a minor or moderate increase in noise level, constituting a medium effect of moving from 2017 to the 10 mppa in 2026 scenario which is rated as probably significant. In practice, these dwellings are eligible under Bristol Airport's current sound insulation scheme (which is based on the air noise effect).

Future (10 mppa in 2026) to Future (12 mppa in 2026) With Development

7.11.28 This section summarises the noise effects expected (compared to that currently permitted) as a result of growth to 12 mppa in 2026. It describes and compares the effects of the two key scenarios assessed in this ES.

7.11.29 Annual aircraft movements are forecast to increase from 86,973 in the 10 mppa scenario to 97,393 in the 12 mppa scenario.

7.11.30 **Table 7.50** and **"Beneficial"** rows include a small number of dwellings with zero change.

7.11.31 **Table 7.51** summarise for the daytime and night-time how this change will affect residential dwellings based on the absolute levels arising under 12 mppa in 2026 scenario and the change in noise level from the 10 mppa in 2026 scenario that is experienced. The beneficial change category includes those dwellings experiencing no change in noise level.

7.11.32 Based on the criteria set out in **Table 7.26**, the number of residential and non-residential receptors experiencing a given air noise effect due to the change between the 10 mppa in 2026 and 12 mppa in 2026 scenarios is set out in **Table 7.52**.

7.11.33 A potential significant effect (adverse or beneficial) is considered to arise in **Table 7.52** if the magnitude of the effect is rated as medium or higher. Whether a significant effect arises will depend on context, such as the number of noise sensitive receptors affected and how often it occurs.

Table 7.50 Dwellings exposed to absolute ground noise and change in ground noise, 10 mppa 2026 to 12 mppa 2026, daytime

Subjective description of impact	Contour band, dB $L_{Aeq,16h}$	Number of dwellings in band, 12 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Significant Moderate	Significant Substantial	Significant Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Negligible	**50 (LOAEL)**	60	Beneficial	20	5	30	4	0
		10	Adverse	10	0	0	0	0
Minor	**55**	0	Beneficial	0	0	0	0	0
		3	Adverse	3	0	0	0	0
Significant Moderate	**60 (SOAEL)**	0	Beneficial	0	0	0	0	0
		1	Adverse	1	0	0	0	0
Significant Substantial	**65**	0	Beneficial	0	0	0	0	0
		0	Adverse	0	0	0	0	0
Significant Very Substantial	**70 (UAEL)**	0	Beneficial	0	0	0	0	0
		0	Adverse	0	0	0	0	0
Total		60	Beneficial	20	5	30	4	0
		10	Adverse	10	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

Table 7.51 Dwellings exposed to absolute ground noise and change in ground noise, 10 mppa 2026 to 12 mppa 2026, night-time

Subjective description of impact	Contour band dB $L_{Aeq,8h}$	Number of dwellings in band, 10 mppa (2026)	Beneficial[1] or adverse change	Change in Noise Level, dB Potential Impact Classification				
				Negligible	Minor	Significant Moderate	Significant Substantial	Significant Very Substantial
				0 – 2 dB	2 – 3 dB	3 – 6 dB	6 – 9 dB	>9 dB
Negligible	**45 (LOAEL)**	80	Beneficial	40	9	30	4	0
		30	Adverse	30	0	0	0	0
Minor	**50**	0	Beneficial	0	0	0	0	0
		2	Adverse	2	0	0	0	0
Significant Moderate	**55 (SOAEL)**	0	Beneficial	0	0	0	0	0
		2	Adverse	2	0	0	0	0
Significant Substantial	**60**	0	Beneficial	0	0	0	0	0
		1	Adverse	1	0	0	0	0
Significant Very Substantial	**65 (UAEL)**	0	Beneficial	0	0	0	0	0
		0	Adverse	0	0	0	0	0
Total		80	Beneficial	40	9	30	4	0
		30	Adverse	30	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

Table 7.52 Ground noise effect on number of dwellings and non-residential receptors – 10 mppa 2026 to 12 mppa 2026

Receptor Type	12 mppa outdoor noise level, dB	Beneficial[1] or adverse change	Magnitude of effect				
			Very low	Low	Medium	High	Very High
			Change in noise level, dB(A)				
Residential Day (07:00-23:00)	50 ≤ $L_{Aeq,16h}$ < 60	Beneficial	20	5	30	4	0
		Adverse	10	0	0	0	0
	$L_{Aeq,16h}$ ≥ 60	Beneficial	0	0	0	0	0

Receptor Type	12 mppa outdoor noise level, dB	Beneficial[1] or adverse change	Magnitude of effect				
			Very low	Low	Medium	High	Very High
			Change in noise level, dB(A)				
		Adverse	0	1	0	0	0
Residential Night (23:00-07:00)	$45 \leq L_{Aeq,8h} < 55$	Beneficial	40	9	30	4	0
		Adverse	30	0	0	0	0
	$L_{Aeq,8h} \geq 55$	Beneficial	0	0	0	0	0
		Adverse	3	0	0	0	0
Schools	$L_{Aeq,30min} \geq 55$	Beneficial	1	0	0	0	0
		Adverse	0	0	0	0	0
Places of worship	$50 \leq L_{Aeq,16h} < 60$	Beneficial	0	0	0	0	0
		Adverse	0	0	0	0	0
	$L_{Aeq,16h} \geq 60$	Beneficial	0	0	0	0	0
		Adverse	0	0	0	0	0
Amenity Areas	$L_{Aeq,T} \geq 55$	Beneficial	0	0	0	0	0
		Adverse	0	0	0	0	0

1. "Beneficial" rows include a small number of dwellings with zero change.

