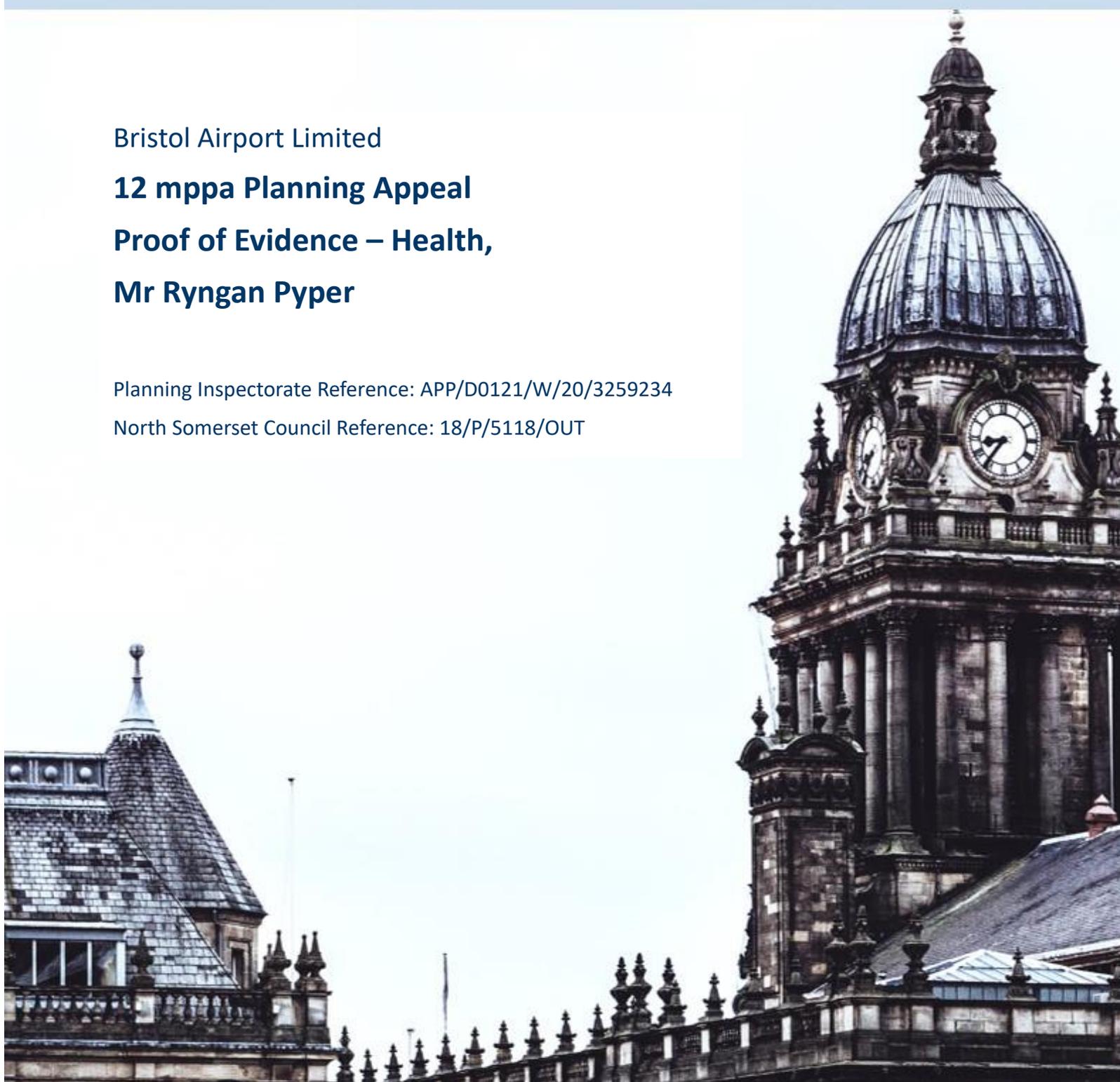




Bristol Airport Limited  
**12 mppa Planning Appeal**  
**Proof of Evidence – Health,**  
**Mr Ryngan Pyper**

Planning Inspectorate Reference: APP/D0121/W/20/3259234  
North Somerset Council Reference: 18/P/5118/OUT



June 2021

Prepared by BCA Insight Ltd

Ryngan Pyper, Ben Cave

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# 1 Introduction

## 1.1 Qualifications and Experience

- 1.1.1 My name is Ryngan Pyper. I am a Director at BCA Insight Ltd and a specialist in delivering health related impact assessments. I work across the fields of public health, environmental science and impact assessment.
- 1.1.2 BCA Insight Ltd is a specialist consultancy working in the UK and Europe. The main focus of our work is integrating health into policy. To this end we work with many professions and we conduct Health Impact Assessments (HIA) for the private and the public sector. We provide health input into Environmental Impact Assessments (EIA) for major infrastructure schemes and for mixed use developments. We advise Government and professional bodies on good practice.
- 1.1.3 Reflecting the interdisciplinary nature of my field, I hold a Master of Arts (2004) and Upper Second Class Honours Bachelor of Arts (2002) from the University of Oxford in Biological Sciences. I have a Graduate Diploma in Law (2005) and a Postgraduate Diploma in Legal Practice, with Distinction, (2007) from the University of Oxford. I also hold a Postgraduate Diploma in Public Health, with Distinction, (2020) from the University of York. As part of the latter I specialised in epidemiology, health statistics, public health ethics, infection & disease, health & social behaviour, and qualitative methods.
- 1.1.4 I have worked as a professional consultant since 2005. In addition to being the author of impact assessments, including aviation EIA health chapters, I also advise local authorities for major developments and spatial plans.
- 1.1.5 I have co-authored guidance on health in impact assessment with organisations such as the Faculty of Public Health, Public Health England and the World Health Organization:
- International Association of Impact Assessment (IAIA) and European Public Health Association (EUPHA), Human health: Ensuring a high level of protection. A reference paper on addressing Human Health in EIA. 2020
  - United Nations Economic Commission for Europe, European Investment Bank and World Health Organization, Draft guidance on assessing health impacts in Strategic Environmental Assessment (SEA). 2020
  - Public Health England, Health and EIA: a briefing for public health teams in England. 2017
  - Institute for Environmental Management and Assessment (IEMA), BCA and Faculty of Public Health, Health in EIA: a primer for a proportionate approach. 2017
- 1.1.6 My other key publications on health in EIA good practice include:
- Cave B, Pyper R, et al. Lessons from an International Initiative to Set and Share Good Practice on Human Health in Environmental Impact Assessment. International Journal of Environmental Research and Public Health. 2021; 18(4):1392.
  - Pyper R, Cave B. Environmental topics: 'Human health' (7.2). In: Carroll B et al. eds. Environmental Impact Assessment Handbook: ICE Bookshop; 2019: 107-62.
  - Amending the EIA Directive – an opportunity for health, environmental assessment and planning. Town & Country Planning, November 2016, 495-498.

- 1.1.7 I am a full member of IEMA, including a member of the IEMA Health Working Group; a member of the Health Section of IAIA; and a Chartered Environmentalist with the Society for the Environment.
- 1.1.8 I led the team that produced the December 2018 Environmental Statement (ES) Health chapter and the November 2020 ES Addendum (ESA). I have worked on other aviation projects including ending of Cranford Agreement at Heathrow Airport (2013), the Heathrow third runway Expansion Project (2019) and a new terminal building at Leeds Bradford Airport (2021).
- 1.1.9 I work on nationally significant infrastructure projects in the UK, I also work on many smaller community level impact assessments. My experience covers sectors including: nuclear; renewable energy; waste; spatial planning; defence; housing; transport (including marine, road and aviation); local government; and health. I take an evidence-based approach to my work and have produced standalone literature reviews, across the determinants of health, for the public and private sector.
- 1.1.10 In addition to HIA work I have also undertaken Health Needs Assessments and have provided support with service specifications for vulnerable adults and children, including within the criminal justice system, for the homeless and for those taken into care by local authorities.
- 1.1.11 I have been supported in preparing this Proof of Evidence (POE) by other members of the BCA Insight team, in particular Ben Cave, current president of IAIA.

## 1.2 Scope of Evidence

- 1.2.1 This POE relates to an appeal, made by BAL pursuant to Section 78 of the Town and Country Planning Act 1990, against the decision of North Somerset Council (NSC) on 19 March 2020 to refuse planning application reference 18/P/5118/OUT for the development of Bristol Airport to accommodate 12 mppa.
- 1.2.2 My evidence relates to the human health effects of the Appeal Proposal, with a focus on responding, from the health perspective, to issue 2 in NSC's reasons for refusal (RFR).
- 1.2.3 My evidence references health assessment detail, on the Appeal Proposal, in two previously published documents:
- Chapter 16 of the ES included with the planning application, dated December 2018 (CD2.5.42); and
  - Section 9 of the ESA to the ES, dated November 2020 (CD2.20.1).
- 1.2.4 In this proof, I address the RFR given by NSC in its Decision Notice, and other comments by NSC and Rule 6 parties, where they relate to human health in their respective Statements of Case (SOC).
- 1.2.5 My POE is structured as follows:
- Section 2: sets out the relevant RFR and my summary response;
  - Section 3: provides a summary of the policy context and recent guidance publications;
  - Section 4: explains the basis of assessment and summarises relevant parts of the ES and ESA;
  - Section 5: provides a point-by-point discussion of the RFR and of other SOC points;
  - Section 6: sets out my conclusions.
- 1.2.6 A separate summary of my proof has also been provided.

1.2.7 The following points provide a general introduction to the framing of my POE:

- My evidence relates to the population health effects of the Appeal Proposal. In line with good practice, this qualitative assessment draws on the quantitative analysis of the ES and ESA noise, air quality and socioeconomic assessments.
- The validity and robustness of the quantitative inputs to the health assessment are addressed in the POEs of Mr Williams in relation to noise, Mr Peirce in relation to air quality and Mr Brass in relation to socioeconomics. My evidence does not address such modelling.
- Whilst my POE makes points from the health perspective in relation to the overall balance of beneficial and adverse effects, the planning balance is discussed in the POE of Mr Melling.
- Similarly, whilst my POE refers to the COVID-19 pandemic, the discussion of air traffic forecasting is covered in the second POE of Mr Brass.
- In line with established practice my evidence takes a public health perspective and thus considers effects at the population level. The appropriateness of this approach is explained.
- I explain that EIA health significance scores are about the recommended weight to give an issue in the planning determination, they are linked to, but not the same as classifying the severity of health effects.
- I discuss the beneficial and adverse health effects of the Appeal Proposal, including the significant population level socio-economic benefits to health.
- I explain that all development has potential to adversely affect the health of a small minority of particularly vulnerable individuals. This is a societal burden weighed up in all planning decisions. I show how this has been reflected within the assessment in line with good practice.
- I acknowledge that professional judgements are reliant on sources of evidence and influenced by professional perspectives. I also show how good practice methods have been used to limit and explain such uncertainties.
- I explain that even if alternative weighting is given to thresholds of significance, this should not change the overall balance of the health assessment.

1.2.8 I focus on RFR 2, which explicitly references health and well-being in relation to noise and air quality effects of the Appeal Proposal.

1.2.9 The RFR 2 statements relate to operational effects. Construction effects are therefore not discussed within the scope of my POE.

1.2.10 Broadly, RFR 1 deals with the balance of economic benefits and environmental harm; RFR 3 deals with climate change; RFR 4 deals with Green Belt development; and RFR 5 deals with public transport. All these issues can be linked to determinants of health, but health is not a cited reason for refusal. For this reason RFR 1, 3, 4 and 5 are not addressed specifically within this Health POE. As appropriate Section 5 of my POE picks up on these wider issues where health related points are made by NSC and other parties in their SOCs.

1.2.11 In this POE I am honest, open and have applied my knowledge and skills to the best of my ability. Holding chartered status, I adhere to the IEMA<sup>1</sup>, Society for the Environment<sup>2</sup> and the IAIA<sup>3</sup> Professional Codes of Professional Conduct.

### 1.3 Summary of Case

- 1.3.1 My POE responds to NSC Decision Notice RFR 2 and issues raised by NSC and Rule 6 parties in their SOC and elsewhere in relation to population health effects of the Appeal Proposal.
- 1.3.2 There are two primary health issues raised by the NSC Decision Notice to which I respond:
- 1) Whether the noise and air quality effects of the Appeal Proposal constitute ‘significant’ ‘population’ health effects. An important technical distinction that adds considerably more weight to an issue.
  - 2) Whether the Appeal Proposal contributes to improving the health and well-being of the local population. A policy test that should weigh-up effects consistently and in their entirety.
- 1.3.3 On issue 1: I conclude that the ‘population health’ effects associated with changes in air quality and noise are not significant and that this is a reasonable professional judgement of such effects. This is the case even if there are a limited number of significant individual receptor effects. I draw on inputs from other EIA chapters and reference to relevant public health evidence sources.
- 1.3.4 On issue 2: I conclude that there are likely to be significant beneficial effects to population health from investment and employment due to the Appeal Proposal and that this is a reasonable professional judgement of such effects. I show that on balance the Appeal Proposal is likely to contribute to improving the health and well-being of the local population more than it detracts from it.
- 1.3.5 I cross-reference the POEs of Mr Williams in relation to noise, Mr Peirce in relation to air quality and Mr Brass in relation to socioeconomics to make the case that, from the health perspective, the ES and ESA have neither overstated the benefits nor downplayed the negative effect of the Appeal Proposal.
- 1.3.6 Whilst I comment on the balance of population health effects, I do not address the overall planning balance. This is addressed by Mr Melling in his POE. I find that it is difficult to reconcile NSC’s Decision Notice judgment with a public health perspective of both the beneficial and adverse influences of the Appeal Proposal on population health.

## 2 Reasons for Refusal (RFR)

### 2.1 NSC's position that health effects are not acceptable

2.1.1 The Health POE focuses on RFR 2 in the NSC Decision Notice of 19 March 2020 (CD4.16) as it explicitly references health and well-being. RFR 2 states:

*“The noise and impact on air quality generated by the increase in aircraft movements and in particular the proposed lifting of seasonal restrictions on night flights would have a significant adverse impact on the health and well-being of residents in local communities and the proposed development would not contribute to improving the health and well-being of the local population contrary to policies CS3, CS23 and CS26 of the North Somerset Core Strategy 2017.” [emphasis added]*

2.1.2 The NSC SOC goes on to contend that:

*In essence, BAL has overstated the economic and other benefits of the Proposed Development and understated the environmental and social harm that the Proposed Development would cause. [6]*

2.1.3 The NSC SOC makes detailed points in relation to air quality and noise that reference health. These are addressed in the POEs of Mr Williams in relation to noise, Mr Peirce in relation to air quality. As relevant these are also discussed in Section 5 of my POE.

2.1.4 In essence the NSC SOC contends that in relation to noise:

- the increase in aircraft movements would have a significant effect on residents' health; and
- this would be contrary to national and local planning policy.

2.1.5 In relation to air quality NSC's SOC contends:

- the Appeal Proposal will not contribute to improving the local population's health;
- which would be contrary to local planning policy; and
- the changes in air quality will increase risks to health, including below statutory limits and in relation to ultra-fine particulates.

2.1.6 My POE responds to the health element of these points. The policy element is addressed in the POE of Mr Melling. I show that it is reasonable to conclude that:

- the appropriate EIA framing of likely significant health effects is in terms of 'populations' not 'individuals';
- whilst it is accepted that there would be a relative increase in 'risks to health', as is the case with most change; there are unlikely to be 'significant' adverse 'population' health effects from noise or air quality;
- the ES health assessment already considers health effects below statutory limit values; and
- the health evidence base on ultra-fine particulates is not sufficiently developed to inform policy, as discussed in the POE of Mr Peirce.

- 2.1.7 Furthermore, I explore the NSC statement that “*the proposed development would not contribute to improving the health and well-being of the local population*”. Including that this statement appears to either be only considering the adverse effects of the project; or NSC have differing interpretations of the Appeal Proposal’s impacts to the point of reversing significance conclusions across the ES and across a wide range of EIA methodologies.
- 2.1.8 It will be shown that the ES and ESA health assessment provides robust conclusions based on reasonable professional judgement as to the public health effects of the proposed development having regard to the public health evidence and inputs from other EIA topic chapters.

