

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix HA-002-00000

Health

Route-wide commentary on
health evidence base

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Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

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1 Introduction

- 1.1.1 This document provides a commentary on the links between the health determinants (environmental, social and economic factors that influence health) that are assessed in the health impact assessment (HIA) presented in the High Speed Rail (Crewe – Manchester) Environmental Statement (ES), and the resulting effects on health and wellbeing, based on a review of available primary¹, secondary² and grey³ literature.
- 1.1.2 The purpose of this document is to provide an overview of the scientific consensus on the types of health outcome associated with impacts on health determinants assessed in the health assessment presented in Volumes 2, 3 and 5 of the ES. This review updates the earlier High Speed Rail (West Midlands – Crewe) Route-wide commentary on health evidence base⁴ which covered evidence over the 5-year period 2012 to 2017. This updated version takes into account evidence published up to January 2021.

¹ A primary source is also called an original source and is any source of information that was created at the time under study. Secondary sources are typically based on primary sources.

² A secondary source is a source that documents an event, period, or issue in history that was produced after the event, period or issue has happened. These include textbooks and literature reviews.

³ Grey literature comprises information produced at all levels of government, academia, business and industry in electronic and print formats not controlled by commercial publishing. Examples of grey literature include government reports, policy statements and issues papers.

⁴ High Speed Two Ltd (2017), High Speed Rail (West Midlands – Crewe), *Environmental Statement, Route-wide commentary on health evidence base*, Volume 5, Appendix HE-003-000. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/627083/E58_HE-003-000_WEB.pdf.

2 Scope and methodology

2.1 Scope of the review

- 2.1.1 The purpose of this document is to provide an overview of the scientific consensus on the types of health outcome associated with impacts on health determinants assessed in the health assessment presented in Volumes 2, 3 and 5 of the ES. A literature search has reviewed evidence published between 2014 and January 2021.
- 2.1.2 A comprehensive review of primary evidence is beyond the scope of this health assessment. Therefore, the review is mainly focused on secondary sources, such as systematic reviews, and grey literature, such as government reports and policy statements, that reflect a scientific consensus on the available evidence. Primary literature is referenced where relevant, or where secondary literature has not been found.
- 2.1.3 The spatial scope of the search included collecting evidence from the UK and high-income/developed countries internationally, as these countries are likely to have a comparable public and environmental health legislative and regulatory context.

2.2 Literature sources

- 2.2.1 The following search engines and databases were used in conducting this review:
- Google and Google Scholar;
 - Biomed Central;
 - JSTOR;
 - National Institute for Health and Care Excellence (NICE) Evidence Search;
 - Pubmed;
 - ScienceDirect; and
 - Scientific American.

2.3 Search for evidence on health determinants

- 2.3.1 The topics covered in this review correspond to the health determinants that have been assessed in the health sections of the ES, as set out in the Scope and Methodology Report (SMR)⁵, these are listed below.
- 2.3.2 The following health determinants are assessed in Volume 3, Route-wide effects, Section 7:
- employment and income;
 - housing; and
 - transport.

⁵ Volume 5: Appendix CT-001-00001, *Environmental Impact Assessment Scope and Methodology Report*.

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- 2.3.3 The health effects of operational sound, noise and vibration are also assessed in Volume 3, Route-wide effects, Section 7. This assessment is based on the Department for Transport's (DfT) WebTAG methodology, which is described in Volume 5, Appendix: SV-001-00000, Sound noise and vibration methodology assumptions and assessment.
- 2.3.4 The following health determinants are assessed in Volume 2, Community Area reports:
- neighbourhood quality (amenity value of the local environment including noise, air quality, visual amenity and traffic);
 - access to green space and physical activity;
 - access to local services;
 - education; and
 - social capital.
- 2.3.5 Local and route-wide exposure to air quality impacts have been scoped out of the health assessment and therefore this review, as the level of overall exposure and changes in exposure to airborne pollution and dust is considered to be too low to affect health and wellbeing.
- 2.3.6 The available literature on links between the above determinants and health outcomes is, in general, not explicitly related to infrastructure projects. The search terms used in relation to broad determinants of health included 'health' OR 'wellbeing' OR 'well-being' AND:
- education/training/employment/unemployment/jobs/income/regeneration;
 - transport/active transport/active travel/connectivity;
 - housing/residential;
 - social capital/isolation;
 - green space/greenspace/open space/nature;
 - sense of place/built environment;
 - physical activity/exercise; and
 - local services/local facilities/neighbourhood services/access to services.