7.11.34 Under the 12 mppa scenario, aircraft movements will increase by 17% in the daytime compared to the 10 mppa scenario. The aircraft mix is forecast to remain broadly similar, with a small shift from small to medium sized jets. Therefore, with no change in infrastructure, the noise levels would be expected to increase by a negligible amount, around 1 dB, at most locations. However, the Proposed Development includes some buildings which will provide additional screening to certain receptors, in particular those in the Lulsgate Bottom area, which leads to decreased ground noise levels.

7.11.35 The number of dwellings exposed to the LOAEL in the daytime decreases slightly from 80 under the 10 mppa scenario to 70 under the 12 mppa scenario. 25 of these dwellings experience a negligible or minor reduction in absolute noise level and 10 experience a negligible increase in noise level, which constitutes a low or very low effect of no significance. 30 dwellings experience a moderate

decrease in noise level, and 4 dwellings experience a substantial decrease in noise level. These constitute medium and high beneficial effects respectively for these dwellings. One dwelling is exposed to the SOAEL under both scenarios, which is Core Hill, on Cooks Bridle Path. This dwelling experiences a negligible increase in noise level.

7.11.36 At night the situation is broadly similar, with aircraft movements increasing by around 15% compared to the 10 mppa scenario and similar small changes in fleet mix. Therefore, negligible increases would be normally expected other than where the additional screening provided by the Proposed Development has a beneficial effect.

7.11.37 The other factor at night is the variation in the restriction of night-time APU usage on stands 38 and 39. This results in slight increases for the dwellings closest to these stands, although the increases are still less than 2 dB and therefore of negligible magnitude.

7.11.38 This results in around 100 dwellings exposed to the LOAEL or above at night under both future scenarios. Of these, around 50 experience a negligible or minor reduction in absolute noise level and 10 experience a negligible increase in noise level, which constitutes a low or very low effect of no significance. 30 dwellings experience a moderate decrease in noise level, and 4 dwellings experience a substantial decrease in noise level. These constitute medium and high beneficial effects respectively for these dwellings. Two dwellings are exposed to the SOAEL under the 10 mppa scenario, which increases to three under the 12 mppa scenario. This additional dwelling is located on Cooks Bridle Path, to the north-west of the western stands at Bristol Airport. These dwellings experience a negligible increase in noise level of 1 to 2 dB and therefore a low effect.

7.11.39 In summary, only one dwelling is exposed to significant levels of ground noise under the 10 mppa scenario in the daytime period, which is expected to remain the case under the 12 mppa scenario. Two dwellings are exposed to significant levels of ground noise in the night-time period, which is expected to increase to three under the 12 mppa scenario. These dwellings experience a negligible increase in noise level of 1 to 2 dB, constituting a low effect of moving from the 10 mppa to the 12 mppa scenario which is rated as not significant. In practice, these three dwellings are all eligible under Bristol Airport's current sound insulation scheme (which is based on the air noise effect).

7.11.40 30 dwellings experience a medium decrease in noise level as a result of moving from the 10 mppa to the 12 mppa scenario which is rated as probably significant (beneficial). 4 dwellings experience a high decrease in noise level as a result of moving from the 10 mppa to the 12 mppa scenario which is rated as significant (beneficial).

7.11.41 A summary of these noise effects is set out in **Table 7.53**.

Table 7.53 Summary of ground noise effects, 10 mppa 2026 to 12 mppa 2026

Receptor type	$L_{Aeq,T}$ noise criterion	No change/Beneficial or Adverse[1]	Receptor Nos. in $L_{Aeq,T}$[2]	Change in noise exposure	Significance of Effect
Residential - Day					**Moderate beneficial, probably significant**
LOAEL	50 dB $L_{Aeq,16h}$	No change/Beneficial	20	Negligible	
			5	Minor	
			30	Moderate	
			4	Substantial	

Receptor type	$L_{Aeq,T}$ noise criterion	No change/Beneficial or Adverse[1]	Receptor Nos. in $L_{Aeq,T}$[2]	Change in noise exposure	Significance of Effect
		Adverse	10	Negligible	
			3	Minor	
SOAEL	60 dB $L_{Aeq,16h}$	No change/Beneficial.	0	N/A	
		Adverse	1	Negligible	
Residential - Night					**Moderate beneficial, probably significant**
LOAEL	45 dB $L_{Aeq,8h}$	No change/Beneficial.	40	Negligible	
			9	Minor	
			30	Moderate	
			4	Substantial	
		Adverse	30	Negligible	
			2	Minor	
SOAEL	55 dB $L_{Aeq,8h}$	No change/Beneficial.	0	N/A	
		Adverse	3	Negligible	
Schools	55 dB $L_{Aeq,30m}$	No change/Beneficial	1	Negligible	**Negligible beneficial, probably significant**
Places of Worship	As residential, day		0	N/A	None
Amenity Areas	55 dB $L_{Aeq,T}$		0	N/A	None

1. States whether noise change is zero or a reduction (No change/beneficial) or an increase (adverse) moving from scenario A to scenario B.