## 2.2 NSC officers’ position that health effects are acceptable

### Committee Report 10<sup>th</sup> February 2020 (CD4.11)

- 2.2.1 The following section provides extracts from the NSC Officer’s Committee Report for the Appeal Proposal. Health is listed as ‘Issue 21: Public Health and Wellbeing’, from page 163 of the Committee Report.
- 2.2.2 NSC Officers’ summing up conclusion references health and states:

*Public health and wellbeing has been considered in consultation with Public Health England (PHE). It is concluded that the proposals do not give rise to additional impacts that need to be mitigated.*

- 2.2.3 In relation to the ES Health chapter’s assessment of noise NSC Officers say:

*The HIA indicates that the health effects from operational noise and vibration are most likely to impact on mental health conditions (stress, anxiety or depression), sleep disturbance and cognitive performance in children. Cardiovascular health impacts could also be an associated factor. The significance of the effect would be negligible for the general population and up to minor adverse (not significant) for vulnerable groups. The small increase in exposure for much of the local population is unlikely to result in a significant population health effect, but this affect is no more than ‘minor adverse’. Officers’ assisted by PHE comments agree with this assessment.*

- 2.2.4 In relation to the ES Health chapter’s assessment of air quality NSC Officers say:

*In terms of air quality, the HIA focusses on the impacts of nitrogen dioxide (NO<sub>2</sub>) and Particulate Matter (PM) dispersion, which are the main combustion-related air pollutants. They say the main health outcomes could be increased risk of cardiovascular and respiratory related conditions. All projected changes in concentrations of all air pollutants will however remain within statutory acceptable levels as set by the World Health Organisation in terms of health protection. Officers agree with this based on the results on the air quality assessment in ‘Issue 7’. To that extent the health impact is contended to be ‘negligible’ to the wider population and ‘minor adverse’ to vulnerable groups. No specific action is required other than ongoing monitoring of air quality. Only if air quality reduced and did not comply with acceptable public health standards would intervention be required.*

- 2.2.5 In relation to the ES Health chapter’s assessment of economic health benefits NSC Officers say:

*The HIA indicates that the main socio-economic health related impacts of the proposal are positive in that the provision of long-term good quality employment opportunities (directly at Bristol Airport, or indirectly through wider economic investment within the region*

*facilitated by the expansion) are likely to have a long-term beneficial effect on population health locally and, to a lesser extent, regionally. Such benefits could include reducing levels of poverty and inequalities. The impacts are contended to be 'minor beneficial' for the general population and up to 'moderate beneficial' for vulnerable groups. While the scale of the benefits set out in BAL's economic impact assessment are considered (based on an independent assessment) to be lower than claimed by BAL, they would still provide long-term good quality employment opportunities, and this is likely to have a long-term beneficial effect on population health.*

2.2.6 NSC Officers conclusion on the ES Health chapter is that:

*BAL's projected Health Impact Assessment is realistic. There are no overriding health or well-being impacts which would warrant refusal of the application, albeit this is contingent on impacts being mitigated in accordance with the planning conditions and planning obligations recommended in this report.*

### **2.3 The recent Stansted Appeal decision and health (CD6.13)**

2.3.1 For context, the relevant parts of the decision on the recent Stansted Airport appeal (Appeal Ref: APP/C1570/W/20/3256619) relating to public health are summarised below as there are parallels to be drawn with this appeal.

2.3.2 The extent to which health was a contested issue is summarised in Stansted's SOC paragraph 4.41:

*Reasons for refusal 1 and 2 refer to the health effects of noise and air quality. The broader topic of 'Public Health' is not a reason for refusal, and UDC do not contest the findings of the Health and Wellbeing chapter of the ES nor the Health Impact Assessment (HIA) that demonstrated no material risk to public health. No health objection was made by any statutory consultee or health stakeholder.*

2.3.3 NSC have similarly referred to the health effects of noise and air quality in their RFR and SOC. In their SOC NSC have not clearly presented a position on whether or not they contest the broader topic of 'public health' and thus the findings of the ES Health chapter and/or health section of the ESA, although they have not agreed that there is no public health issue in the emerging Statements of Common Ground (SoCG). This Health POE responds to this issue in the context of that ambiguity. Like the Stansted HIA this Appeal Proposal's health assessment shows there to be no material risk to public health.

2.3.4 The Stansted Decision states that 'Health and Wellbeing' was a topic considered during the Inquiry (para 103) and concluded in relation to Health and Wellbeing, para 106 and 107:

*The Health Impact Assessment (HIA) considers health impacts arising from noise and air quality both from airport operations and from surface access, and socio-economic factors....*

*Whilst criticisms are made by other parties, no alternative detailed assessment has been put forward that would cast doubt on the findings of the ES and ESA or indicate that the likely effects would differ from those assessed. The conclusions of the ES and ESA are considered reliable.*

## 3 Legislative and Policy Context

### 3.1 Legislation

3.1.1 A review of relevant health legislation is set out in the ES (paragraph 16.3.1). This POE does not introduce any additional legislation.

### 3.2 Policy

3.2.1 In this section, I consider the key statements from the health policy context relevant to the proposed growth of Bristol Airport to 12 mppa. These policies were referenced in the ES and ESA.

3.2.2 I have highlighted some relevant passages below:

Policy reference	Policy issue
<b>National Planning Policy Framework (NPPF) 2019<sup>4</sup> (CD 5.8)</b>	
Paragraph 91	Planning policies and decisions should aim to achieve healthy, inclusive and safe places which... promote social interaction... are safe and accessible... and enable and support healthy lifestyles, especially where this would address identified local health and well-being needs...
Paragraph 180	Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment... In doing so they should: avoid noise giving rise to significant adverse impacts on health and the quality of life; identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason...
Paragraph 181	Planning policies and decisions should sustain and contribute towards compliance with relevant limit values or national objectives for pollutants... Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications.
<b>The Aviation Policy Framework<sup>5</sup> (CD6.1)</b>	
	Sets out the government's policy to allow the aviation sector to continue to make a significant contribution to economic growth across the country. The points included here are noted in relation to health: <ul style="list-style-type: none"> <li>• The aviation sector is a major contributor to the economy (with economic prosperity being an important positive determinant of health).</li> <li>• For aviation related local environmental impacts, such as air pollution, the overall objective is to ensure appropriate health protection by focusing on meeting relevant legal obligations;</li> <li>• Emissions from transport, including at airports, contribute to air pollution. EU legislation sets legally binding air quality limits for the protection of human health. Around airports, sources of air pollution include aircraft engines, airport-related traffic on local roads and surface vehicles. The most important pollutants are oxides of nitrogen (NOx) and particulate matter (PM). Studies have shown that NOx emissions from aviation-related operations reduce rapidly beyond the immediate area around the runway. Road traffic remains the main problem with regard to NOx in the UK. Airports are large generators of surface transport journeys and as such share a responsibility to minimise the air quality impact of these operations;</li> <li>• The Government's overall policy on aviation noise is to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise. This is consistent with the</li> </ul>

Policy reference	Policy issue
<p><b>Noise Policy Statement for England (NPSE)<sup>6</sup> (CD 10.4)</b></p>	<p>Government’s Noise Policy, as set out in the Noise Policy Statement for England (NPSE) which aims to avoid significant adverse impacts on health and quality of life. The Government wants to strike a fair balance between the negative impacts of noise (on health, amenity (quality of life) and productivity) and the positive economic impacts of flights. The Government expects that the aviation industry will continue to reduce and mitigate noise as airport capacity grows. As noise levels fall with technology improvements the aviation industry should be expected to share the benefits from these improvements with local communities;</p> <ul style="list-style-type: none"> <li>• The Government will continue to treat the 57dB LAeq 16-hour contour as the average level of daytime aircraft noise marking the approximate onset of significant community annoyance. However, this does not mean that all people within this contour will experience significant adverse effects from aircraft noise. Nor does it mean that no-one outside of this contour will consider themselves annoyed by aircraft noise. The Government recommends that average noise contours should not be the only measure used when airports seek to explain how locations under flight paths are affected by aircraft noise; and</li> <li>• The Government recognises that the costs on local communities are higher from aircraft noise during the night, particularly the health costs associated with sleep disturbance. Noise from aircraft at night is therefore widely regarded as the least acceptable aspect of aircraft operations. However, the Government also recognises the importance to the UK economy of certain types of flights, such as express freight services, which may only be viable if they operate at night. In recognising these higher costs upon local communities, the Government expects the aviation industry to make extra efforts to reduce and mitigate noise from night flights through use of best-in-class aircraft, best practice operating procedures, seeking ways to provide respite wherever possible and minimising the demand for night flights where alternatives are available.</li> <li>• Whilst the Government’s policy is to give particular weight to the management and mitigation of noise in the immediate vicinity of airports, there may be instances where prioritising noise creates unacceptable costs in terms of local air pollution. For example, displacing the runway landing threshold to give noise benefits could lead to significant additional taxiing and emissions. For this reason, the impacts of any proposals which change noise or emissions levels should be carefully assessed to allow these costs and benefits to be weighed up.</li> </ul> <p>Noise is an inevitable consequence of a mature and vibrant society. The application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight when assessing the noise implications.</p> <p>Unlike many other pollutants, noise pollution depends not just on the physical aspects of the sound itself, but also the human reaction to it. The NPSE sets out the Government’s position on the underlying principles and aims of noise management decisions. The NPSE applies to all forms of noise, including environmental noise (except occupational noise). The NPSE has three aims:</p> <ul style="list-style-type: none"> <li>• Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.</li> <li>• Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.</li> <li>• Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.”</li> </ul>

Policy reference	Policy issue
	<p>The vision and aims of NPSE should be interpreted by having regard to the set of shared UK principles that underpin the Government's sustainable development strategy.</p> <p>[These include:]</p> <ul style="list-style-type: none"> <li>• Ensuring a Strong Healthy and Just Society – Meeting the diverse needs of all people in existing and future communities, promoting personal wellbeing, social cohesion and inclusion, and creating equal opportunity for all.</li> <li>• Achieving a Sustainable Economy – Building a strong, stable and sustainable economy which provides prosperity and opportunities for all, and in which environmental and social costs fall on those who impose them (polluter pays), and efficient resource use is incentivised.</li> </ul> <p>Sustainable development is a core principle underpinning all government policy. For the UK Government the goal of sustainable development is being pursued in an integrated way through a sustainable, innovative and productive economy that delivers high levels of employment and a just society that promotes social inclusion, sustainable communities and personal wellbeing.</p> <p>There is a need to integrate consideration of the economic and social benefit of the activity or policy under examination with proper consideration of the adverse environmental effects, including the impact of noise on health and quality of life. This should avoid noise being treated in isolation in any particular situation, i.e. not focussing solely on the noise impact without taking into account other related factors.</p> <p>SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur. It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times.</p>
<p><b>Air Quality Strategy for England, Scotland, Wales and Northern Ireland</b> <sup>7</sup> (CD 8.2.1)</p>	<p>The Environment Agency works with local authorities, Highways England and others to manage the government's Air Quality Strategy in England and Wales. The strategy sets air pollution standards to protect people's health and the environment. The Strategy sets out the National Air Quality Objectives (AQOs) and Government policy on achieving these objectives.</p>
<p><b>Beyond the horizon - the future of UK aviation: next steps towards an aviation strategy</b> <sup>8</sup> (CD6.3)</p>	<p>The Strategy notes that:</p> <ul style="list-style-type: none"> <li>• The Government expects that demand for air services will continue to rise significantly through to 2050. Aviation plays a crucial role in the UK's wider economy and export markets. Economic benefits would be expected to make a positive contribution as a determinant of health.</li> <li>• The government must ensure that growth is sustainable and is balanced with local and global environmental concerns;</li> <li>• The government recognises the impact on communities living near airports and understands their concerns over local environmental issues, particularly noise. As airports grow, it is important that communities share in the economic benefits of this growth, and that adverse impacts are mitigated where possible.</li> </ul>
<p><b>Somerset County Plan 2016 - 2020</b> <sup>9</sup></p>	<p>The vision includes reducing inequalities. These are set out as:</p> <ul style="list-style-type: none"> <li>• Economic inequalities, where people in deprived areas have fewer chances to succeed and are less likely to find good quality jobs; and</li> <li>• Health inequalities, where people from deprived backgrounds have poorer health, are more likely to live with long-term conditions, and have a shorter lifespan than people living in more affluent areas.</li> </ul>
<p><b>North Somerset Council (NSC) Core Strategy January 2017</b> <sup>10</sup> (CD 5.6)</p>	<p>The Strategy has the following policies under the Sustainable Community Strategy theme of 'Ensuring safe and healthy communities'. Policy CS26 Supporting healthy living and the provision of health care facilities. The policy includes:</p>

Policy reference	Policy issue
	<ul style="list-style-type: none"> <li>• Requiring HIA on all large-scale developments in the district that assess how the development will contribute to improving the health and wellbeing of the local population;</li> <li>• Working with relevant stakeholders to reduce geographical inequalities in health within the district.</li> </ul>

### 3.3 Guidance and good practice

3.3.1 The approach to assessing health in the EIA has also been informed by relevant UK guidance on HIA. In England there is no overarching guidance for HIA. However, generic principles are evident in specialist guidance such as that by the Department of Health in relation to HIA of government policy<sup>11</sup>, or that by the London Healthy Urban Development Unit in relation to urban planning<sup>12</sup>. In Wales there is good quality project level guidance on HIA<sup>13</sup>, while, in Northern Ireland overarching project level HIA guidance is provided by the Institute of Public Health in Ireland<sup>14</sup>. HIA guidance from Scotland includes discussion of issues relevant to rural contexts<sup>15</sup>.

3.3.2 Whilst there is limited formal UK guidance on health in EIA methods, the methods used by the ES Health chapter are consistent with recent international good practice publications. In October 2020 Public Health England published guidance on HIA in spatial planning<sup>16</sup>. This makes reference to health in EIA. I advised PHE on this guidance and have taken it into account.

3.3.3 Other recent publications include frameworks for reaching professional judgments on health significance, including in relation to the importance, desirability or acceptability of the changes for population health.

3.3.4 This has been a developing technical area in the period between the publication of the BAL ES Health chapter in December 2018 and this inquiry. Key documents include:

- Cave, B., Claßen, T., Fischer-Bonde, B., Humboldt-Dachroeden, S., Martín-Olmedo, P., Mekel, O., Pyper, R., Silva, F., Vilianni, F., Xiao, Y. 2020. Human health: Ensuring a high level of protection. A reference paper on addressing Human Health in Environmental Impact Assessment. As per EU Directive 2011/92/EU amended by 2014/52/EU. International Association for Impact Assessment and European Public Health Association. [https://eupha.org/section\\_page.php?section\\_page=200](https://eupha.org/section_page.php?section_page=200)
- Cave B, Pyper R, Fischer-Bonde B, Humboldt-Dachroeden S, Martin-Olmedo P. Lessons from an International Initiative to Set and Share Good Practice on Human Health in Environmental Impact Assessment. International Journal of Environmental Research and Public Health 2021; 18(4). <http://dx.doi.org/10.3390/ijerph18041392>
- Winkler MS, et al. Health Impact Assessment International Best Practice Principles. Fargo, USA: International Association for Impact Assessment. 2021. <https://www.iaia.org/best-practice.php>
- IAIA. Key citations. 2021. <https://www.iaia.org/key-citations.php>

## 4 Assessment Summary

- 4.1.1 In this section, I explain the approach taken to ‘significance’ for health effects in EIA and the reaching of ‘population health’ conclusions. I refer to the ES methods and to recent academic and practitioner publications. Methodological issues of ‘likelihood’ are also relevant to EIA, but are not part of the reasons for refusal, so not elaborated on further.
- 4.1.2 I then summarise the ES health conclusions and the ESA health conclusions.
- 4.1.3 I show that the methods used, and professional judgements reached, are reasonable and robust.

### 4.2 Framing conclusion on health in EIA

#### Position on EIA health significance

- 4.2.1 This section considers, in general terms, the meaning of EIA health ‘significance’. This responds to the fact that there are different conclusions on the significance of health effects between the ES and the NSC Decision Notice.
- 4.2.2 I am clear that a non-technical meaning of ‘significance’ should not be confused with the technical EIA usage of the term ‘significance’.
- 4.2.3 I am the author of, and on the writing teams for, key academic and practitioner publications on EIA health significance<sup>17,20,21,24</sup>. In this section I explain the basis for determining ‘significance’ for health in EIA. I show that this is the output of a careful and structured analysis. I show that there are recent publications clarifying methods for such analysis. I show how the ES Health chapter methodology is aligned to the recent publications. I show that such methods built consensus on the ES Health chapter conclusions.
- 4.2.4 As a starting point, I note that the objective of EIA is “to ensure a high level of protection of the environment and of human health”, as set out in recital 41 of Directive 2014/52/EU<sup>18</sup>. ES paragraph 16.9.23 sums up the intentions of the EIA health methods based on the EIA Directive wording:

*“Ultimately a likely significant health effect is one that should be brought to the attention of the determining authority, as the effect of the Proposed Development is judged to provide, or be contrary to providing, a high level of protection to population health. This may include reasoned conclusions in relation to health protection, health improvement and/or improving services.”*

- 4.2.5 This is a clear statement that a significance score is a means of highlighting to a decision maker the weight that a health issue should carry. Within this a significance score considers a wide range of factors that contribute to that issue’s recommended influence on the decision. For health, the severity of the health effect is clearly relevant. However, it is not the only factor. Severity is in the context of other factors including: what proportion of the population is affected; the reversibility of the outcome; and the health service implications. These will be across a spectrum of vulnerability to the change and also in the context of policy and regulation on what is acceptable and the science and health priorities of what is important. All this is weighed up in scoring significance.
- 4.2.6 I would like to be very clear that a conclusion that an effect is ‘not significant’ is not to deny or to downplay that there may be a small minority of people who may experience adverse health outcomes. Such groups should be identified within the assessment and the potential for adverse effects should

be targeted with mitigation; as is the case in the ES Health chapter. However, all development has the potential for significant adverse effects to some particularly vulnerable individuals. The role of EIA significance scoring is therefore not to set a threshold of 'no harm' from development, but to show where, at a population level, the harm should weigh strongly in the balance alongside the development's benefits for health and other outcomes.