2. The receptor numbers for LOAEL are those exposed to a noise level equal to or greater than LOAEL (assessed in terms of $L_{Aeq,16h}$ daytime, $L_{Aeq,8h}$ night-time) but less than SOAEL, following a move from scenario A to scenario B. Those for SOAEL, relate to receptors exposed to a noise level equal to or greater than SOAEL. For non-residential receptors, it shows the change in the number of those exposed to the specified criterion level.

7.12 Assessment of effects – road traffic noise

7.12.1 **Section 7F.5** of **Appendix 7F** provides the detailed results of the road traffic noise assessment. Noise has been assessed due to road traffic using roads in the vicinity of Bristol Airport, specifically the A38, Downside Road, West Lane, and North Side Road. Road traffic noise contours are presented, along with receptor counts within each contour band. Key results are presented in this section.

7.12.2 For all tables in this section, receptor counts are rounded to the nearest 50 above 100 and to the nearest 10 below 100. Below 10, the actual number is given. Where percentage changes are given, these are based on unrounded values.

7.12.3 **Table 7.54** shows the number of receptors exposed to the LOAEL, SOAEL and UAEL values.

Table 7.54 Number of receptors, $L_{A10,18h}$

Contour $L_{A10,18h}$ dB(A)	Number of Receptors		
	Baseline 2017	10 mppa 2026	12 mppa 2026
55	100	100	100
68	20	30	30
75	2	4	4

7.12.4 **Table 7.54** shows that currently, around 100 of the assessed receptors are adversely affected by road traffic noise in the vicinity of Bristol Airport. This total is expected to remain much the same going forward to 2026 under both scenarios.

7.12.5 Currently, around 20 of the assessed residential receptors are predicted to experience road traffic noise above the SOAEL of 68 dB $L_{A10,18h}$. This is predicted to increase to around 30 in 2026 under both scenarios.

7.12.6 Two of the assessed receptors are currently exposed to road traffic levels above the UAEL. In 2026, four receptors are exposed to this level under both scenarios. These are all located very close to the A38 and are comprised of the Forge Motel and surrounding buildings. The Forge Motel and Hathaway House have unlikely benefitted from previous noise insulation since these are commercial businesses. Other residential properties in the vicinity that have benefitted from the 2000-2001 noise insulation scheme are as follows:

- 1 School Lane, Felton;
- 2 School Lane, Felton;
- 1 Church View, School Lane, Felton;
- 2 Church View, School Lane, Felton;
- Clyde House, School Lane, Felton;
- The Cottage, School Lane, Felton; and
- End House, School Lane, Felton.

Predicted road traffic noise effects and their significance

7.12.7 This section sets out the road traffic noise effects arising from operations at Bristol Airport by comparing the following key scenarios:

- Baseline year (2017) vs future (10 mppa in 2026); and
- Future (10 mppa in 2026) vs future (12 mppa in 2026) With Proposed Development.

Baseline year (2017) vs Future (10 mppa in 2026)

7.12.8 Road traffic on roads in the vicinity of Bristol Airport is forecast to increase by around 30% from the baseline (2017) scenario to the 10 mppa 2026 scenario. This results in a negligible increase in noise exposure for the dwellings affected by road traffic noise of 1 to 2 dB for all assessed dwellings, constituting a very low effect. The number of receptors exposed to the LOAEL is around 100 in 2017

and remains similar under the 10 mppa 2026 scenario. The corresponding number of receptors exposed to the SOAEL increases from around 20 to around 30.

Future (10 mppa in 2026) to Future (12 mppa in 2026) With Development

7.12.9 This section summarises the noise effects expected (compared to those currently permitted) as a result of growth from 10 mppa to 12 mppa and the resulting effects on the local community. It describes and compares the effects of the two key scenarios assessed in this ES.

7.12.10 Road traffic on the roads in the vicinity of Bristol Airport is forecast to increase by around 15% from the baseline (2017) scenario to the 10 mppa 2026 scenario. This results in a negligible increase in noise exposure for the dwellings affected by road traffic noise of less than 1 dB for all assessed dwellings, constituting a very low effect. There are also negligible beneficial changes for a small number of dwellings as a result of infrastructure changes related to the Proposed Development. The number of receptors exposed to the LOAEL, SOAEL, and UAEL are around 100, 30, and 4 respectively under both scenarios.