- 4.2.7 The European Commission's 2017 guidance on EIA<sup>19</sup> provides a general definition of significance, which acknowledges the contextual and subjective elements.

*"The assessment of significance relies on informed experts' judgements about what is important, desirable or acceptable with regards to changes triggered by the Project in question. These judgements are relative and must always be understood in their context:*

- *They are value-dependent: while judgements are, in most cases, informed by scientific data (e.g. regarding the type of impact being examined), they are subjective to some degree as they are the opinion of one practitioner or by a team of practitioners. Experts' judgements vary, depending on the perspective (legal or institutional recognition, political or public recognition), deemed to be important professionally.*

- *They are context-dependent: judgements are made within the socio-cultural, economic, and political contexts of a Project. A thorough understanding of contextual factors (e.g., local ecological, social, and cultural conditions, judgements in related decision-making areas), likely to influence judgements' significance, is essential when identifying a Project's impact on the environment."*

- 4.2.8 The challenge of needing to clarify what this means for health was articulated in the 2017 joint publication by IEMA and the UK's Faculty of Public Health<sup>17</sup>. IEMA is the largest professional body for EIA practitioners in the UK. The Faculty of Public Health is a membership organisation for public health professionals across the UK and around the world. I was one of the authors of this 2017 publication. This is a frequently cited document within EIA practice. The publication states:

*"In impact assessment, the significance of an effect is usually a matter of expert professional judgements informed by reference to an evidence base and to practitioner guidance." [emphasis added]*

*"Defining significance for population and human health can be challenging and there is currently no guidance for considering population and health in UK EIA practice."*

*"Population and human health significance in EIA should include a professional judgement supported by evidence, for example on an issue's 'importance' and 'acceptability'. Available evidence to cite in the EIA may include: scientific literature; consultation responses; baseline conditions; local health priorities; and regulatory standards." [emphasis added]*

- 4.2.9 The broad statements from the European Commission, IEMA and the Faculty of Public Health were both affirmed and clarified for health in EIA by a 2020 joint publication between EUPHA, representing public health, and IAIA, representing EIA practitioners<sup>20</sup>. EUPHA is an umbrella organisation for public health associations and institutes in Europe. IAIA is the leading global network on best practice in the use of impact assessment for informed decision-making regarding policies, programs, plans and projects.

- 4.2.10 The EUPHA/IAIA publication's robustness is evident in that it was widely consulted upon and was peer reviewed, as documented in the academic literature<sup>21</sup>. It is also referenced as a key citation for health in Impact Assessment<sup>22</sup> and by Public Health England's 2020 guidance on health in spatial planning<sup>16</sup>. The EUPHA/IAIA publication states:

*“A determination of significance should be based on professional judgement and best available evidence. It means that a given effect is considered important, desirable or acceptable (21, 23). It is worth noting that in most cases, evidence on health effects and their significance is incomplete. This can lead to differences in public, political and expert opinions. The way in which a decision is reached should be transparent.” [emphasis added]*

- 4.2.11 Responding to this challenge the EUPHA/IAIA publication provides practitioners with guidance on determining health significance. This includes a framework to support analysis and develop transparent, evidence based, reasoned conclusions. This brings together the different perspective and evidence sources that influence decisions on significance, be they scientific literature, social conditions, regulatory standards, or government policy. This supports consensus building.
- 4.2.12 I can confirm the that the approach is applicable to the UK. The EUPHA/IAIA publication applies to EIA practice based on EU Directive 2011/92/EU as amended by 2014/52/EU, which is the case in for the UK EIA Regulations<sup>23</sup>, even post-Brexit. To confirm its broad application the publication states *“Whilst this reference paper is structured around compliance with the EIA Directive, the principles and approaches have broad application to health in impact assessment globally.”*
- 4.2.13 I am clear that the ES Health chapter, although predating the EUPHA/IAIA publication, is aligned with this good practice approach. This reflects that I was author of the ES chapter and on the writing team for the EUPHA/IAIA publication. The methods build on the UK’s 2019 EIA Handbook Third Edition<sup>24</sup>, in which I authored the health section.
- 4.2.14 The EUPHA/IAIA publication represents the clearest and most up-to-date consensus position statement on what a determination of health significance means. It also shows how it should be a transparent process. The reference paper sets out in full a model for determining health significance based on the analysis of multiple criteria.

*“Analysis of multiple criteria is an established approach to determining significance in EIA (14,16). Sensitivity and magnitude are two criteria that are used across EIA topics. ... The sensitivity of the population and the magnitude of effect need to be considered in the context of other sources of evidence such as:*

- *scientific literature;*
- *baseline conditions for the population;*
- *consultation for the project;*
- *health priorities in the jurisdiction;*
- *regulatory standards in the jurisdiction; and*
- *health policy context in the jurisdiction.”*

- 4.2.15 The EUPHA/IAIA publication provides a model to break down significance in terms of criteria (segments) and indicative classifications (levels) to transparently explore what it means for a health effect to be significant or not significant. It goes on to state that:

*“Reporting the likely significant health effects of a project should aim to present the professional judgment as a narrative (rather than a formulaic checklist or matrix) setting out the reasoned conclusions and supporting evidence.” [emphasis added]*

- 4.2.16 The three-step model, being c.10 pages long, is not reproduced here. In summary, the model shows a professional judgement that a health effect is ‘significant’ would evidence and weigh up the following, as relevant:

- In terms of magnitude and sensitivity (each is explored in the model):
  - the magnitude of change due to the project is high or medium; and
  - the sensitivity of the affected population is high or medium.
- AND in terms of importance (positive or negative effect):
  - the scientific literature shows there is a causal relationship, or a clear association, between changes that would result from the project and changes to health outcomes;
  - the project would result in an important change in the health baseline, this could be a substantial change or it could be a small change in a large or highly vulnerable population; and/or
  - health priorities have been set for the relevant study area that are of specific or general relevance to the determinant of health or population group affected by the project.
- OR in terms of acceptability (negative effect), or desirability (positive effect):
  - changes, due to the project, have a substantial or influential effect on the ability to deliver current health policy;
  - change, due to the project, results in a regulatory threshold or standard being crossed or nearly crossed; and/or
  - there is consensus, or a mix of views, among stakeholders on themes that have emerged, in consultation for the project, on relevant determinants of health or health outcomes.

4.2.17 Whilst the model is not obligatory, it is a clear demonstration of the depth of analysis involved. The model relates evidence to decision prompts, which collectively inform a professional judgement. Such a thorough and robust analysis was undertaken as part of the ES Health chapter.

4.2.18 The EUPHA/IAIA publication approach to determining significance supports all parties to reach a consensus. This responds to the point made by the European Commission that different conclusions on significance can be reached if professional perspectives or evidence sources differ. The ES's methodology means such differences should not arise at a late stage. Indeed, consensus was reached between the EIA team, NSC Officers and Public Health England.

4.2.19 The ES Health chapter sets out the methods for providing reasoned conclusions for the identification and assessment of any likely significant effects of the Proposed Development on population health.

4.2.20 ES paragraph 16.9.15 sets out in summary the same process as the EUPHA/IAIA publication. This involves determining sensitivity, determining magnitude and then citing relevant contextual evidence sources to reach a professional judgment. ES Table 16.7 and Table 16.8 provide supporting detail on factors that inform the professional judgements on sensitivity and magnitude, respectively.

4.2.21 ES Table 16.9 sets out guide questions, aligned with contextual evidence sources of the EUPHA/IAIA publication, to support the determination of significance. The ES Health chapter assessment provides an analysis that responds to these questions for each health issue.

4.2.22 Whilst the UK still lacks national EIA specific health guidance, I have shown that the ES Health chapter methods are robust because they are aligned with up-to-date consensus international public health and impact assessor methods on EIA health significance. The development of which included UK practitioners.

- 4.2.23 I have demonstrated that the reaching of an EIA conclusion on health significance is an analysis of multiple criteria and multiple evidence sources.
- 4.2.24 I have noted that the methods bring together different types of evidence, e.g. academic literature, public health priorities, regulatory standards and health policy. The methods thus not only take into account a range of evidence sources, but also a diversity of professional perspectives, e.g. academics, public health practitioners, regulators and policy makers.
- 4.2.25 I have made the case that the methods used support consensus building, such that late changes in viewpoints on the significance of effects should be avoided, or at least be transparent.
- 4.2.26 I have referenced the consensus on the significance of the Appeal Proposal’s health effects that was built between the EIA team, NSC Officers and Public Health England.
- 4.2.27 Whilst the NSC Decision Notice is entitled to reach its own professional judgment, I find it hard to reconcile the NSC Decision Notice conclusions on health significance with the methods presented in the ES. The NSC Decision Notice does not reference alternative methods or evidence sources as part of a reasoned conclusion.

### Position on a population health approach

- 4.2.28 A second area of general clarification is that EIA takes a ‘population health’ approach.
- 4.2.29 The reason for this clarification is that selectively taking an ‘individual’ perspective to significance is one conceivable reason for the NSC Decision Notice reaching contrary conclusions on health significance. As noted above, the potential to adversely affect the health of particularly vulnerable individuals is inherent to most development and, if singled out, could explain the NSC conclusions.
- 4.2.30 I show that EIA takes a population health approach. I reference the academic and practitioner literature that a population health approach is normal, and indeed best, practice. I also note that to take an individual level approach to significance would likely mean that all effects, positive and negative, would be significant on all projects. This would be contrary to supporting decision makers in identifying the material issues. Finally, I note that even if an approach is taken that gives increased weight to effects that only extend to relatively few individuals within a population; if applied consistently, this should not affect the balance of conclusions in the ES.
- 4.2.31 ‘Health’ is a “state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity”<sup>25</sup>.
- 4.2.32 ‘Population health’ refers to the health outcomes of a group of individuals, including the distribution of such outcomes within the group<sup>26</sup>.
- 4.2.33 Cave et al.<sup>21</sup> note that the health component of environmental assessment is usually applied at a population, and not an individual, level.
- 4.2.34 The EUPHA/IAIA publication states in relation to good practice:

*“EIA takes a population health approach. Inequalities are a key feature of population health, so where there is potential for significant health effects consider differences between the general population and vulnerable groups.”*

- 4.2.35 The EUPHA/IAIA model for determining significance includes characterising the population extent, as one of the criteria informing health magnitude. This is a judgment of whether the proportion of the population affected is best characterised as: the majority; a large minority; a small minority; or very

few people. The explanatory text explains that these terms are relative to the population defined in the assessment and states:

*“Where the effect is best characterised as only affecting a few individuals, this may indicate that a population health effect would not occur. Such individuals should still be the subject of mitigation and discussion, but in EIA and public health terms the effect may not be a significant population health change.”*

4.2.36 Public Health England’s 2020 Guidance on health in spatial planning<sup>16</sup> considers magnitude in relation to determining significance for health. The guidance includes discussion of EIA but is not limited to EIA. Table 5 of the PHE Guidance finds on the measure of population extent:

- ‘not significant’ effects are associated with a *“small minority of population affected”* (slight effect) or *“very few people affected”* (neutral effect).
- ‘significant’ effects are associated with a *“large minority of population affected”* (moderate effect) or a *“majority of population affected”* (major effect).

4.2.37 The PHE Guidance aligns with the EUPHA/IAIA model for determining health magnitude. Whilst qualitative terms are used, the intention of both the international and national guidance is, on the issue of population extent, to clearly direct EIA to require a sizable proportion of the population to be affected for there to be a significant health effect.

4.2.38 I can confirm that the ES Health chapter is consistent with the EUPHA/IAIA and PHE publications in taking a population health approach. At paragraph 16.9.25 the ES Health chapter states:

*A population health approach has been used, as it would be disproportionate to reach conclusions on the potential health outcomes of individuals. To take account of potential inequalities, where appropriate, conclusions on a particular health issue have been reached for more than one population. For example:*

- *One conclusion for the general population (for a defined area); and*
- *A second separate sub-population conclusion for relevant vulnerable groups (as a single defined class of sensitivities for that issue).*

4.2.39 The ES Health chapter therefore follows good practice in, not only taking a population health approach, but also, within this, exploring the potential for inequalities. The latter however remains at a sub-population level and does not identify or conclude on the health outcomes of individuals.

4.2.40 I am clear that although populations are comprised of individuals, the utility of an EIA health analysis is in providing a population level understanding of effects. To do otherwise would be simply to restate for every health issue that there would be a wide range of individual level responses based on behaviours, circumstances, genetics, chance etc. Such conclusions would have limited value.

4.2.41 That there is variation between people is widely acknowledged in public health. Public health frames this variation in terms of a likely distribution of effects within a population. This distribution can be applied conceptually or statistically as a way of describing how most individuals are likely to be affected. This links to the ‘general population’ analysis within the ES Health chapter.

4.2.42 Because there are invariably people towards the extremes of the distribution, e.g. experiencing much smaller or larger effects, it is relevant to also consider sub-populations who may be more likely to experience such extremes because of certain characteristics. This links to the ‘vulnerable group’ analysis within the ES Health chapter.

- 4.2.43 Extending this line of thinking could allow for further analyses, ultimately developing a profile for and assessing the significance of effects to the hypothetically most sensitive individual. I share the consensus view amongst public health and impact assessment practitioners that taking the analysis to the extreme of individual level effects would not be proportionate. This is because it would be resource intensive, diverting from other assessment, and it would ultimately only confirm that almost any change brought about by a project could have a significant effect for the most vulnerable individuals.
- 4.2.44 It is worth clarifying that a public health, population level, approach is distinct from some other EIA specialism methods, such as air quality and noise. Such assessments identify individual receptors, such as dwellings, in order to quantify the magnitude of effects at indicative locations. Such receptor level assessments can help in the characterisation of the magnitude of the population health effects, e.g. by broadly indicating population extent. However, to accurately conclude on health outcomes at individual receptor locations would require receptor level sensitivity data, e.g. individual medical histories. There are ethical considerations, and laws, that restrict access to individual medical histories and the publication of any subsequent, patient identifiable, conclusions.
- 4.2.45 To take a health assessment to an individual receptor level, whilst possible, would be a large and lengthy collaboration of specialisms, including from the NHS due to the sensitive nature of data. This would have substantial time and cost implications, likely exceeding the costs of most development projects. For a given development project, the output would likely be a demonstration of small changes in individual's risk factors, with high margins of error. Such data would also need to be aggregated and anonymised to inform a planning decision. This brings us back, the long way round, to a population health conclusion. It would rarely be proportionate for EIA to undertake such an individual level analysis.
- 4.2.46 By contrast there are anonymised population level statistics on relevant sensitivities. These allow a proportionate means of analysis to reach population level conclusions.
- 4.2.47 It is also worth noting that population level conclusions can also be more accurate. Both individual and population level analysis consider the change in 'risk factors' that affect health outcomes. This is a statement about how the project affects the probability of a change in health outcomes. In public health epidemiology this is termed 'relative risk'. Being a prospective assessment (before the event), EIA analysis is not able to state with certainty that such a change in health outcomes will in fact occur in a given individual. Such predictions can, however, be relatively accurate across a population, particularly where vulnerability is taken into account. At the individual level the uncertainties are higher.
- 4.2.48 My view, supported by consensus from public health and impact assessment publications, is that a project can respond to effects that are limited to the level of individuals, or small groups of individuals, through mitigation, including avoiding and reducing effects, or compensation as a last resort. However, to provide actionable information to decision makers, significance conclusions should be on the basis of whether or not there are likely to be population level effects, including sub-population analysis in relation to inequalities. This was the approach taken in the ES Health chapter. It is unclear on what basis the NSC Decision Notice conclusions have been reached.
- 4.2.49 Notwithstanding the points made above advocating a population level approach, consistency in whatever method is adopted is important. If NSC's significance conclusions are reached on the basis of a very small minority of individuals within a population experiencing adverse effects, then it is only appropriate to take a consistent approach with beneficial effects.
- 4.2.50 For example, if the NSC Decision Notice health significance conclusion on adverse noise and air quality effects is based on the individuals who may be particularly sensitive within the small minority of the

population affected by the change, then a consistent approach should be taken in relation to those who would be particularly sensitive to the beneficial effects of the project.

- 4.2.51 In the ES methods, population extent is one factor in determining the magnitude of the health effect, which feeds into significance. If a consistent approach is taken in lowering the threshold for significance based on affected population size, this would need to be applied across the assessment. Although I do not take this view, working this through by way of example shows: if the noise and air quality effects for vulnerable groups are considered to be moderate adverse, rather than minor, and therefore significant; then similarly the active travel benefits would be significant and the employment benefits would be more significant. This would not change the overall balance of the conclusions presented in the ES.
- 4.2.52 To sum up this section. I am clear that a proportionate and informative EIA health assessment considers the population health effects of a project, including in relation to inequalities for vulnerable groups. Public health and impact assessor consensus is that EIA takes a population health approach.
- 4.2.53 Even if effects to small numbers of individuals are given more weight; consistently applied, this should not change the balance of conclusions presented in the ES.

### Position on uncertainty

- 4.2.54 All decision making is within the context of imperfect information and therefore uncertainty. Reducing uncertainty is a key element of Impact Assessment. Whilst not all uncertainty can be removed, the following steps have been taken to allow confidence in the EIA health assessment conclusions:
- Methods are used that triangulate evidence sources and professional perspectives.
  - The scientific literature reviews undertaken (ES Appendix 16A (CD2.5.43)) give priority to high quality study design, such as systematic reviews and meta-analysis, and strength of evidence.
  - Quantitative inputs for other assessments have been used, which included model validation, as described in the POEs of Mr Williams in relation to noise, Mr Peirce in relation to air quality and Mr Brass in relation to socioeconomics.
  - The health assessment has been cautious, with conservative assessments, for example in taking account of non-threshold effects and vulnerable group findings.
  - The ESA explains how fast and slow growth sensitivity tests were considered.
  - The POE of Mr Williams explains the caps and contours that restrict noise effects to the parameters assessed in the ES and ESA.
  - Monitoring and adaptive management is conditioned as part of ongoing compliance.
  - The health assessment has been transparent in its analysis and follows good practice.

### Position on expertise to reach professional judgements

- 4.2.55 I briefly touch on the expertise involved in making a professional judgment. The EIA Regulations<sup>23</sup> (CD 5.5) require that the ES be prepared by 'competent experts' (reg. 18(5)(a)) and the planning authority, in examining the ES has, or has access to, 'sufficient expertise' (reg. 4(5)). Both these requirements apply to the assessment of health within the ES.
- 4.2.56 The EUPHA/IAIA publication cites public health and impact assessment competence frameworks and states in relation to good practice:

*Competence includes a requirement to understand the ways that human health needs to be addressed within the EIA process.*

*Both public health and impact assessment (IA) competencies are relevant to health in EIA competency, i.e. being a competent expert or having sufficient expertise. [Emphasis added]*

*Public health competencies comprise of soft skills, such as leadership and advocacy, and technical skills, ranging from epidemiology and natural sciences to ethics and sociology.*

*Good practice is for those involved in health in EIA, on behalf of the Developer and on behalf of the Competent Authority to have knowledge of impact assessment, public health and environmental sectors.*

- 4.2.57 'Competent experts' and 'sufficient expertise' are not formally defined in UK EIA guidance. I have set out my competence in terms of qualifications and experience in section 1.1 of this POE. Similarly, the requirement for 'sufficient expertise' has been met by NSC Officers taking advice from Public Health England and the Council's Public Health Team. The NSC Decision Notice does not reference the expertise that has informed its judgments on the ES health conclusions.

### **4.3 Summary of the ES**

- 4.3.1 This section summarises the health assessment submitted with the planning application. The summary is in two parts. Section 4.3 covers to the original December 2018 ES Health chapter (ES Chapter 16). Section 4.4 covers the November 2020 ESA updated health assessment (ESA Section 9). The latter was informed by updates to the air quality, noise and socioeconomic assessments as described in the ESA.

#### **Overview of the ES Health chapter**

- 4.3.2 The ES Health chapter introduces the health assessment, including its links with other ES chapters, and notes (para 16.2) that the assessment is based on publicly available statistics and evidence sources. It then goes on to set out (para 16.3) relevant framing legislation, planning policy and technical guidance. I have summarised relevant policy statements in section 2.3 of this POE.
- 4.3.3 The ES health chapter sets out (para 16.4) the study areas and data gathering methodology. This includes noting (para 16.4.3) that as study areas do not necessarily define the boundaries of potential health effects, the health chapter uses study areas to broadly define representative population groups rather than to set boundaries on the extent of potential effects. In relation to this POE the most relevant geographically defined population group for noise and air quality effects is 'the population near Bristol Airport'. This is referred to as the 'site-specific' population, which is the smallest geographic area considered by the health assessment. As set out in ES Appendix 16B (CD2.5.43) the 'site-specific' population baseline uses North Somerset 013D Lower Layer Super Output Areas (LSOA) and North Somerset 013B LSOA. For socioeconomic health benefits the wider local, North Somerset Unitary Authority, and regional, South West England and South East Wales, populations are also relevant.
- 4.3.4 Key sources of data that informed the ES health chapter are summarised (para 16.4.5). These include: Public Health England datasets; the PubMed health literature database; the NSC Joint Strategic Needs Assessment; North Somerset Partnership strategies; Clinical Commissioning Group health priorities; UK Government Official Statistics; Office for National Statistics data; and Nomis official labour market statistics. In my experience this is an extensive range of data sources for an ES health chapter. This data is presented in full in ES Appendix 16A and 16B. Key data is summarised in the assessment, (para 16.11).

- 4.3.5 An overall baseline to inform the health assessment is set out (para 16.5). This shows, based on a standardised selection of routine population health indicators, how the health of people in North Somerset compares with the rest of England. ES Figure 16.1 shows that overall, the health of people in North Somerset is similar to regional and national comparators. This suggests that the general population does not have a heightened sensitivity to changes that may affect health.
- 4.3.6 It is explained (para 16.5.8) that this baseline is a suitable proxy for the future baseline. This reflects that the main change between the current and future baseline is the number of people within the population who have increased sensitivity to change due to being in certain vulnerable groups, such as older age or poor health. The assessment methodology includes a categorisation of vulnerable population groups, which, for example, allows for the effects of ‘older people’ and ‘people with existing poor health’ to be distinguished from the general population. The assessment sensitivity score for each vulnerable group is independent of the population size within that group, which would be the main change between the current and future baseline. This means that the future baseline, including due to COVID-19, is reflected within the assessment conclusions. The assessment maintains a focus on the relative change between the with development and without development scenarios.
- 4.3.7 A summary of health issues that have been raised by consultees is set out (para 16.6) and responses are given. This relates to the EIA scoping stage. Table 16.2 confirms that NSC are satisfied with the scope and the methodology of the health section.
- 4.3.8 The scope of the health assessment is set out (para 16.7). This includes the spatial, temporal, population and topic scopes. It is confirmed (para 16.7.7) that health effects are assessed in terms of population, rather than individual receptor outcomes. This is consistent with established principles of public health and impact assessment practice<sup>27</sup>. Four vulnerable population groups are defined (para 16.7.9): children and young people; older people; people with existing poor health (physical and mental health); and people living in deprivation, including those on low incomes. These population groups are consistently referenced throughout the assessment. It is confirmed (para 16.7.16) that for noise and air quality a qualitative assessment of population health effects has been undertaken, based on the quantitative modelling and analysis reported in those ES chapters respectively. Table 16.3 sets out the effects that the health chapter assessed. This scope is not disputed in the NSC Decision Notice or their SOC. The operational scope of the health assessment covers:
- air quality;
  - noise;
  - travel;
  - community identity;
  - economic effects;
  - healthcare services; and
  - climate change.
- 4.3.9 The ES Health chapter cross references (para 16.8) the key environmental measures (mitigation) embedded into the development proposals that were taken into account by the health assessment. This includes the noise envelopes and quota counts as well as the noise insulation scheme.
- 4.3.10 The health assessment methodology is set out (para 16.9). Relevant aspects of this have been discussed in section 4.2 of this POE in relation to my position on EIA health significance and a population health approach. It has been shown that the methods are robust and aligned with national and international publication on EIA good practice. In my experience this is a more thorough and transparent explanation of EIA health methods than is found in most other ES reports.

- 4.3.11 It is confirmed (para 16.9.30) that cumulative effects for human health are reported in ES Chapter 18: Cumulative Effects Assessment. This includes assessment of the combined air quality and noise effects to population health from the Appeal Proposal, including to vulnerable groups.
- 4.3.12 The ES Health chapter sets out (para 16.10) the construction stage assessment of health effects. This is not referenced in the NSC RFR or SOC so is not summarised here.
- 4.3.13 The operational stage assessment of health effects is then set out (para 16.11). I elaborate on these below for noise, air quality and socioeconomic health effects. This focus reflects issues cited in RFR 2. The health effects for travel, community identity, healthcare services and climate change are not referenced as issues within the RFR, so mindful of brevity, these are not summarised.
- 4.3.14 Optional additional mitigation recommended by the health assessment is summarised (para 16.13). These measures reflect (para 16.13.2) that although the assessment does not expect a change in significant adverse effects, it would be appropriate to ensure adverse effects to health are as low as reasonably practicable (e.g. where there would be an incremental increase in health risk factors for conditions such as cardiovascular disease due to the Proposed Development). For noise, the recommendations for additional measures are largely addressed by the noise insulation grant scheme in its current form. The Community Fund would also be open for schemes supporting other measures.
- 4.3.15 The key conclusions of the assessment are summarised. Paragraph 16.14.1 states:
- Significant beneficial effects to population health are likely in relation to investment and employment due to the Proposed Development. Other effects that are likely to be beneficial, but which would not be significant in EIA terms, include the infrastructure improvements around the airport entrance that improve road safety and promote walking and cycling.
  - A change in significant adverse effects to population health is considered unlikely. Compared to the existing baseline and the consented increase to a 10 mppa capacity, the Proposed Development results in similar environmental exposures. Whilst there would be some localised increases in adverse effects during construction and operation for people living closest to the airport; at the population level the Proposed Development is unlikely to result in a discernible change to health outcomes.
- 4.3.16 Before providing detail on the health conclusions in relation to operational noise, air quality and socioeconomics I would like to highlight the following statement from the NSC's March 2020 Committee Report:

*“Chapter 16 of the ES examines the impact of the proposed development on human health and wellbeing. It is referred to as a ‘Health Impact Assessment’ (HIA)... To assess the HIA, officers consulted with Public Health England (PHE) and the Council’s Public Health Team. PHE are a statutory consultee for HIA’s and has the expertise to advise on its acceptability. PHE’s comments on the application show that it considers that the HIA has been carried out in accordance with good practice and its methodology and scope to assess the likely impacts on health and wellbeing is proportionate to the proposed development.”*

*“BAL’s projected Health Impact Assessment is realistic. There are no overriding health or well-being impacts which would warrant refusal of the application, albeit this is contingent on impacts being mitigated in accordance with the planning conditions and planning obligations recommended in this report.”*

## Operational Noise

- 4.3.17 The conclusion of the ES Health chapter operational noise assessment is that the significance of the effect would be **negligible** for the general population and up to **minor adverse** (not significant in EIA terms) for vulnerable groups.
- 4.3.18 The conclusion reflects that whilst a low magnitude of change is expected due to the Appeal Proposal (compared to the future baseline position), the effects would be experienced across a wide area. The small increase in exposure for much of the local population is unlikely to result in a significant population health effect (i.e. not a moderate or high significance score). The assessment notes that this effect is recognised as not being a negligible for those groups who are more vulnerable to the effects of noise.
- 4.3.19 The operational noise effects should be considered long-term, making an incremental addition to population risk factors for sleep disturbance, cardiovascular outcomes and for learning outcomes at one school (Winford Primary school). It is noted that the baseline conditions are likely to already be resulting in such influences on health outcomes. In population health terms the change due to the Proposed Development is unlikely to be discernible.
- 4.3.20 In reaching this conclusion the ES Health chapter references the ES Chapter 7: Noise and vibration assessment (CD2.5.16) for relevant quantitative inputs. The key metrics from the noise analysis to illustrate the population health issues are the size of population exposed to noise levels above which adverse effects on health and quality of life can be detected (LOAEL); or the level above which significant adverse effects on health and quality of life occur (SOAEL). The POE of Mr Williams shows that the threshold used for SOAEL is consistent with that adopted in other recent UK airport planning applications.
- 4.3.21 The ES explains that the SOAEL is a significance threshold to rate health effects, but that it differs from EIA significance in that the SOAEL is a measure of the absolute noise level, whereas an ES assesses the significance of the proposed change (ES para 7.9.4). For air noise, the relationship between ‘absolute’ thresholds and ‘relative’ change when determining magnitude for the noise assessment is described in ES Table 7.22. The relative change is important context to any exceedance of the SOAEL as very small changes, even above the SOAEL, may in practice not be discernible to most people within the context of the existing airport activity. The relative change also provides an indication on the likely effectiveness of mitigation. Small changes are likely to be offset with insulation improvements.
- 4.3.22 As noted by NSC Officers in their Committee Report:

*The application assesses the projected noise impacts using the LAeq (equivalent continuous A-weighted sound pressure level over a defined period of time) noise metric. This accords with current policy.*

- 4.3.23 This conclusion on the validity of the noise metric is consistent with that in the recent Stansted Appeal Decision (para 45). This is discussed further in the POE of Mr Williams.
- 4.3.24 In 2018, the WHO published its Environmental Noise Guidelines (ENG) for the European Region. Regard has been had to the WHO guide values. However, the assessment does not hold the Appeal Proposal to WHO guide values where they are different to UK guidance and regulation. This is consistent with the Government’s statement at paragraph 3.106 of Aviation 2050, which states:

*“The government is considering the recent new environmental noise guidelines for the European region published by the World Health Organisation (WHO). It agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of action and recent UK specific evidence which the WHO report did not assess.”*

4.3.25 The recent Stansted Appeal Decision (para 37) found that in relation to the UK Government position quoted above “*These factors limit the weight that can be given to the lower noise levels recommended in the ENG.*”

4.3.26 The WHO systematic review<sup>29</sup> that informed the ENG notes why it does not recommend limit values for awakenings:

*It is currently unclear how many additional noise-induced awakenings are acceptable and without consequences for sleep recuperation and health, especially given the large inter-individual differences in the susceptibility to noise.*

4.3.27 The systematic review also notes more generally in relation to setting of limit values

*As exposure-response functions are typically without a clearly discernible sudden increase in sleep disturbance at a specific noise level and because of individual variation in noise sensitivity, defining limit values ... usually involves expert judgement of the existing evidence ... and political weighing of negative health consequences of noise and societal benefits of the noise source.*

4.3.28 ES paragraph 16.11.18 notes that the greatest potential for population level changes to health relates to night-time air noise (exposure at or above the SOAEL for 100 more dwellings when comparing the 2026 ‘with development’ and the 2026 ‘without development’ scenarios).

4.3.29 Whilst ground noise and road traffic noise are also associated with some exposures at or above the SOAEL, the extents are smaller i.e. fewer dwellings are affected.

4.3.30 For the LOAEL, the extents are larger (the largest being night-time air noise affecting 900 more dwellings when comparing the 2026 ‘with development’ and the 2026 ‘without development’ scenarios). These noise levels would be expected to make a smaller contribution to any change in population health compared to levels at the SOAEL or above.

4.3.31 ES paragraph 16.11.19 notes the mitigation taken into account in reaching a conclusion on the magnitude of the noise effects to health. This includes the expected benefits from the existing air noise insulation scheme and expected air fleet modernisation over time (i.e. quieter planes).

4.3.32 The changes in magnitude are in the context of the sensitivity of the population affected. The sensitivity scores reflect that most people in the affected dwellings are likely to have up to a medium sensitivity, this is the ‘general population’ group. A smaller number are likely to have high sensitivity, this is the ‘vulnerable population’ group.

4.3.33 ES paragraph 16.11.20 explains that the general population’s sensitivity reflects existing noise stressors (from air noise, ground noise and road traffic noise) and a heightened sensitivity to aviation noise as an issue. The vulnerable population group’s sensitivity is linked to a range of characteristics, including: living close to sources of noise; existing poor health; spending more time in affected dwellings; and the potential for more deprived communities to live in areas of high noise disturbance, such as under night-time flight paths.

4.3.34 The high sensitivity score also recognises that some people will have strong views or high degrees of uncertainty about the Proposed Development, which may be associated with health effects even below thresholds that are generally considered acceptable.

4.3.35 The health assessment thus acknowledges that, relative to the study area population, the health of a small proportion of people is likely to be sensitive to the change in noise effects of the Appeal Proposal. This change in noise is considered small as it is relative to existing permitted aviation growth at the airport. The assessment then places this change within its context.