7.12.11 A summary of these noise effects is set out in **Table 7.55.**

Table 7.55 Summary of road traffic noise effects, 10 mppa 2026 to 12 mppa 2026

Receptor type	$L_{Aeq,T}$ noise criterion	No change/Beneficial or Adverse[1]	Receptor Nos. in $L_{Aeq,T}$[2]	Change in noise exposure	Significance of Effect
Residential - Day					**Negligible adverse, not significant**
LOAEL	55 dB $L_{A10,18h}$	No change/Benef.	4	Negligible	
		Adverse	80	Negligible	
SOAEL	68 dB $L_{A10,18h}$	No change/Benef.	0	N/A	
		Adverse	30	Negligible	
UAEL	75 dB $L_{A10,18h}$	No change/Benef.	0	N/A	
		Adverse	4	Negligible	

1. States whether noise change is zero or a reduction (No change/beneficial) or an increase (adverse) moving from scenario A to scenario B.

2. The receptor numbers for LOAEL are those exposed to a noise level equal to or greater than LOAEL (assessed in terms of $L_{A10,18h}$) but less than SOAEL, following a move from scenario A to scenario B. Those for SOAEL, relate to receptors exposed to a noise level equal to or greater than SOAEL.

7.13 Assessment of Effects – construction noise and vibration

7.13.1 A detailed assessment of construction noise and vibration is presented in **Appendix 7G**. A summary of the key findings is presented here to describe the effects and significance of noise and vibration arising from the Proposed Development.

7.13.2 Construction will take place at different times over a period of up to seven years. Some works will occur in isolation while others will occur in phases, some of which might overlap in time. This raises the possibility of a noise sensitive receptor being affected simultaneously by different types of operations at a given site. In addition, works at multiple sites might take place at the same time. To

assess this risk, consideration has been given to the current programme of works (refer to **Chapter 2: Description of the Proposed Development**). Construction noise levels likely to arise at a series of representative noise sensitive receptors have been determined based on a single phase of works, for overlapping phases of works (where relevant) as well as in conjunction with any works packages programmed to occur at a similar time.

7.13.1 Predictions of construction noise values have been made using the methods described in BS 5228-1. Assumptions used for these calculations are described in **Appendix 7G**.

7.13.2 Noise has been predicted at representative noise sensitive receptors for each construction site of the Proposed Development and for each phase of construction activity. Where phases of construction activity at a site are expected to be concurrent, a worst-case value has been predicted alongside noise estimates for each phase. Worst-case values have also been predicted where work is provisionally scheduled to occur concurrently at different construction sites.

7.13.3 Construction sites where piling and vibratory compaction will take place have been identified. The vibration impact on the identified noise sensitive receptors has been considered with reference to guidance given in BS5228-2.

7.13.4 The Proposed Development includes a number of buildings, structures and surface works, which are summarised in

7.13.5 **Table** 7.56. Most construction works will take place during the daytime during the hours of 07:30 to 18:00 Monday to Friday and Saturday 08:00 to 13:00. There is no planned working on Sundays or Bank Holidays. Some work will need to be undertaken at night, specifically for the east taxiway link and taxiway widening fillets. These works are scheduled to occur between 23:00 and 06:00 over a 6-month period. This is the only night-time construction work scheduled.

Table 7.56 Construction sites of the Proposed Development

Development	Access route	Provisional dates	Notes
New arrivals area	North Side Road	11/2019 – 04/2020	
South terminal extension	North Side Road	11/2019 – 03/2021	
West terminal extension (Phase 2A)	North Side Road	09/2020 – 06/2021	
West terminal extension (Phase 2B)	North Side Road	11/2024 – 03/2026	
New service yard	North Side Road	11/2025 – 03/2026	
Walkway and east pier	North Side Road	09/2025 – 06/2026	
New canopy to front of existing terminal	North Side Road	09/2022 – 05/2023	
Multi-storey car park	North Side Road	09/2024 – 07/2025	
Gyratory road with internal surface car parking	North Side Road	10/2020 – 06/2021	
East taxiway link	North Side Road	01/2024 – 06/2024	Night-time
Silver Zone Car Park Extension (Phase 2	Silver Zone Car Park	04/2019 – 07/2019	
Highway improvements (A38)	A38	10/2025 – 04/2026	
Taxiway widening and fillets	North Side Road	01/2024 – 06/2024	Night-time
Silver Zone Car Park Extension (Phase 1)	Silver Zone Car Park	10/2019 – 11/2019	

7.13.6 Construction noise and vibration impacts likely to arise as a result of the Proposed Development have been assessed having regard to representative sensitive receptors in the vicinity of the proposed works. These 11 receptors, A to K, can be seen in **Figure 7.2** and are described in **Appendix 7G**.

7.13.7 Baseline noise levels for receptors A to D, used in determining the noise assessment criteria, have been taken from the baseline measurements carried out at these locations, as described in **Appendix 7C**. Typical daytime ambient noise levels around Bristol Airport lie between 50 dB $L_{Aeq,12h}$ and 60 dB $L_{Aeq,12h}$ during the daytime (refer to **Appendix 7C**) and 45 dB $L_{Aeq,8h}$ and 55 dB $L_{Aeq,8h}$ during the night-time.