4.3.36 Linked to further detail in ES Appendix 16A, ES paragraph 16.11.21 summarises key contextual evidence sources against the guide questions for determining health significance. It shows that:

- there is scientific evidence for noise related health effects, though thresholds are uncertain;
- the baseline close to the airport is already strongly influence by transport noise;
- relevant public health priorities link, in general terms, with noise as a determinant of health;
- consultation has raised concerns about sleep disturbance due to night-flights;
- with mitigation and control measures implemented, the changes due to the Appeal Proposal are assessed as meeting relevant standards; and
- the health policy context of North Somerset Council raises expectations in relation to achieving 'acceptable' noise levels through mitigating and monitoring.

4.3.37 I stand by my reasoned and evidence-based professional judgment that, the EIA health significance for noise effects would be negligible for the general population and up to minor adverse (not significant in EIA terms) for vulnerable groups. This reflects the points made in section 4.2 of this POE on determining health significance and reaching population health conclusions. It also reflects that mitigation, including the insulation scheme, would be available and would be conditioned as part of any approval.

4.3.38 In relation to this conclusion NSC Officers stated in their Committee Report:

*The HIA indicates that the health effects from operational noise and vibration are most likely to impact on mental health conditions (stress, anxiety or depression), sleep disturbance and cognitive performance in children. Cardiovascular health impacts could also be an associated factor. The significance of the effect would be negligible for the general population and up to minor adverse (not significant) for vulnerable groups. The small increase in exposure for much of the local population is unlikely to result in a significant population health effect, but this affect is no more than 'minor adverse'. Officers' assisted by PHE comments agree with this assessment.*

*This however is dependent on noise mitigation being implemented. This will comprise operational restrictions and acoustic mitigation which will be controlled through planning conditions. This is further explained in set out in 'Issue 5. The effect of this mitigation will require BAL to commit to a higher proportion of modern (quieter) aircraft being based at BA, with more stringent controls at night, where night impacts are, for most, more sensitive. The current noise insulation grant scheme is also improved. Officers consider these measures will limit the impacts on noise between the consented baseline and proposed development to acceptable levels in accordance with current policy.*

### **Operational Air quality**

4.3.39 The conclusion of the ES Health chapter operational air quality assessment is that the significance of the effect would be **negligible** for the general population and up to **minor adverse** (not significant in EIA terms) for vulnerable groups.

4.3.40 The conclusion reflects the UK Government view that compliance with UK Air Quality Standards demonstrates an acceptable level of health protection and that these air quality protection measures are produced in the knowledge that particular groups within a population will have particular health vulnerabilities<sup>7</sup>. The operational air quality effects should be considered long-term, making an incremental addition to air quality related risk factors for population health.

4.3.41 The UK Air Quality Objects (AQOs) are derived from, and are numerically identical to, the UK Air Quality Standards.

*UK Government, Department for Environment, Food and Rural Affairs, Definitions: <sup>28</sup>*

*Air Quality Standards are concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment.*

4.3.42 In reaching its conclusions the ES Health chapter references the ES Chapter 8: Air Quality assessment (CD2.5.19) for relevant quantitative inputs, notably conclusions of air pollutant concentrations relative to UK AQOs. As noted above, these are the standards that the UK Government, as the relevant jurisdiction, has determined are acceptable in terms of their effect on population health.

4.3.43 Based on the ES Air Quality assessment the health assessment notes that changes in concentrations of all modelled air pollutants are within UK AQOs, levels considered acceptable.

4.3.44 As noted by NSC Officers in their Committee Report:

*The method used to establish the air quality results and the number and distribution of the assessment locations provide a realistic projection of the impacts.*

*... there is no objection to the proposed development in terms of air quality, which complies with Policy CS3 of the North Somerset Core Strategy, the relevant legislation and other policy including the NPPF and APF.*

4.3.45 The health assessment focuses on the discussion of nitrogen dioxide (NO<sub>2</sub>) and the finer fraction of particulate matter (PM<sub>2.5</sub>). These are the main combustion related air pollutants that affect health, and which may change due to the Appeal Proposal.

4.3.46 Recognising the non-threshold nature of some air pollutants the health assessment has had regard to WHO guide values. However, consistent with UK air quality policy, the assessment does not hold the Appeal Proposal to WHO guide values where they are more stringent than the UK AQOs.

4.3.47 ES paragraph 16.11.8 explains that for health, the magnitude of the change due to the Proposed Development is considered medium. This reflects a precautionary view that, although not exceeding the UK AQO, in the case of NO<sub>2</sub> there is small increase in concentrations at a small number of receptors that would approach the UK AQO. This caution takes into account scientific evidence that, for some pollutants, there is no known exposure threshold level below which adverse health effects may not occur. It is also noted that the existing baseline accounts for the majority of exposure.

4.3.48 ES paragraph 16.11.8 discusses the sensitivity of the affected population. The majority of those exposed are represented by the 'general population' score of low sensitivity. This reflects that most people live, work or study at a distance from Bristol Airport where emissions would benefit from high levels of dispersion, reducing exposure. Furthermore, most people enjoy good respiratory health and are not at a life stage for which lower levels of emissions could be of concern.

4.3.49 For some people the sensitivity would be greater. This 'vulnerable population group' is scored as having high sensitivity to air quality. This reflects the presence of people likely to spend extended periods near to Bristol Airport or parts of the local road network that are expected to experience additional vehicle movements. It also reflects the generally higher sensitivity of children and older people to air pollution. Within these groups people with existing respiratory conditions may be particularly sensitive.

4.3.50 The health assessment thus acknowledges that, relative to the study area population, a small minority of the population are likely to be sensitive to the changes in air quality that are due to the Appeal

Proposal. The change in air quality to a small number of people is considered to be of medium magnitude for health, taking a precautionary approach to non-threshold health effects. The assessment then places this change within its context.

4.3.51 Linked to further detail in ES Appendix 16A, ES paragraph 16.11.10 summarises key contextual evidence sources against the guide questions for determining health significance. It shows that:

- there is scientific evidence from sufficiently high-quality studies to support an association between air pollutants (including NO<sub>2</sub> and PM<sub>2.5</sub>) and health. The literature also shows the potential for non-threshold health effects, including for NO<sub>2</sub> and PM<sub>2.5</sub>;
- the baseline conditions show that there is a population, including people with increased sensitivity to air quality, that are likely to be at work, or at home, close to the airport and relevant parts of the road network;
- relevant public health priorities link with air quality as a determinant of health;
- with mitigation and control measures implemented, operational emissions of the Appeal Proposal would be within statutory requirements (UK AQOs); and
- the health policy context of North Somerset Council raises expectations in relation to achieving 'acceptable' air quality levels through mitigating and monitoring.

4.3.52 On this basis, the conclusion of the assessment for human health is that the significance of the effect would be negligible for the general population and up to minor adverse (not significant in EIA terms) for vulnerable groups. This represents a reasoned and evidence-based conclusion. This seeks to balance the fact that there will be some health effect among people who are vulnerable with the stated Government policy, which takes account of all population groups. It gives weight to the fact that the UK Government health protection standards for acceptable air quality would be met.

4.3.53 The minor adverse (rather than negligible) score for vulnerable groups represents a conservative assessment on the basis of scientific uncertainty (and emerging evidence) about non-threshold health effects of NO<sub>2</sub> and PM<sub>2.5</sub>. This acknowledges the incremental contribution to air pollution that the Appeal Proposal would make, but also recognises that, at the project level, this should not be considered a significant effect on population health.

4.3.54 In relation to this conclusion NSC Officers stated in their Committee Report:

*In terms of air quality, the HIA focusses on the impacts of nitrogen dioxide (NO<sub>2</sub>) and Particulate Matter (PM) dispersion, which are the main combustion-related air pollutants. They say the main health outcomes could be increased risk of cardiovascular and respiratory related conditions. All projected changes in concentrations of all air pollutants will however remain within statutory acceptable levels as set by the World Health Organisation in terms of health protection. Officers agree with this based on the results on the air quality assessment in 'Issue 7'. To that extent the health impact is contended to be 'negligible' to the wider population and 'minor adverse' to vulnerable groups. No specific action is required other than ongoing monitoring of air quality. Only if air quality reduced and did not comply with acceptable public health standards would intervention be required.*

### Operational Socioeconomic

4.3.55 Employment is an important determinant of health and well-being. Effects occur both directly and indirectly by making financial resources available to an employee and any dependants that can be used to promote health. The socio-economic benefits associated with employment are improved

living conditions and the potential to make healthier choices, e.g. eating a healthier diet and undertaking more physical activity. If members of the community are employed, this can also generate indirect economic activity.

- 4.3.56 The conclusion of the ES Health chapter operational economic assessment is that the significance of the effect would be up to **minor beneficial** for the general population and up to **moderate beneficial** (significant in EIA terms) for vulnerable groups.
- 4.3.57 The provision of long-term good quality employment opportunities (directly at Bristol Airport, or indirectly through wider economic investment within the region facilitated by the expansion) should be considered likely to have a long-term beneficial effect on population health.
- 4.3.58 In reaching its conclusions the ES Health chapter references the ES Chapter 15: Socio-economics assessment (CD2.5.41) for relevant quantitative inputs, notably direct and indirect employment. The jobs are expected to be filled by existing residents, rather than an influx of new residents taking up these roles.
- 4.3.59 ES paragraph 16.11.40 explains that for health, the magnitude of the change due to the Appeal Proposal is considered medium. This reflects the potential for long-term health benefits through good employment opportunities. Benefits could include reducing levels of poverty and inequalities, as well as facilitating healthier decision-making behaviours through additional household resources. The effects are expected to be greatest at the local level (North Somerset), but also extend to the regional level (South West England and South East Wales).
- 4.3.60 ES paragraph 16.11.41 finds the sensitivity of the general population to be low. This reflects that the majority of people would already be within stable employment that would be unaffected. However, for the vulnerable population group sensitivity to the benefits of employment are considered to be high. Vulnerability in this case relates to people and their dependants who are on low incomes or who are unemployed. Young people, including leaving education or early in their careers may have the most to gain from an increase in good quality job opportunities. Future young or older people may also come to rely on those employed. The Appeal Proposal's Skills and Employment Plan includes measures focused to vulnerable groups.
- 4.3.61 Linked to further detail in ES Appendix 16A, ES paragraph 16.11.42 summarises key contextual evidence sources against the guide questions for determining health significance. It shows that:
- the scientific literature supports an association between employment opportunities and health and wellbeing outcomes;
  - the baseline shows the conditions to achieve for employment related health benefits are likely to be present, including in relation to unemployment and inequalities;
  - relevant public health priorities link economic effects with determinants of health;
  - the health policy context promotes an employment-led approach to achieve a more sustainable alignment between jobs and the economically active population.
- 4.3.62 In these circumstances it is reasonable to conclude that there would be up to minor beneficial population health effects for the general population and up to moderate beneficial (significant in EIA terms) for vulnerable groups.
- 4.3.63 In relation to this conclusion NSC Officers stated in their Committee Report:

*The HIA indicates that the main socio-economic health related impacts of the proposal are positive in that the provision of long-term good quality employment opportunities (directly at Bristol Airport, or indirectly through wider economic investment within the region facilitated by the expansion) are likely to have a long-term beneficial effect on population*

*health locally and, to a lesser extent, regionally. Such benefits could include reducing levels of poverty and inequalities. The impacts are contended to be ‘minor beneficial’ for the general population and up to ‘moderate beneficial’ for vulnerable groups. While the scale of the benefits set out in BAL’s economic impact assessment are considered (based on an independent assessment) to be lower than claimed by BAL. they would still provide long-term good quality employment opportunities, and this is likely to have a long-term beneficial effect on population health.*

## 4.4 Summary of the ES Addendum

### Overview of the ESA Health section

4.4.1 Section 9 of the ES Addendum supplements Chapter 16: Human Health of the original ES.

4.4.2 This supplementary information takes account of the following:

- Updated forecast aircraft fleet mix and movement numbers (aircraft and road traffic) driven by updated passenger demand forecasts. The updated forecasts take account of the COVID-19 pandemic and longer-term factors in the UK and world economies, such as BREXIT;
- Change in Assessment Year from 2026 to 2030 (year in which 12 mppa will be reached). 2030 is the Core Case assessed within this chapter;
- A Faster Growth Case (where 12 mppa is reached in 2027) and a Slower Growth Case (where 12 mppa is reached in 2034) in comparison to the Core Case; and
- Details of the assumptions and modelling of updated forecasts, as set out in the Passenger Traffic Forecasts report accompanying the ES Addendum.

4.4.3 The assessment uses the Core Case of 2030 as the Assessment Year. Sensitivity testing of the Faster Growth Case (2027) and Slower Growth Case (2034) has been undertaken on a qualitative basis.

4.4.4 The methodology used is the same as the ES.

4.4.5 The delay in reaching the 12 mppa year acts to both delay the negative effects and delay the positive effects. It also spreads a given effect over a longer duration.

4.4.6 Broadly the relationship between the ‘With Development’ and ‘Without Development’ scenarios remain the same as in the ES.

4.4.7 The ES health chapter assessment conclusions remain valid when considered against the Core Case of 2030 rather than 2026.

### Faster and Slower Growth Scenarios

4.4.8 The ESA health chapter concludes, following a qualitative analysis, that neither the Core Case, nor the Faster or Slower Growth Cases would change the conclusions of the ES health chapter.

4.4.9 The Faster Growth Case (12 mppa in 2027) would have had three year’s less opportunity to progress fleet modernisations. Aircraft emission levels (e.g. air and ground noise) would therefore be expected to be slightly higher. There would also be three years less population and economic growth, though the rate of economic growth is assumed to be faster than the Core Case. The relative ‘With Development’ compared to ‘Without Development’ change is likely to be small given the Faster Growth Case brings forward both the year 10 mppa is reached and the year 12 mppa is reached. The Faster Growth Case is characterised as being slightly ‘more intensive’ but potentially affecting a slightly

smaller population. By way of context, the ESA Fast Growth scenario, 12 mppa by 2027, is not as fast as the ES scenario of 12 mppa by 2026.

- 4.4.10 The Slower Growth Case (12 mppa in 2034) would have had four additional years to progress fleet modernisations. Aircraft emission levels (e.g. air and ground noise) would therefore be expected to be slightly lower. Road traffic emissions may increase over time due to an increase in the number of vehicles on the road. By 2034 vehicle and road surface modernisations including the transition to electric vehicle may, however, also act to reduce emissions to air and noise. Under the Slower Growth Case there would also be four years more population and economic growth compared to the Core Case, though the rate of economic growth is assumed to be slower. The Slower Growth Case is characterised as being slightly 'less intensive' but potentially affecting a slightly larger population.
- 4.4.11 For the Faster and Slower Growth Cases, as with the Core Case: the beneficial economic effects are considered significant for population health; and the adverse effects are considered not significant for population health.
- 4.4.12 As noted in the recent Stansted Appeal Decision (para 30), the precise timing of growth does not have a material effect on adverse impacts, though there may be socio-economic benefits to early grant of planning permission, compared to delay, linked to certainty for airline and airport investors.

### Operational Noise

- 4.4.13 The ESA concludes that the ES health chapter assessment conclusions remain valid.
- 4.4.14 The assessment identifies similar or lower impacts when compared to the original ES.
- 4.4.15 The greatest potential for population level changes to health continue to relate to the night-time air noise SOAEL. The forecast change in night-time aircraft movements in 2030 with the Appeal Proposal equates to an additional three arrivals and four departures (ESA Table 6.18). The changes do not commence before 23:30. All changes in departures are after 06:00. As with the ES, the annual limit of 4,000 night-time aircraft movements does not change with the Appeal Proposal. The POE of Mr Williams discusses the limited effect of removing seasonal restrictions.
- 4.4.16 The ES gives the difference between the 'With Development' and 'Without Development' scenarios in 2026. The ESA gives the difference between the 'With Development' and 'Without Development' scenarios in 2030. I now discuss the change in the difference between the 'With Development' and 'Without Development' scenarios when comparing the 2026 and 2030 models. This shows how the quantitative input the health assessment changes between the ES and the ESA. I do this first for SOAEL, then for LOAEL.
- 4.4.17 As described in ESA paragraph 9.5.22, the difference between the 'With Development' and 'Without Development' scenarios is an increase of 50 dwellings above the SOAEL in the ESA 2030 model compared to the ES 2026 model. This gives a total of 150 more dwellings above the SOAEL (55  $L_{Aeq,8h}$  contour, air noise dwelling counts for an average mode summer night) with the Appeal Proposal (i.e. comparing 10 mppa in 2030 vs 12 mppa in 2030). This is however in the context of:
- an overall trend of reducing noise levels and consequently reducing numbers of affected dwellings above the SOAEL in 2030 compared to 2026;
  - of the dwellings affected above the SOAEL, the level of exposure above SOAEL is decreased in 2030 compared to 2026 (see the 57  $L_{Aeq,8h}$  contour); and
  - for all dwellings, including those above the SOAEL, the noise level change between the 2030 10 mppa and 12 mppa scenarios is negligible, see ESA Appendix 6A: Noise and Vibration Supporting Data Table 6A.63 (CD2.20.4).