7.13.8 On this basis, based on the ABC method in BS 5288-1, the threshold for a potentially significant effect from construction noise adopted in this assessment is 65 dB $L_{Aeq,12h}$ for the daytime (07:00-19:00) and 55 dB $L_{Aeq,8h}$ for the night-time (23:00-07:00).

7.13.9 The threshold adopted for a potentially significant effect from construction vibration in this assessment is 1.0 mms^{-1} PPV during the daytime (07:00-23:00) and 0.3 mms^{-1} during the night-time (23:00-07:00).

7.13.10 The construction noise levels associated with the Proposed Development have been assessed at each of the eleven representative receptors for each construction site, for each phase of work. These are tabulated in in **Appendix 7G.**

Predicted construction noise and vibration effects and their significance

7.13.11 **Section 7G.6** of **Appendix 7G** provides the detailed results of the construction noise assessment. Construction noise and vibration predictions are presented, along with receptor counts within each relevant noise band. Key results are presented in this section. This section sets out the noise and vibration effects arising due to construction related to the Proposed Development.

Daytime noise

7.13.12 On an individual site and phase basis, no significant effects from daytime construction noise are expected, with one exception.

7.13.13 Noise sensitive receptors adjacent to the A38 are predicted to be exposed to construction noise levels above the adopted daytime SOAEL and threshold for a potentially significant effect from the A38 highway improvements due to their close proximity to the construction site. The predictions indicate that this threshold is likely to be exceeded for all phases of work associated with the A38 highway improvements throughout the six-month duration of these works, with daytime noise levels lying in the range 68 to 72 dB $L_{Aeq,12h}$. As a result, a significant effect is predicted in the absence of any mitigation.

7.13.14 Certain phases of daytime construction activity are scheduled to occur concurrently at the various components of the Proposed Development. For these cases, a worst-case value has been predicted for each site, assuming all construction activities for concurrent phases are to be carried out simultaneously. These are presented **in Appendix 7G**.

7.13.15 On this worst-case basis, residential receptors at the east end of Downside Road are predicted to experience construction noise levels at the daytime threshold level of 65 dB from the construction works on the gyratory road. A potentially significant effect is therefore predicted from concurrent activity on the gyratory road in the absence of any mitigation.

7.13.16 For the case of the A38 highway improvements, residential receptors in the vicinity of the A38 are already expected to be exposed to construction noise levels greater than 65 dB from individual phases of works. These receptors are predicted to experience construction noise levels of up to 75 dB from concurrent activity on the A38 roadworks site.

7.13.17 Consideration has also been given to the cumulative effects of daytime noise from multiple construction sites where the schedule of works is expected to overlap. Worst-case values have been predicted for these periods, where all construction activities for concurrent phases have been assumed to be carried out simultaneously in a given month. These are presented in in **Appendix 7G**. As resulting levels lie below 65 dB $L_{Aeq,12h}$, no significant effects are predicted due to cumulative noise from multiple construction sites, aside from at those receptors already identified to be close to the A38 roadworks and those close to the new gyratory roadworks.

7.13.18 Where significant effects have been identified, mitigation measures are required to be deployed and these are discussed in **Section 7.16**.

Night-time noise

7.13.19 On an individual site and phase basis, no significant effects from night-time construction noise are expected.

7.13.20 Due to the sequential phasing of activity of the runway construction works, no concurrent activity at individual sites is expected during the night. However, work on the east taxiway link and taxiway widening and fillets sites is provisionally scheduled to be concurrent. In this scenario, if the noisiest phase of activity (earthworks) is assumed to take place at both sites simultaneously in a given hour

then construction levels will remain below the threshold above which any potential significant effects could arise. This is shown in in **Appendix 7G**.

Vibration

7.13.21 Vibration from piling would be expected to attenuate below the criteria for a potential significant effect over the distances (≥170m) to the nearest receptors and therefore **no significant effects** are predicted from piling vibration.

7.13.22 In practice, piling is planned to involve use of a rotary bored piling rig along with the insertion of steel casings using a vibratory technique. These methods produce less vibration than that arising from driven piles which have been assessed above.

7.13.23 In **Appendix 7G** at a distance of 20m, the closest distance between site and receptor for this activity (receptor I during the A38 works), a vibration level of 0.4mms^{-1} PPV would be expected with 50% probability of this value being exceeded. This is equivalent to a vibration level of 0.8mms^{-1} PPV with 33% chance of exceedance or 1.6mms^{-1} PPV with 5% chance of exceedance.

7.13.24 Based on the results for vibratory compaction during the daytime, vibration is most likely to remain below the limit for a possible significant effect to be indicated (1mms^{-1} PPV), although there is a slim chance of levels rising to a potential moderate significant effect but remaining below a potential substantial significant effect. Considering the low probability and context that only a few residential receptors could be affected for a short duration and assuming that Best Practicable Means, including forewarning the few receptors that could be affected, are followed it is not expected that a significant effect would occur due to vibratory compaction during the A38 works.

7.13.25 Vibratory compaction during the night-time, during the east taxiway works and taxiway widening and fillets works, will take place at large distances from the nearest noise sensitive residential receptors. As a result, vibration levels at these receptors are predicted to lie well below the threshold at which any potential significant effects might be expected.