- 4.4.18 A minor adverse effect continues to be considered appropriate to reflect that a small minority of the local population would be affected.
- 4.4.19 In relation to noise for those affected at the LOAEL (particularly at night), the incremental effect to a larger number of people is in population health terms not negligible; but equally, given the very small change and the many other sources contributing to the local soundscape, it continues to be considered a not significant project level effect. The POE of Mr Williams discusses operational controls, including the caps and contours, that restrict the noise effects of the Appeal Proposal.
- 4.4.20 In quantitative terms, as described in ESA paragraph 9.5.22, there is an improvement between the ES 2026 model and the ESA 2030 model, that is, the change in the difference between the 'With Development' and 'Without Development' scenarios when comparing the 2026 and 2030 models. The change is from 600 more dwellings at the LOAEL instead of 900 more dwellings at the LOAEL; in other words, a reduction (improvement) of 300 dwellings.
- 4.4.21 The overall picture for air noise is thus of similar or reducing numbers of dwellings being affected by elevated night-time noise levels. The same trend applies to day-time noise. There is little change in ground noise or road traffic noise comparison of original ES.
- 4.4.22 The original ES health chapter assessment conclusions remain valid. The original ES health chapter conclusion was that the effect would be negligible for the general population and up to minor adverse (not significant) for vulnerable groups.

#### **Operational Air quality**

- 4.4.23 The ESA concludes that the ES health chapter assessment conclusions on operational air quality remain valid.
- 4.4.24 The ESA concludes that NO<sub>2</sub> effects on human health would be lower than reported in the ES and that conclusions for PM<sub>2.5</sub> are unchanged from the ES (with some minor variations in modelled concentrations).
- 4.4.25 The ES air quality assessment identified moderate adverse impacts at seven receptors that are reduced in the ESA due to: emissions factors improving over time; updated data on the performance of Euro 6c cars; and improved modelling of traffic queues.
- 4.4.26 On the basis that the inputs to the health assessment show either no change or an improvement, the conclusion of the ESA is that the ES health chapter's findings are unchanged.
- 4.4.27 The ES health chapter conclusion was that the effect would be negligible for the general population and up to minor adverse (not significant) for vulnerable groups.

#### **Operational Socioeconomic**

- 4.4.28 The ESA concludes that the ES health chapter assessment conclusions on socioeconomic effects also remain valid.
- 4.4.29 The ESA socioeconomic assessment finds that the population and economy are forecast to have underlying long-term growth and that the conclusions of the ES are unchanged. Notably, the Gross Value Added (GVA) from the Appeal Proposal remains major in comparison to the local economy and the increases in jobs remain major in comparison to the level of claimant unemployment for the local economy.
- 4.4.30 In contrast to the spreading out of environmental emissions over a longer time period, which tends to reduce exposures and therefore lessen the adverse effect, the spreading out of economic benefits over a longer time period tends to lessen the beneficial effect. However, the economic effects of

COVID-19 may increase the sensitivity of the economy to economic stimulus, investment and opportunities to increase employment in a context of higher rates of unemployment.

- 4.4.31 For the health assessment, any delay in the timeframe over which operational jobs come forward is likely to be balanced (or exceeded) by the increased relative benefit of those jobs to health outcomes (including for dependants) in an economic climate of (potentially) increased unemployment.
- 4.4.32 Thus, the socio-economic benefits to health remain likely to occur but would be realised later than the original assessment forecasted. On this basis the ES health chapter conclusions for economic health benefits are unchanged.
- 4.4.33 The ES health chapter conclusion was that the effect would be up to minor beneficial for the general population and up to moderate beneficial (significant) for vulnerable groups.

## 5 Response to Issues Raised by North Somerset Council and Third Parties

### 5.1 Overview

- 5.1.1 NSC Decision Notice RFR 2 states:

*“The noise and impact on air quality generated by the increase in aircraft movements and in particular the proposed lifting of seasonal restrictions on night flights would have a significant adverse impact on the health and well-being of residents in local communities and the proposed development would not contribute to improving the health and well-being of the local population contrary to policies CS3, CS23 and CS26 of the North Somerset Core Strategy 2017.”*

- 5.1.2 This is a two-part statement:

- NSC are stating that the effects from noise and air quality would have a significant effect on residents’ health; and
- the Appeal Proposal will not contribute to improving the local population’s health.

- 5.1.3 Variations on these two statements are elaborated on in the NSC SOC. I therefore respond to RFR 2 through the specific points made in the NSC SOC. This is set out below.

- 5.1.4 First, I would like to reiterate the following key points that apply across this section of my POE:

- The noise, air quality, and socioeconomic POEs show that their individual assessments are robust. These assessments are inputs for the health assessment.
- The ES and ESA health assessment methods for determining significance are in line with national and international publications on good practice, see section 4.2.
- Whilst there would be some adverse health effects, it is reasonable to describe these as not significant population level health effects. There are also significant beneficial population health effects.

- There is general agreement between the ES/ESA health assessment and NSC Officers who were advised by the Council’s Public Health Team and by Public Health England, as set out in the Committee Report.

## 5.2 North Somerset Council Statement of Case

5.2.1 The NSC SOC states (paragraph 6) that:

*In essence, BAL has overstated the economic and other benefits of the Proposed Development and understated the environmental and social harm that the Proposed Development would cause. [emphasis added]*

5.2.2 I disagree with this statement as it applies to the health assessment. I have shown in section 4.3 and section 4.4 of this POE that the ES and ESA present reasoned, evidence-based, professional judgments as to the population health significance of the beneficial and adverse effects. These conclusions are consistent with those reached by NSC Officers, supported by the Council’s Public Health Team and by Public Health England.

5.2.3 The health conclusion are informed by inputs from other assessments, which are shown to be robust in the POEs of Mr Williams in relation to noise, Mr Peirce in relation to air quality and Mr Brass in relation to socioeconomics.

5.2.4 I have described in section 4.2 the health assessment methodology used, including that this aligns with national and international EIA good practice. I showed how the reaching of a conclusion of EIA health significance is the endpoint of a careful and structured analysis. I also showed that the methods draw together evidence sources and professional perspectives to build consensus. A consensus that was reached with NSC Officers.

### Noise

5.2.5 The NSC SOC states (paragraph 61) that:

*The Council’s position is that the increase in aircraft movements and the lifting of the current seasonal restrictions on night flights arising from the Proposed Development would have a significant adverse impact on the health and wellbeing of residents in local communities [emphasis added].*

5.2.6 I am concerned by two aspects of the NSC SOC assertion. Firstly, I disagree that there is a ‘significant’ effect. Secondly, and linked to this, the conclusion should relate to ‘population health’. The general way in which the statement is linked to ‘residents’ implies this is not a population health conclusion.

5.2.7 On the first point. I have explained in section 4.2 of this POE that ‘significant’ has a technical meaning in EIA that attaches weight to an issue within the planning determination. That label should be the output of a careful and structured analysis. I have shown in section 4.3 how such an analysis was undertaken within the ES and in section 4.4 how this was confirmed in the ESA. I find the change in noise level to be negligible for the general population and minor adverse for vulnerable groups. These conclusions acknowledge that there would be a small change in health-related risk factors for a small minority of the population. In public health terms this is not an unacceptable level of change in risk factors in the context of other noise sources and other influences on population health. It is thus not a significant change. My conclusion that the effect is not significant aligns with that of NSC Officers, who took advice from the Council’s Public Health Team and Public Health England.

5.2.8 On the second point. NSC appear not to be taking a public health, population level, approach. The framing of the conclusion in relation to ‘residents in communities’ is ambiguous. As noted in section

4.2 of this POE, all development has the potential for significant adverse effects to some particularly sensitive individuals. To determine the significance of effects on that basis would mean all issues, positive and negative, considered within a health assessment would be significant. This does not help the decision-making process. I am clear that a public health approach should be taken, i.e. conclusions should relate to populations, including vulnerable population groups. In my opinion the NSC SOC (para 61) statement is not consistent with taking a population health approach. The ES and ESA show that, in population health outcome terms, significant health effects are not expected. This conclusion extends to the sub-population of people, including residents, who may be more sensitive to noise.

5.2.9 Whilst it would not be proportionate to quantify, qualitatively it can be noted that even within this sub-population who experience increased noise and who are potentially more sensitive to its effects, only a proportion would experience a change in risk factors; and of those, only a further sub-proportion may experience a change in health outcomes. This small minority is further reduced as all properties above the SOAEL at night would be eligible for the enhanced noise insulation scheme that accompanies the Appeal Proposal. This scheme does not require matched contributions by residents, making it more widely accessible, including for those on low incomes. Given the targeted mitigation, the potential for adverse changes in health outcomes within the vulnerable group sub-population due to the Appeal Proposal is therefore limited.

5.2.10 The following points from the WHO systematic review<sup>29</sup> on noise are also noted as they give context to any change in noise levels:

*Noise is only one reason for sleep disturbance. There are many other external (e.g., temperature, humidity, light levels) and internal (e.g., sleep disorders, health conditions, bad dreams) causes.*

*Whether or not noise will disturb sleep also depends on situational (e.g., depth of sleep phase, background noise level) and individual (e.g., noise sensitivity) moderators.*

*A healthy adult briefly awakens ca. 20 times during an 8 h bed period (most of these awakenings are too short to be remembered the next morning).*

5.2.11 The NSC SOC states (paragraph 46) that:

*Thus, at a national and a local policy level, development which gives rise to unacceptable noise impacts including those relating to health and quality of life, will be contrary to the Development Plan and contrary to the NPPF [46].*

5.2.12 I have shown that from the health perspective that there is a strong case to conclude that the changes in noise, as they affect population health, are not unacceptable in public health terms. The planning balance is discussed in the POE of Mr Melling. Further points are made in the POE of Mr Williams.

5.2.13 The NSC SOC states (paragraph 52) that:

*The Council intends to explore whether the methodology employed underplays the potential impact upon health/quality of life as a result [52].*

5.2.14 I have been clear about the robustness of the health methods used. Similarly, Mr Williams set out the case for the robustness of the noise methods in his POE. The methods of both are in accordance with UK Government policy.

5.2.15 It is worth reflecting that the aim of the health method is not to detect the most significant adverse effects to the most sensitive individuals. As noted in section 4.2, it would not be a proportionate or valuable assessment if it focused on confirming the worst-case individual level effects. Rather, the health assessment methodology aims to give a public health perspective of how changes in noise are

influencing health related risk factors at the population level, including for vulnerable groups. The key metrics (LOAELS and SOAELS) summarised from the ES noise analysis to illustrate the population health issues are therefore appropriate. It is my view that the health analysis is proportionate and accessible in the metrics it uses.

- 5.2.16 Looking across the arguments made by the NSC SOC in relation to noise, the following additional points can be made to given confidence to the health assessment conclusions and that they take a conservative approach.
- 5.2.17 In addition to the average noise exposure metric, which is the correct policy requirement, other supplementary indicators, including the potential to be highly sleep disturbed and Single Event Level (SEL), have been used to provide context to the changes (see ES para 7.1.5 to 7.1.22).
- 5.2.18 In terms of the number of people potentially highly sleep disturbed, effects would be similar to the 2017 baseline and under peak effects of current consented growth to 10 mppa (see ESA Table 6.11). There is an increase of less than 100 people with the Appeal Proposal in 2030. The actual number are likely to be less, as this does not account for the expected benefits of the noise insulation grant scheme. The indicator shows that a small minority of people may be sleep disturbed by the existing airport activity and that the great majority of these people would continue to be sleep disturbed with or without the Appeal Proposal. This supports my view that significant population health effect from the change due to the Appeal Proposal are unlikely.
- 5.2.19 Also relevant to sleep disturbance is that flight paths are not changing as part of this Appeal Proposal. Consequently, for those affected, the change is a small relative addition to overflights already experienced. This is important context, as the literature<sup>29</sup> (Basner, 2018) notes that whilst evidence is limited and habituation is not complete, *“subjects exposed to noise usually habituate”*. For example, *“exposure-response relationships derived in the field (where subjects have often been exposed to the noise for many years) are usually much shallower than those derived in laboratory settings...”*<sup>29</sup>.
- 5.2.20 In terms of the number of dwellings exposed to individual high noise events from aircraft at least once per night (e.g. at least 90dB SEL) the number with the Appeal Proposal is no difference from without the Appeal Proposal. Put another way, the noisiest night-time flight does not change. This indicates that there is limited potential for people who are not currently woken by a passing night flight to be woken by the changes due to the Appeal Proposal.
- 5.2.21 These supplementary indicators, consistent with the main average noise exposure metric, support the conclusion that significant population health effects due to the Appeal Proposal are unlikely. The trends reflect that noise exposure levels are predicted to rise slightly as aircraft movements increase under the 12 mppa scenario, as compared to the 10 mppa scenario, with little difference in fleet mix. (ES para 7.10.71).
- 5.2.22 Finally on noise I would like to address a viewpoint, which I do not hold, but which some may take. This is that ‘any’ exceedance of the SOAEL constitutes a significant EIA adverse health effect, even if the relative change is small and a significant ‘population’ health effect is unlikely. If that viewpoint is taken, then the existing baseline and consented increase to 10 mppa would both already exceed this threshold (see ESA Table 6.9). On this viewpoint there would be similar significant adverse health effects currently, with consented growth to 10 mppa and with the Appeal Proposal. The position for the decision maker would be of no change in terms of the significance of noise related health effects either with or without the Appeal Proposal.
- 5.2.23 As I have shown in section 4.2, it is my view, and that of national and international good practice, that a population health approach is the appropriate framing. Consequently, it is reasonable to conclude that the Appeal Proposal would not have significant adverse population health effects from noise.

## Air quality

5.2.24 In RFR 2 the wording also implies that a 'significant' air quality effect on the health of residents is anticipated. This air quality assertion is not reiterated within the NSC SOC, except on a very specific point about ultra-fine particulates. However, the same points made above (para 5.2.5 to 5.2.8), in relation to the framing of conclusions on the significance of noise related population health effects, also apply to the EIA health assessment of air quality.

5.2.25 The NSC SOC does state (paragraph 73) that:

*The Council will contend that in relation to air quality the Proposed Development will not contribute to improving the health and well-being of the local population – indeed, it will result in an increase in emissions of air pollutants and consequential increased risk to health, contrary to Policy CS26 of the CS [emphasis added].*

5.2.26 I would simply point out in relation to this statement that the NSC SOC is being very selective in singling out a single adverse effect as the sole basis for this policy test. It is also an adverse effect that has been shown to be not significant. If this approach is taken consistently every development would fail this policy test.

5.2.27 It is my view that this policy test can only be usefully explored based on the overall balance of effects from the Appeal Proposal, including giving more weight to those effects that are shown to be significant.

5.2.28 As show in section 4.3 for the ES, and confirmed in section 4.4 for the ESA, the economic beneficial effects of the Appeal Proposal are likely to be moderate and extend to the population level; whilst the adverse environmental exposures are incremental in their level of change and limited to a small minority. Even if the basis for significance is re-weighted, consistently applied this would not change the overall picture that on balance as the Appeal Proposal is likely to contribute to improving the health and well-being of the local population more than it detracts from it.

5.2.29 I accept that there is some increase in emissions of air pollutants and consequently some increase in risk to health. I do not accept that this results in a significant population level health effect. Furthermore, I do not accept that the statement that '*the Proposed Development will not contribute to improving the health and well-being of the local population*' can fairly, or helpfully, be determined on this one measure.

5.2.30 RFR 2 makes the policy test statement more generally without specific reference to air quality. This implies a more overarching approach was perhaps intended. I consider this overarching approach is more appropriate. However, as shown above, the balance of population health effects reported in the ES and ESA does not support the RFR 2 conclusion.

5.2.31 Consequently, whilst the NSC Decision Notice is entitled to reach its own professional judgment, I find it hard to reconcile the NSC Decision Notice RFR 2 conclusion with an evaluation of significance using the appropriate methods for assessment, as presented in the ES. The NSC Decision Notice does not reference alternative methods or evidence sources as part of a reasoned conclusion.

5.2.32 The NSC SOC states (paragraph 74) that:

*...the Council will contend that increases in exposure even below air quality objectives increases the risk of harm to health and well-being [74].*

5.2.33 This issue is acknowledged in the ES, see section 4.3. The ES health assessment has specifically taken this point into account in reaching its conclusions on population health.

5.2.34 However, it is also the case the AQOs are the relevant standard to benchmark health protection acceptability, as set by the UK Government. AQOs are standards that the UK Government states are “considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health”.