7.14 Assessment of Effects – All noise and vibration sources

Predicted effects and their significance

7.14.1 The assessment of the effects of noise considers each type of source in isolation, such as aircraft air and ground noise, road traffic and construction noise, rather than in combination. The reason for this is that the primary research undertaken into community response and noise considers each noise source separately, not in combination. A summary of the results of the assessment of the noise and vibration from various sources is provided in **Table 7.57**. These are taken from the assessment results in **Section 7.10**, **Section 7.11**, **Section 7.12** and **Section 7.13** and relate to the change from Without to With Proposed Development in 2026. In the case of air noise, the table describes noise effects likely to occur accounting for how conditions might change under 10 mppa between 2021 and 2026.

Table 7.57 Summary of significance of adverse effects

Source	Receptor type and assessment period	Magnitude of change[2]	Significance[3]	Summary rationale
Air Noise	Residential – Day	Negligible	Not significant	A small number of dwellings are exposed to a significant air noise level. Changes due to the development are negligible and therefore not significant.
	Residential – Night	Negligible	Not significant	Although some dwellings are exposed to a significant air noise level, changes due to the development are negligible and therefore not significant.
	Schools	Negligible	Not significant	One school is exposed to a significant air noise level. Changes due to the development are negligible and therefore not significant.
	Places of Worship	Negligible	Not significant	A small number of places of worship are exposed to a significant air noise level. Changes due to the development are negligible and therefore not significant.
	Amenity Areas	Negligible	Not significant	A small number of amenity areas are exposed to a significant air noise level. Changes due to the development are negligible and therefore not significant.
Airborne Aircraft Vibration	Residential	Negligible	Not significant	A very small number of dwellings are exposed to a significant vibration level. This is expected to remain similar or reduce due to the development.
Ground Noise	Residential – Day	Negligible + moderate (beneficial)	Not significant	A very small number of dwellings are exposed to a significant ground noise level. Some dwellings experience moderate reductions in noise due to screening by the new development. Overall, changes due to the development are negligible and therefore not significant.
	Residential – Night	Negligible + moderate (beneficial)	Not significant	A very small number of dwellings are exposed to a significant ground noise level. Some dwellings experience moderate reductions in noise due to screening by the new development. Overall, changes due to the development are negligible and therefore not significant.
	Schools	Negligible	Not significant	No schools are exposed to a significant ground noise level.

Source	Receptor type and assessment period	Magnitude of change[2]	Significance[3]	Summary rationale
	Amenity Areas	N/A	Not significant	No amenity areas are exposed to a significant ground noise level.
Road Traffic Noise	Residential	Negligible	Not significant	A small number of dwellings are exposed to a significant road traffic noise level. Changes due to the development are negligible and therefore not significant.
Construction Noise	Residential	N/A	Not significant	A small number of dwellings are exposed to a significant construction noise level.
Construction Vibration	Residential	N/A	Not significant	No dwellings are exposed to significant construction vibration levels.

1. The sensitivity of receptor is defined using the criteria set out in **Section 7.9** above and is defined as low, medium, high and very high.
2. The magnitude of change on a receptor resulting from activities relating to the development is defined using the criteria set out in **Section 7.9** and is defined as negligible, minor, moderate, substantial and very substantial. The change is shown as adverse unless otherwise stated.
3. The significance of the environmental effects is based on the combination of the sensitivity of a receptor and the magnitude of change and is expressed as major (significant), moderate (probably significant) or minor/negligible (not significant), subject to the evaluation methodology outlined in **Section 7.9**.

7.14.2 From **Table 7.57** it can be seen that there are no receptors subject to significant noise and vibration effects due to any noise or vibration source between the Without Development (10 mppa 2021) and With Development (12 mppa 2026) scenarios, with the exception of construction noise, which is predicted to expose a small number of dwellings to significant levels of noise.

7.15 Consideration of optional additional mitigation or compensation

7.15.1 This assessment has shown that there are no receptors subject to significant operational noise and vibration effects due to the change between the Without Development (10 mppa) and With Development (12 mppa) scenarios. Therefore, no further mitigation is required to reduce the noise and vibration effects that are identified in this ES. However, some receptors are exposed to significant levels of noise and therefore BAL already have in place a number of mitigation measures, one of which is the noise insulation grant scheme. BAL are proposing to enhance this scheme as part of the Proposed Development.

7.15.2 The assessment has found that, with no mitigation, some receptors are likely to be exposed to significant levels of noise during the construction of the Proposed Development. Therefore, a number of measures are set out in the Outline Construction Environmental Management Plan (CEMP), which forms **Appendix 2B**. These measures, described in paragraphs 7.15.14 and 7.15.15, alongside relevant and implementable embedded measures, are considered to be likely to be effective and deliverable and address the potential significant effects of the construction of the Proposed Development.

Enhanced noise insulation grant scheme

7.15.3 As part of the Proposed Development, Bristol Airport are proposing to offer an enhanced noise insulation grant scheme.