5.2.35 The NSC SOC states (paragraph 82) that:

*Furthermore, the ES does not demonstrate that the Proposed Development would avoid adverse impacts on health due to increases in levels of PM<sub>2.5</sub> and nitrogen dioxide, in the context of evidence that health impacts arise at levels below current standards, and the expected tightening of PM<sub>2.5</sub> standards over the lifetime of this development [82].*

5.2.36 I find that NSC are setting an unreasonably high bar with this statement. Almost all development is likely to make a small contribution to PM<sub>2.5</sub> and NO<sub>2</sub>. Whilst the non-threshold nature of health effects from these pollutants can be acknowledged, as is the case with the ES; any increase in concentrations has to be placed within the context of acceptability in terms of health protection standards, i.e. AQOs. It is not possible to ‘avoid’ the small change in health-related risk factors associated with a small change in PM<sub>2.5</sub> and NO<sub>2</sub> exposures. Requiring such would preclude all development.

5.2.37 The Appeal Proposal’s consistency with the PM<sub>2.5</sub> policy position is discussed in the POE of Mr Peirce.

5.2.38 The recent Stansted Appeal Decision (para 61) reached the same conclusion in relation to the acceptability development making some contribution to air pollution: “The overall effect of the development in terms of air quality would be in accordance with the [NPPF] and with the Clean Air Strategy, which refers to the need to achieve relevant air quality limit values. While the [NPPF] seeks to improve air quality where possible, it recognises that it will not be possible for all development to improve air quality.”

5.2.39 The NSC SOC states (paragraph 80) that:

*The Council is also particularly concerned to ensure that the potential impacts of increases in ultrafine particles are considered and given weight in the decision making process, as envisaged in para. 3.127 of Aviation 2050 [80].*

5.2.40 The issue of ultra-fine particulates (UFP) is discussed in the POE of Mr Peirce. I agree with his conclusions. I also note that there is no threshold defined in UK Government policy against which to benchmark an ‘unacceptable’ concentration of UFP, i.e. no AQO for UFP. Being an area of emerging research, current methodological quality and strength of evidence is limited. In this context, I consider that the appropriate response is for public health officials to maintain a watching brief on UFP as a topic area.

5.2.41 This conclusion is consistent with that in the recent Stansted Appeal Decision (para 58) which found “there is no recognised methodology for assessing UFP”.

5.2.42 The NSC SOC states (paragraph 77) that:

*The Council will contend that the risk to the health and well-being of the local population needs to be considered in combination with the increased noise impacts to which that same population will be exposed if the Proposed Development is granted planning permission [77].*

5.2.43 I can confirm that this has been considered by the EIA team, including my inputs in relation to health.

5.2.44 Chapter 18 of the ES assesses cumulative effects, including in relation to health. Both inter-project and inter-related (combined effects of the Appeal Proposal) are discussed.

- 5.2.45 ES paragraph 18.6.3 summarises that residents of some properties surrounding the application site, the adjacent road network and humans on site are potentially at risk from the combined effects resulting from changes in air quality, noise and vibration, visual changes, land quality, surface water quality and flood risk during construction and operation. The combined effect of these changes could be a reduction in residential amenity and health.
- 5.2.46 ES paragraph 18.6.4 states that as generally no significant effects were reported for noise, air quality, flood risk, land quality and visual changes, the inter-related effect for the majority of the surrounding properties, adjacent road network and humans on site is anticipated to be minor, and not significant. The exception to this is the properties off the A38 (around Lulsgate Bottom) where effects of moderate significance are anticipated from annual mean nitrogen dioxide which could result in an inter-related effect that is moderate (i.e. no change from the air quality effect).
- 5.2.47 ESA paragraph 11.3.2 updates this assessment, noting that as the revised air quality assessment no longer reports moderate adverse (significant effects) on the seven properties on the A38, the inter-related effects on these receptors are now not significant.

### 5.3 Parish Councils Airport Association Statement of Case, Feb 2021

- 5.3.1 The PCAA SOC states (paragraph 47) that:

*“Significant beneficial effects to population health are likely in relation to investment and employment due to the Proposed Development. ... A change in significant adverse effects to population health is considered unlikely ... at the population level the Proposed Development is unlikely to result in a discernible change to health outcomes.” These [health] conclusions are absurd. They conflate the socio-economic benefits of airport employment with the adverse health impact of the airport’s operation on local communities. [47].*

- 5.3.2 The detail of each health effect in isolation is explained within the ES and ESA. Noise, air quality and socioeconomics health effects are summarised in section 4.3 and section 4.4 of this POE.
- 5.3.3 The health assessment is a population level assessment as explained in section 4.2. The assessment does not suggest that the effects will be experienced by the same individuals, though there may be some overlap.
- 5.3.4 Whilst the health assessment reaches a summary conclusion that states the separate beneficial and adverse effects, there is no ‘conflating’ or reaching of a ‘net’ effect for population health. This reflects that that different individuals within a population may be affected, and that even where there is overlap, positive and negative effects do not necessarily cancel each other out.
- 5.3.5 Throughout the health assessment the professional judgements for each health issue are clearly mapped out so that each health effect can be considered on its own merits.
- 5.3.6 The PCAA SOC states (paragraph 49) that:

*There is a body of scientific evidence that aircraft noise and emissions have a harmful effect on the health of people exposed to them: <https://www.bmj.com/content/367/bmj.l6258>; Schmidt F et al].; Stansfeld SA, Berglund B, et al, [49].*

- 5.3.7 I agree that there is scientific evidence for noise and air quality related health effects, including as this applies to aviation. This is stated within the ES Health chapter and ESA health section, including a summary of the literature in ES Appendix 16A. This establishment of a causal relationship between emissions and health outcomes is one of the criteria that has been taken into account in determining

the significance of the health effects, see ES Table 16.9. This point therefore does not change the ES or ESA conclusions.

5.3.8 The sources referenced by PCAA and many other publications collectively provide a body of research that demonstrates the importance of the relationship between noise and health. This is not disputed. The ES references the systematic review by Basner and McGuire (2018)<sup>29</sup> for the World Health Organization. This is a high-quality synthesis of the research evidence on noise and health. This source informed the health assessment.

5.3.9 The PCAA SOC states (paragraph 51) that:

*The proposal is clearly incompatible ... with Policy CS26, which requires large-scale developments “to contribute to improving the health and well-being of the local population” and the requirement in paragraph 180(a) of the NPPF that planning decisions should “mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development and avoid noise giving rise to significant adverse impacts on health and the quality of life” [51].*

5.3.10 The POE of Mr Melling addresses the policy position on CS26. I have covered the issue of “improving the health and well-being of the local population” in paragraphs 5.2.24 to 5.2.31 above in relation to the similar point made in the NSC SOC.

5.3.11 In relation to the point on NPPF paragraph 180, this is principally covered within the POEs of Mr Williams in relation to noise and Mr Melling in relation to policy. I would add that from the health perspective it is my professional judgment that the Appeal Proposal avoids giving rise to significant adverse population health effects. This position aligns with that of NSC Officers supported by Public Health England.

5.3.12 Even if this was not the case, NPPF paragraph 180 references the NPSE Explanatory Note for interpretation. This clarifies that the aims of NPSE, including to avoid significant adverse impacts on health from noise, should be interpreted by having regard to the set of shared UK principles that underpin the Government’s sustainable development strategy. These are listed in the NPSE and include: “Meeting the diverse needs of all people in existing and future communities” and “Building a strong, stable and sustainable economy which provides prosperity and opportunities for all”. The NPSE states that its application “should enable noise to be considered alongside other relevant issues and not to be considered in isolation”.

5.3.13 The PCAA SOC states (paragraph 52) that:

*The Appeal will clearly have a negative effect on human health which is down played by BAL’s ES and addendum [52].*

5.3.14 I do not dispute that there will be some negative effects to health. I have however shown that it is reasonable to conclude that such effects are not ‘significant’ ‘population’ health effects. This is discussed in section 4.2 of this POE.

5.3.15 I have covered the point of ‘downplaying’ in relation to the NSC SOC, see paragraphs 5.2.2 to 5.2.4 of this POE. I have shown the judgments reached are reasonable, transparent and consistent.

## **5.4 Bristol Extinction Rebellion (XR) Elders Group Statement of Case**

5.4.1 The points made in the XR Elders SOC relate primarily to the validity of the air traffic forecasting in light of the ongoing COVID-19 pandemic. The discussion of air traffic forecasting is covered in the second POE of Mr Brass.

## 5.5 Bristol Airport Action Network (BAAN) Statement of Case, Feb 2021

- 5.5.1 The health-related points made in the BAAN SOC relate to the 'harms' of climate change (paragraphs 6.3 and 6.6). Climate change is discussed in the POE of Mr Ösund-Ireland. The planning balance is discussed in the POE of Mr Melling.
- 5.5.2 In my experience the potential for significant population health effects from climate change may arise in relation to strategic environmental assessment and decision making, not project level development control. This reflects why climate change is necessarily being addressed through international cooperation, with emissions targets and strategies set at the national level not the individual project level.
- 5.5.3 I find it is reasonable to conclude that the Appeal Proposal's effects constitute a very small contribution to climate related changes in risk factors for population health, locally, nationally or globally. I conclude that such a level of change is not significant in EIA health terms. NSC Officers agree with this conclusion in their Committee Report.

## 6 Conclusion

- 6.1.1 In this POE, I have set out my conclusions on the health effects of the Appeal Proposal.
- 6.1.2 I have clearly shown the EIA health assessment methods to be robust and in line with national and international publications on good practice.
- 6.1.3 I have explained that the qualitative methods provide a consistent analysis across determinants of health to provide an understanding of the likely population health effects of the Appeal Proposal. The methods are not intended to identify the most significant effects to the most sensitive individuals. That significant effects are likely for some individuals is inherent to almost all development. The value of the EIA health assessment for decision makers is in understanding whether there are likely to be significant population level effects, including to vulnerable groups. The ES health assessment does this.
- 6.1.4 I have shown that the qualitative health assessment has been informed by quantitative inputs from other EIA disciplines. The robustness of those inputs is covered within the POEs of Mr Williams in relation to noise, Mr Peirce in relation to air quality and Mr Brass in relation to socioeconomics.
- 6.1.5 I have shown that the assessment accords with relevant Government air quality standards, the AQOs, which sets the basis for determining the acceptability of population health effects.
- 6.1.6 I have shown that the conclusions reached in the ES are consistent with those of NSC Officers who were advised by the Council's Public Health Team and by Public Health England, as set out in the Committee Report.
- 6.1.7 I have demonstrated that the NSC Decision Notice RFR 2 is not consistent with the findings of the ES and ESA health assessment.
- 6.1.8 I have shown that the Appeal Proposal would be associated with a range of health effects, some beneficial and some adverse. Operational noise and air quality impacts may result in slightly greater health risks for some residents. This is the case with most development projects and weighs in the balance alongside the beneficial health effects. Both the beneficial and adverse effects extend to those who are more vulnerable.
- 6.1.9 To assist decision makers, assessments classify the 'significance' of the various effects. This is a technical usage of the term significance in the context of Impact Assessment. In the case of the Appeal

Proposal the beneficial population level effect to vulnerable groups is considered 'significant', indicating this should carry more weight; and the adverse population level effects to vulnerable groups are considered 'not significant', indicating these should carry less weight.

- 6.1.10 These professional judgements are reached with reference to an evidenced based analysis.
- 6.1.11 My conclusion is that significant beneficial effects to population health are likely in relation to investment and employment due to the Appeal Proposal. Other effects that are likely to be beneficial, but which would not be significant in EIA terms, include the infrastructure improvements around the airport entrance that improve road safety and promote walking and cycling.
- 6.1.12 I consider that significant adverse effects to population health are unlikely. Compared to the existing baseline and the consented increase to a 10 mppa capacity, the Appeal Proposal results in similar environmental exposures. Whilst there would be some localised increases in adverse effects for people living closest to the airport; at the population level the Proposed Development is unlikely to result in a discernible change to health outcomes.
- 6.1.13 On this basis, it is my professional judgement that health effects are not a proper ground for refusing the Appeal. I conclude by reiterating the NSC Officers conclusion:

*BAL's projected Health Impact Assessment is realistic. There are no overriding health or well-being impacts which would warrant refusal of the application.*

## 7 Appendix: Additional Supporting Documents and Excerpts

### 7.1 Somerset County Council. County Plan 2016 – 2020<sup>9</sup>, page 5.

**We will work to deliver these ambitions, but we will continue to have a clear vision and prioritise those residents who need our support now. Our ambitions will undoubtedly assist, but they will take a little time to deliver. Therefore we will continue to have the vision to reduce inequalities wherever we can across the county:**

- Social inequalities, such as within our education system where children on free school meals underachieve.
- Economic inequalities, where people in deprived areas have fewer chances to succeed and are less likely to find good quality jobs.
- Health inequalities, where people from deprived backgrounds have poorer health, are more likely to live with long-term conditions, and have a shorter lifespan than people living in more affluent areas.

7.2 Public Health England. Guide for local authority public health and planning teams to improve the use of HIAs in spatial planning London. 2020<sup>16</sup>, page 23.

Identify health impacts and their potential significance

3.10 Significance is not absolute and can only be identified in relation to the project and its location. Through the identification of major adverse impacts, local authorities can justify the adoption of an HIA policy or guidance. Significance can be determined by the expected magnitude of the health and wellbeing impact on specific population characteristics (Table 5). These may be positive (beneficial), neutral (no discernible change), or negative (adverse), direct or indirect, cumulative, permanent or temporary (short, medium or long term).

**Table 5. Significant impact**

Major adverse	Major benefit	<b>Significant</b> based on: high exposure or scale; long-term duration; continuous frequency; severity predominantly related to mortality; majority of population affected; permanent change; and substantial service quality implications. Prevention measures will be required.
Moderate adverse	Moderate benefit	<b>Potentially significant</b> based on: low exposure or medium scale; medium-term duration; frequent events; severity predominantly related to moderate changes in morbidity; large minority of population affected; gradual reversal; and small service quality implications. Prevention or mitigation measures will be required.
Slight adverse	Slight benefit	<b>Not significant</b> based on: very low exposure or small scale; short-term duration; occasional events; severity predominantly related to minor change in morbidity; small minority of population affected; rapid reversal; and slight service quality implications. Mitigation measures will be required.
Neutral		<b>Not significant</b> based on: negligible exposure or scale; very short-term duration; one-off frequency; severity predominantly relates to a minor change in quality-of-life; very few people affected; immediate reversal once activity complete; and no service quality implication.

**7.3 Cave, B. Fothergill, J., Pyper, R. Gibson, G. and Saunders, P. (2017) Health in Environmental Impact Assessment: A Primer for a Proportionate Approach. Ben Cave Associates Ltd, IEMA and the Faculty of Public Health. Lincoln, England<sup>17</sup>, page 13.**

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In impact assessment, the significance of an effect is usually a matter of expert professional judgements informed by reference to an evidence base and to practitioner guidance. In EIA, the concept of significance is a key element in determining whether such an assessment is required and determining whether specific impacts, or even an entire topic (e.g. health, water, ecology), is included within the scope of the assessment. As such, the significant environmental effects identified through the EIA become the focus of the information presented in the Environmental Statement, which is then taken into account during a planning determination.

Deciding on the *significance* of a potential effect on human health, or on other topics, does not necessarily mean finding that effect to be *statistically significant*. As set out in the definition of HIA (see p.15) this is a judgement and the assessor should seek to reach consensus with consultees and other stakeholders.

It should be recognised that statistical significance, which is routinely used in scientific analysis refers to whether the effects are real rather than chance occurrences, and is not necessarily a test of importance. The latter is also powerfully influenced by the existence of other stressors on communities and populations, their cumulative effect, the susceptibility of the population (e.g. disproportionate levels of deprivation), equity, and the impact of broader quality of life factors which are challenging to measure objectively. Population and human health significance in EIA should include a professional judgement supported by evidence, for example on an issue's 'importance' and 'acceptability'. Available evidence to cite in the EIA may include: scientific literature; consultation responses; baseline conditions; local health priorities; and regulatory standards.

**7.4 European Commission. Environmental Impact Assessment of Projects: Guidance on Scoping (Directive 2011/92/EU as amended by 2014/52/EU). Luxembourg: European Union. 2017.<sup>19</sup> , page 42.**

While the concept of ‘significant effects’ remains largely undefined, certain common characteristics are associated therewith, as shown in the box below.

**Box 20: The concept of ‘significant effects’**

The assessment of significance relies on informed experts’ judgements about what is important, desirable or acceptable with regards to changes triggered by the Project in question. These judgements are relative and must always be understood in their context:

- They are *value-dependent*: while judgements are, in most cases, informed by scientific data (e.g. regarding the type of impact being examined), they are subjective to some degree as they are the opinion of one practitioner or by a team of practitioners. Experts’ judgements vary, depending on the perspective (legal or institutional recognition, political or public recognition), deemed to be important professionally.
- They are *context-dependent*: judgements are made within the socio-cultural, economic, and political contexts of a Project. A thorough understanding of contextual factors (e.g., local ecological, social, and cultural conditions, judgements in related decision-making areas), likely to influence judgements’ significance, is essential when identifying a Project’s impact on the environment.