7.15.4 In this proposed scheme, the thresholds for insulation will remain as current (refer to paragraph 7.8.25), i.e. daytime 57 dB $L_{Aeq,16h}$ for the 50% grant and 63 dB $L_{Aeq,16h}$ for the 100% grant. It is noted that in all scenarios the night-time 55 dB $L_{Aeq,8h}$ contour is completely enclosed within the daytime 57 dB $L_{Aeq,16h}$ contour. Therefore, people exposed to significant levels of night-time noise will also benefit from the scheme.

7.15.5 The minimum specification of the ventilators that can be installed as part of the scheme will also be improved. These provide a benefit as with sufficient ventilation, residents are not required to open windows and therefore can experience the full acoustic benefit of the glazing.

7.15.6 The grant amount available will increase by 50%, i.e. up to £7,500 for those properties within the 63 dB $L_{Aeq,16h}$ contour and up to £3,750 for those properties within the 60dB & 57 dB $L_{Aeq,16h}$ contour.

7.15.7 For a limited time, all properties within the 57 dB $L_{Aeq,16h}$ contour for the 12 mppa 2026 scenario will be eligible to use the grant amount towards 100% of the cost of works, rather than 50%. This is intended to incentivise uptake in the short-term in order to encourage implementation of mitigation measures prior to BAL reaching 12 mppa by 2026.

7.15.8 BAL will also contact all properties within the forecast eligibility contour to make them aware of the scheme and the offer being provided. Furthermore, BAL will advertise the scheme in the constituencies where the eligibility contour reaches twice a year in order to encourage uptake.

Construction noise and vibration mitigation

7.15.9 The assessment of construction noise effects has shown that daytime construction works in the north-east area of Bristol Airport, specifically the roadworks required for the new gyratory road with internal surface parking may have a significant effect on residential properties located at the east end of Downside Road.

7.15.10 *BS5228-1* suggests that site hoardings may provide a noise reduction from 5 dB, when plant is just visible over the noise barrier, to 10 dB, when the plant is not visible over the noise barrier. On the assumption that a conventional solid timber site hoarding is installed along the northern edge of the gyratory road site, near Downside Road, with a minimum height of 2.4m, then noise at the most affected receptors is predicted to be mitigated to below the threshold for a potentially significant effect to be indicated. This is shown in **Appendix 7G** and will be secured as part of the CEMP (**Appendix 2B**).

7.15.11 Further roadworks constituting the A38 highway improvements also pose a risk to the amenity of residential properties situated close to the road, with noise levels predicted to reach up to 75 dB in the worst-case, where there is concentrated activity on site.

7.15.12 Using the same assumptions for screening as for the gyratory road, temporary barriers surrounding stationary plant such as hand-held road breakers would be predicted to mitigate noise at affected receptors. Further mitigation would be required for those residences directly adjacent to the road due to their close proximity to the works. Additional temporary solid road-side site hoardings to screen these receptors would be predicted to mitigate noise levels below the threshold for a potentially significant effect for these receptors as well. This is shown in **Appendix 7G** and will be secured as part of the CEMP (**Appendix 2B**).

7.15.13 No significant effects are expected to arise from construction vibration and therefore no vibration mitigation will be required.

Recommendations relating to the Outline Construction Environmental Management Plan

7.15.14 Measures to be considered in implementing Best Practicable Means, adopted as part of the CEMP (**Appendix 2B**) will be consistent with the recommendations in BS 5228-1[33], including:

- Project supervision – the Proposed Development will include the designation of a Project Environmental Manager to supervise the implementation of the works;
- Community Relations – keeping local people informed of progress and treating complaints fairly and expediently;
- Site Personnel Training – informing site personnel about the need to minimise noise and advising on the proper use and maintenance of tools and equipment and the positioning of machinery to reduce noise emission to the neighbourhood;
- Site Location – setting noise emission limits with due regard to the proximity of noise sensitive premises;
- Noise Monitoring – to ensure compliance with noise emission limits applicable to relevant items of plant or around the boundary of a site;
- Programme - Details of operations with an indication of the expected duration of each phase and key dates. Local residents may be willing to accept higher levels of noise if they know that the activity causing the noise will only last for a short time; and
- Type of Plant – consideration will be given to using quiet techniques taking account of practical site constraints and best practicable means. Where reasonably practicable, quiet working

methods will be employed, including use of the most suitable plant, reasonable hours of working for noisy operations, and economy and speed of operations.

7.15.15 Many of the work sites relating to the Proposed Development are located at a reasonable distance from the nearest residential receptor and the effects of construction noise and vibration will therefore be negligible. For some sites however, such as for the highway improvements to the A38, some works will take place in close proximity to dwellings. In such cases, it will be particularly important to establish a procedure by which consultation between the contractor and local residents can take place regularly, to keep them informed of progress and steps being taken to protect them from any significant effects of noise and vibration.

7.16 Conclusions of significance evaluation

Air noise and vibration

7.16.1 The Proposed Development will allow a greater number of passenger movements at Bristol Airport compared to the Without Development scenario (approximately 2 mppa beyond current permission).