At present, there is no international consensus among practitioners on a single or common approach for assessing the significance of impacts. This makes sense considering that the concept of significance differs across the varying political, social, and cultural contexts that Projects face.

Nevertheless, the determination of impacts’ significance can vary considerably, depending on the approach and methods selected for the assessment. The choice of appropriate procedures and methods for each judgement varies depending on the Project’s characteristics. Several methods, be they quantitative or qualitative, can be used to identify, predict, and to evaluate the significance of an impact.

As a good practice, all assessment methods should define clear thresholds or criteria for determining whether an impact is significant, based on the characteristics of an impact, in a clear and unambiguous manner that can be understood by anyone reading the EIA Report.

7.5 Cave, B., Claßen, T., Fischer-Bonde, B., Humboldt-Dachroeden, S., Martín-Olmedo, P., Mekel, O., Pyper, R., Silva, F., Vilianni, F., Xiao, Y. 2020. Human health: Ensuring a high level of protection. A reference paper on addressing Human Health in Environmental Impact Assessment. As per EU Directive 2011/92/EU amended by 2014/52/EU. International Association for Impact Assessment and European Public Health Association.<sup>20</sup>, page 7 (excerpts), pages 19, 30, 33 and 77.

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<b>Population</b>	is defined in this reference paper as any group of people with shared characteristics. This could be the entire population of an area, or a population defined by relevant characteristics that make them more vulnerable to a project change e.g. age or socio-economic status. Health in EIA considers the effects on such populations rather than on individuals.
<b>Population health</b>	is the health outcomes of a group of individuals, including the distribution of such outcomes within the group (48).
<b>Public health</b>	is a theoretical and practical discipline in its own right and is the science and art focussing on: 1. population health; 2. human systems and interventions intended to improve population health; and 3. interactions between these two systems (adapted from source 44).
<b>A risk factor for health and/or disease</b>	is social, economic or biological status, behaviours or environments which are associated with, or cause, increased susceptibility to a specific disease, ill health, or injury (38).  Box 3-3 looks at the relation between health determinants and risk factors.
<b>The Reasoned Conclusion</b>	is the explanatory statement made by the Competent Authority on the significant effects of the project on the environment. The Reasoned Conclusion is based on the Competent Authority's examination of the Developer's EIA Report, the consultation responses, the Developer's application and, where appropriate, the results of its own supplementary examination (adapted from source 22).
<b>Significance</b>	relies on informed, expert judgement about what is important, desirable or acceptable with regards to changes triggered by the project in question (21, 23).

Page 19:

### **What is a significant effect for human health in EIA?**

- 5.1.6 The EIA Directive requires *likely significant effects* to be assessed. A determination of *significance* should be based on professional judgement and best available evidence. It means that a given effect is considered important, desirable or acceptable (21, 23). It is worth noting that in most cases, evidence on health effects and their significance is incomplete. This can lead to differences in public, political and expert opinions. The way in which a decision is reached should be transparent.
- 5.1.7 The use of *significance* in this reference paper, and in EIA, is distinct from *statistical significance*. Statistical significance indicates whether an effect is due to chance or to a specific factor of interest.
- 5.1.8 Significance is an overarching concept that is relevant to all stages of EIA. The granularity with which significance can be determined increases as the EIA progresses from screening, to scoping, assessment and examination.

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## 7. EIA Report – assessment

### **Key messages**

The EIA Report is the document prepared by the Developer that presents the output of the assessment. The EIA Report is submitted by the Developer to the Competent Authority. Health authorities may informally advise during the production of the EIA Report and may then be formally consulted on the final EIA Report.

An EIA Report should present the likely significant effects of the project, including those affecting health. It also includes a health baseline, the reasonable alternatives considered and measures to mitigate (avoid, prevent or reduce) or to monitor significant adverse effects. Good practice is to include a health chapter in the EIA Report.

EIA takes a population health approach. Inequalities are a key feature of population health, so where there is potential for significant health effects consider differences between the general population and vulnerable groups.

Deciding whether an effect is significant relies on informed, expert judgement about what is important, desirable or acceptable with regards to changes triggered by the project in question.

A range of criteria is used to reach a conclusion on the significance of health effects. The criteria include, but are not limited to, the sensitivity of the population and the magnitude of the effect.

### Assessing effects on the environment including human health

- 7.2.12 It is appropriate to define specific criteria for health significance as the preamble to Directive 2014/52/EU notes that Competent Authorities should identify the most relevant criteria to be considered “when determining whether significant effects on the environment are likely to be caused by a project ...”.
- 7.2.13 What does it mean to “identify, describe and assess in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on ... population and human health” (as required by Article 3 (1))? We set out below some considerations when reaching a judgement on significance. Our starting point is the statement in the EC Guidance that: “the assessment of significance relies on informed, expert judgement about what is important, desirable or acceptable with regards to changes triggered by the project in question” (21, 23).
- 7.2.14 An analysis of multiple criteria is an established approach to determining significance in EIA (23) and typically involves consideration of the *sensitivity* of a receptor and the *magnitude* of the effect that the project will have.
- Sensitivity is understood as the sensitivity of the receptor (e.g. population) to change, including its capacity to accommodate the changes the project may bring about; and
  - Magnitude considers the characteristics of the change which would affect the receptor as a result of the project (adapted from (23)).
- 7.2.15 [Appendix C](#) on page 71 illustrates three steps for determining significance for health. The steps involve characterising criteria relevant to *sensitivity*, *magnitude* and contextual considerations. Contextual considerations include:
- scientific literature;
  - baseline conditions for the population;
  - consultation for the project;
  - health priorities in the jurisdiction;
  - regulatory standards in the jurisdiction; and
  - health policy context in the jurisdiction.
- 7.2.16 A robust reasoned conclusion on significance relates the evidence to the specific context of each determinant of health within the scope. The reporting should include a structured narrative that draws together the range of relevant information to support the professional judgment



[Appendix C](#), on page 71, provides tools for analysing multiple criteria to establish significance in EIA.



[Table C-4](#) on page 80 provides an illustrative narrative for reporting the assessment of a determinant of health.

<p><b>Population extent</b></p>	<p>How much of the population (defined by the assessment) is affected is influential to the magnitude decision? Where most of the study area’s population is affected this would indicate a higher magnitude. This is not to downplay cases where only a few people are affected to a high degree. However, given that a population health conclusion is being reached it is helpful to understand how widespread the change may be. E.g. where only a few people are affected this may indicate greater potential for targeted mitigation. Where feasible the size of the affected population should be estimated quantitatively. It is noted that this measure is influenced by how the ‘population’ is defined. Also consider if there is likely to be substantial population displacement or influx. Where the effect is best characterised as only affecting a few individuals, this may indicate that a population health effect would not occur. Such individuals should still be the subject of mitigation and discussion, but in EIA and public health terms the effect may not be a significant population health change.</p>
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7.6 Cave, B.; Pyper, R.; Fischer-Bonde, B.; Humboldt-Dachroeden, S.; Martin-Olmedo, P. Lessons from an International Initiative to Set and Share Good Practice on Human Health in Environmental Impact Assessment. *Int. J. Environ. Res. Public Health* 2021, 18, 1392.<sup>21</sup>, page 5.

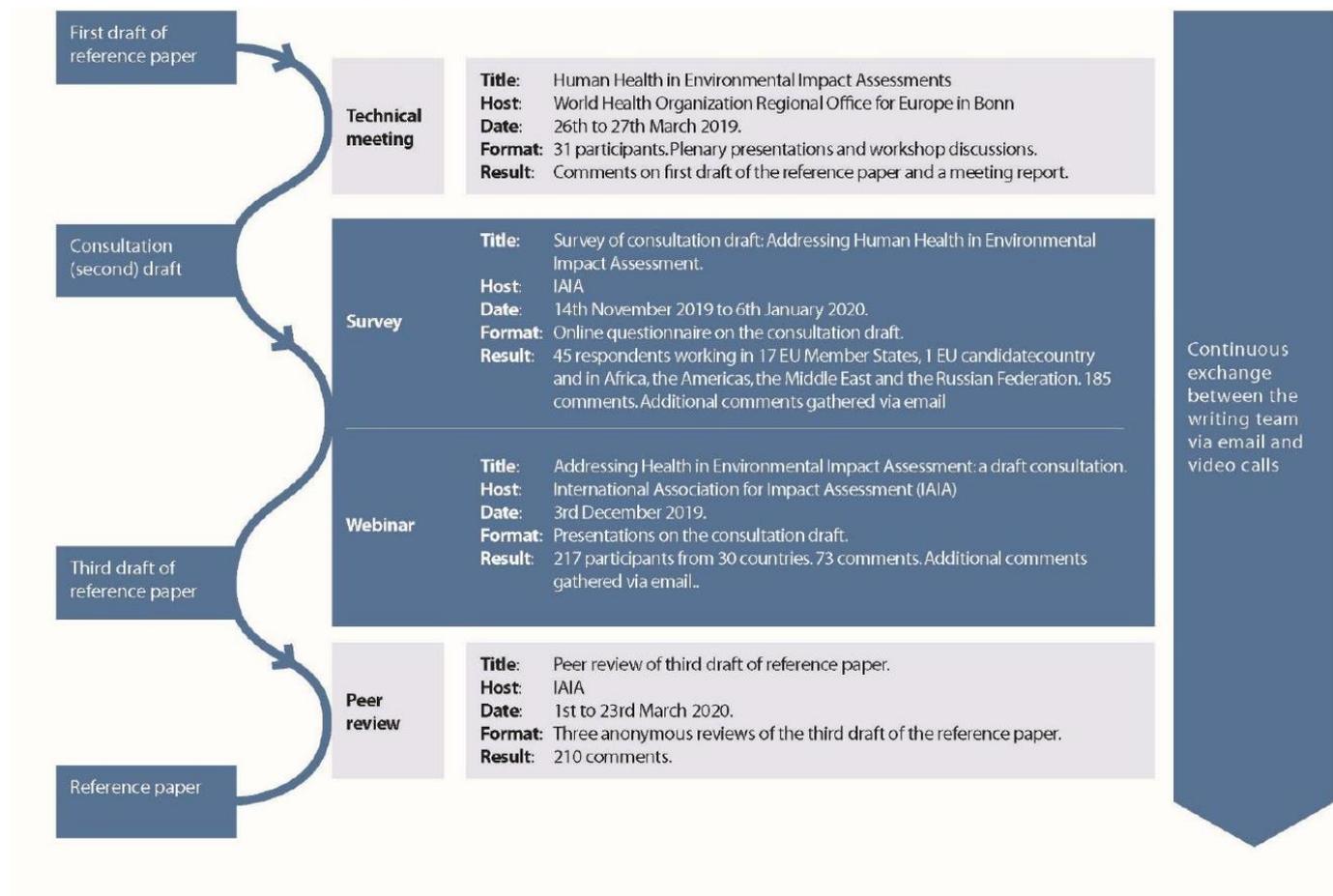


Figure 1. Preparing the reference paper. Figure from Cave et al. [1]. Reproduced with permission from Cave et al. Human

## 7.7 International Association for Impact Assessment. Key Citations Series. Health Impact Assessment. April 2021.<sup>22</sup>, page 2.

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## UK and EU Air Quality Limits

There are a wide range of terms and concepts in national and international initiatives, for example, standards, objectives, target values and limit values. The two which feature within the UK's air quality strategy are standards and objectives. The EU Ambient Air Quality Directive and fourth Daughter Directive contain Limit Values and Target Values. The national Air Quality Objectives and EU limit and target values with which the UK must comply are summarised in the [National air quality objectives](#) (PDF 109 KB) of the [Air Quality Strategy](#).

Definitions:

- Air Quality Standards are concentrations recorded over a given time period, which are considered to be acceptable in terms of what is scientifically known about the effects of each pollutant on health and on the environment. They can also be used as a benchmark to indicate whether air pollution is getting better or worse.
- An exceedance is a period of time (defined for each standard) where the concentration is higher than that set out in the Standard. In order to make useful comparisons between pollutants, (the Standards may be expressed in terms of different averaging times), the number of days on which an exceedance has been recorded is often reported.
- An objective is the target date on which exceedances of a Standard must not exceed a specified number.
- EU Limit values are legally binding EU parameters that must not be exceeded. Limit values are set for individual pollutants and are made up of a concentration value, an averaging time over which it is to be measured, the number of exceedances allowed per year, if any, and a date by which it must be achieved. Some pollutants have more than one limit value covering different endpoints or averaging times.
- Target values – are used in some EU Directives and are set out in the same way as limit values. They are to be attained where possible by taking all necessary measures not entailing disproportionate costs.

**7.9 Basner, M., McGuire, S. (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; doi:10.3390/ijerph15030519.<sup>29</sup> , pages 3, 4, 24**

Page 3:

Non-acoustic factors can also affect sleep: external (e.g., high temperature and humidity) and internal (e.g., sleep disorders, nightmares) factors may induce arousals from sleep, complicating the unequivocal attribution of arousals from sleep to noise [29]. At the same time, classical indicators of fragmented sleep (e.g., awakenings, body movements) are part of the physiological sleep process and occur multiple times throughout the night in healthy sleepers and environments without external stressors, with no pathologic consequences. For example, a healthy adult briefly awakens ca. 20 times during an 8 h bed period (most of these awakenings are too short to be remembered the next morning) [30]. It is currently unclear how many additional noise-induced awakenings are acceptable and without consequences for sleep recuperation and health, especially given the large inter-individual differences in the susceptibility to noise. Although compensatory mechanisms have been observed [28], it is unclear at what point these mechanisms are exhausted or what biological cost they carry. In typical noise scenarios, noise-induced sleep-disturbance is usually less severe than, e.g., that observed in clinical sleep disorders like obstructive sleep apnea [31].

Page 4 (A):

One of the main goals of noise effects research is to derive exposure-response functions that can then be used for health impact assessments and ultimately to inform political decision making [3]. Numerous studies have associated several transportation noise sources (e.g., road, rail, and aircraft noise) with awakenings, briefer brain activations, and vegetative arousals (e.g., increases in heart rate and blood pressure) in both laboratory and field settings [25]. Unfortunately, sample sizes and response rates of the studies that are the basis for exposure-response functions were usually low, which restricts generalizability of the latter. These functions are usually sigmoidal (s-shaped) and show monotonically increasing reaction probabilities with increasing maximum sound pressure levels (SPL) or sound exposure levels (SEL). Maximum SPLs as low as 33 dBA induce physiological reactions during sleep, i.e., once the organism is able to differentiate a noise event from the background, physiologic reactions can be expected (albeit with a low probability at low noise levels) [35]. This reaction threshold should not be confused with limit values used in legislative and policy settings, which are usually considerably higher. As exposure-response functions are typically without a clearly discernible sudden increase in sleep disturbance at a specific noise level and because of individual variation in noise sensitivity, defining limit values is not a straightforward task. It usually involves expert judgement of the existing evidence (e.g., Night Noise Guidelines [36]), and political weighing of negative health consequences of noise and societal benefits of the noise source.

**Page 4 (B):**

Subjects exposed to noise usually habituate. For example, the probability that noise causes physiologic reactions is in general higher during the first nights of a laboratory experiment compared to the last nights [28], and exposure-response relationships derived in the field (where subjects have often been exposed to the noise for many years) are usually much shallower than those derived in laboratory settings, which often include exposure to unfamiliar noise events in an unfamiliar environment [35,37]. Habituation is a reasonable mechanism that preserves energy resources. However, habituation is not complete, i.e., subjects continue to react to noise events even after several years of noise exposure. Unfortunately, little is known about individual differences in the ability to habituate to noise and potential predictors. Importantly, activations of the vegetative nervous system habituate to a much lesser degree to noise compared to cortical arousals. They provide biologic plausibility for the observed association between long-term noise exposure and cardiovascular disease [28,38,39]. It is also possible that exposed subjects become more sensitive to the effects of noise on sleep. This sensitization may be related to, e.g., individual changes (like aging, new incident disease), changes in noise exposure, or changes in media coverage. However, scientific knowledge about noise sensitization is currently very limited.

Sensitivity to nocturnal noise exposure varies considerably between individuals. Little is known about characteristics that predict someone's sensitivity to nocturnal noise-exposure. Men were found

**Page 24:**

*4.3. Conclusions*

Noise is only one reason for sleep disturbance. There are many other external (e.g., temperature, humidity, light levels) and internal (e.g., sleep disorders, health conditions, bad dreams) causes. For this reason, odds ratios for sleep disturbance were calculated separately for those studies that did and did not ask about sleep disturbance, awakenings, or problems falling asleep relative to a specific noise-source. The odds ratios calculated for all noise sources and sleep outcomes were greater than 1 but not statistically significant when the noise source was not specifically mentioned in the question except in one case. However, odds ratios were much higher and mostly statistically significantly different from 1 when the noise source was mentioned in the question. This difference could be due to lack of adjustment for confounding factors in the analysis, such as age, gender, socio-economic status, and pre-existing sleep or health conditions. However, the context and wording of the questions can also bias the results.

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