7.16.2 The number of dwellings exposed to significant levels of aircraft air noise during the daytime period will generally stay the same as now and as for the Without Development scenarios (either 2021 or 2026). This is primarily due to the change in aircraft utilising Bristol Airport, with more modern, quieter types being introduced in the future.

7.16.3 The number of dwellings exposed to significant levels of air noise during the night will increase compared to the 2017 baseline and will be slightly more for the Proposed Development compared to the Without Development scenarios. This is due to an increase in the numbers of aircraft operating at Bristol Airport during the night in the future, and in the Proposed Development compared to the Without Development scenarios.

7.16.4 The change in air noise levels between the Without Development scenarios and the Proposed Development scenario is **negligible** (0 to 2 dB) for all dwellings in both the day and night periods.

7.16.5 Bristol Airport will continue to implement the various current air noise mitigation measures and will provide an enhanced noise insulation grant scheme, which includes all those dwellings exposed to significant levels of air noise as per the 12 mppa with development scenario.

7.16.6 More people will become affected by aircraft noise at night as Bristol Airport continues to grow within its permitted limits, irrespective of whether the Proposed Development goes ahead or not. The Proposed Development will give rise to a **negligible adverse** effect compared to if the Proposed Development does not go ahead and so will have **no significant effect** on the surrounding noise climate.

7.16.7 The number of people exposed to significant levels of vibration due to airborne aircraft in 2017 is very small. This is expected to remain similar or reduce in the future due to the introduction of more modern, quieter aircraft types. No significant effects are expected due to the Proposed Development.

Ground noise

7.16.8 The principle difference between future ground noise levels under the Proposed Development, as compared to those without the Proposed Development, is the change in the distribution of ground noise around the area and therefore the change in the population that will be exposed to ground noise, resulting in increased ground noise levels for some and decreases for others.

7.16.9 There is a small increase in the number of dwellings exposed to the ground noise during the day and night in the future compared to now for both the Proposed Development and Without Development scenarios. In the future, there is an increase of one in the number of dwellings exposed to the ground noise SOAEL if the Proposed Development occurs compared to if it doesn't, and a slight decrease in the number of dwellings exposed to the LOAEL in the daytime for the Proposed Development compared to the Without Development scenarios. In the future with the Proposed Development, some receptors will benefit from the additional screening provided by infrastructure leading to some significant reductions in ground noise. For all other receptors, any changes in ground noise arising from the Proposed Development as compared to Without Development in the future will experience a **negligible** change in noise level of **no significance**.

7.16.10 More people will become affected by ground noise at night as Bristol Airport continues to grow within its permitted limits, irrespective of whether the Proposed Development goes ahead or not. The Proposed Development will give rise to a **negligible adverse effect** compared to if the Proposed Development does not go ahead and so will have **no significant effect** on the surrounding noise climate.

Road traffic noise

7.16.11 The Proposed Development will change the road traffic noise levels around Bristol Airport. There is a small increase in the number of dwellings exposed to road traffic noise in the future compared to 2017 for both the Proposed Development and Without Development scenarios. There is no change in the number of dwellings exposed to road traffic noise if the Proposed Development occurs or not. The Proposed Development will give rise to a **negligible adverse effect** compared to if the Proposed Development does not go ahead, which is **not significant**.

Construction noise and vibration

7.16.12 The construction noise and vibration assessment has been carried out using predictions to a number of representative noise and vibration sensitive receptors. Accounting for the use of best practicable means and some specific mitigation measures, the construction of the Proposed Development will give rise to a **negligible adverse effect** which is **not significant**.

7.16.13 It has been recommended that the Principal Contractor develop and implement a site-specific Construction Noise and Vibration Management and Mitigation Strategy (refer to **Appendix 2B**) covering demolition and new construction. This will ensure that best practicable means are used to mitigate construction noise effects.

7.17 Implementation of environmental measures

7.17.1 **Table 7.58** describes the environmental measures accompanying the Proposed Development and the means by which they will be implemented. Full details of these are given in **Section 7.8**.

Table 7.58 Summary of environmental measures to be implemented – relating to noise and vibration

Environmental measure	Responsibility for implementation	Compliance mechanism	ES section reference
Fixed 57dB $L_{Aeq,\ 16hr}$ summer Air Noise Contour at 12.42 sq km	Bristol Airport	Planning condition[40]	**n/a**
Noise Control Scheme providing noise violation limits and penalties	Bristol Airport	Section 106 Agreement	**n/a**

Environmental measure	Responsibility for implementation	Compliance mechanism	ES section reference
for Air Noise, specification and adoption of noise and track keeping system and associated community engagement			
Fixed Shoulder Period movement limits	Bristol Airport	Planning condition[40]	**n/a**
Air noise – night noise quota count used to restrict night flying	Bristol Airport	Planning condition[40]	**Section 7.8.**
Air noise – enhanced noise insulation grants	Bristol Airport	Section 106 Agreement	**Section 7.8.**
Ground noise – limits on APU use	Bristol Airport	Planning condition[40]	**Section 7.8.**
Air and ground noise – noise abatement procedures	Bristol Airport	Aeronautical Information Package (AIP) for Bristol Airport[44.]	**Section 7.8.**