2.4 Evaluating the strength of evidence

- 2.4.1 The strength of evidence for health outcomes associated with health determinants has been evaluated and classified as follows:
- strong: a wide range of peer-reviewed research studies showing similar associations. The association is widely accepted by the public health community and there is consensus on the specific causal factors, the mechanism of effect and the strength of association;
 - moderate: a range of peer-reviewed research studies showing similar associations. The association is widely accepted by the public health community, though there may be debate about the specific causal factors, the mechanism of effect and/or the strength of association; or
 - weak: a few peer-reviewed/non-peer reviewed research studies to suggest an association, or studies showing conflicting findings.

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- 2.4.2 It should be noted that weak evidence does not necessarily indicate an absence of association between a health determinant and a health outcome, but shows that there is uncertainty in the assessment of the likely effect.

3 Commentary on evidence for health determinants

3.1 Employment and income

- 3.1.1 The World Health Organization (WHO) identifies a list of health determinants⁶ that combine to affect the health of individuals and communities. Included in this list is 'income and social status - higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health.'
- 3.1.2 The Marmot Review, first published in 2010⁷, was commissioned by the Department of Health to investigate health inequalities in England and focused on correlations between health and socio-economic status. The Review stated that 'being in good employment is protective of health. Conversely, unemployment contributes to poor health.' An updated review published in 2020⁸, identified a fall in life expectancy in the decade 2010-2020 in the most deprived communities outside London for women and in some regions for men. The report linked this to 'the conditions in which people are born, grow, live, work and age and inequities in power, money and resources – the social determinants of health.' It reinforced the conclusions from the previous report on the social gradient of health, stating that 'There are clear socioeconomic gradients in preventable mortality. The poorest areas have the highest preventable mortality rates and the richest areas have the lowest.'
- 3.1.3 Public Health England (PHE)'s Health Profile for England (2018)⁹ presents research and analysis on the effects of income, work and the labour market on health. In relation to income, the report states that 'Many physical and mental health outcomes improve incrementally as income rises. Income is related to life expectancy, disability free life expectancy, self-reported health and a range of biomarkers. The relationship operates through a variety of mechanisms. Financial resources determine the extent to which a person can both invest in goods and services which improve health and purchase goods and services which are bad for health. Low incomes can also prevent active participation in social life and day to day activities, affecting feelings of self-worth and status.' On the effects of work itself, the report states that 'On the whole, work is good for mental and physical health. In addition to the health benefits associated with an adequate wage, work can provide valuable social interactions, a place to develop and practice skills, and a sense of social

⁶ World Health Organization (2017), *Health Impact Assessment - The determinants of health*. Available online at: <http://www.who.int/hia/evidence/doh/en/>.

⁷ Marmot, M., Allen, J., Goldblatt, P., Boyce, T., McNeish D., Grady, M. and Geddes, I. (2010), *Fair society, healthy lives: Strategic review of health inequalities in England post-2010*, The Marmot Review.

⁸ Michael Marmot, Jessica Allen, Tammy Boyce, Peter Goldblatt, Joana Morrison (2020), *Health equity in England: The Marmot Review 10 years on*. Institute of Health Equity.

⁹ Public Health England (2018), *Health Profile for England*. Available online at: <https://www.gov.uk/government/publications/health-profile-for-england-2018>.

participation and contribution to society.’ The report presents data on mental health, stating that ‘In financial year 2016 to 2017, 4.5% of the population reported low life satisfaction, but this varied considerably by employment status. Low life satisfaction among the unemployed was almost four times higher than among the employed, while for the economically inactive it was over twice as high.’ The health effects associated with income and socio-economic status encompass a range of physical and mental health outcomes.

- 3.1.4 A Briefing by the British Medical Association (2017)¹⁰ stated that ‘Most long-term conditions are more common in adults from lower socio-economic groups, including the working poor, such as diabetes, chronic obstructive pulmonary disease, arthritis and hypertension. For example, two-fifths of adults in England aged 45 to 64 with below-average incomes have a limiting long-term illness, more than twice the rate of adults of the same age with above-average incomes. Multimorbidity is also more common among deprived populations.’ A 2017 report by the Mental Health Foundation¹¹ found that three in four people living in the lowest household income bracket report having experienced a mental health problem, compared to six in ten of the highest household income bracket.
- 3.1.5 Based on the criteria set out in Section 2.4, the evidence linking income and employment to health and wellbeing is considered to be strong.

3.2 Education

- 3.2.1 The WHO identifies a list of health determinants¹² that combine to affect the health of individuals and communities. Included in this list is ‘education - low education levels are linked with poor health, more stress and lower self-confidence.’
- 3.2.2 The PHE Health Profile for England⁹ states that ‘Educational attainment is strongly linked with health behaviours and outcomes. Better-educated individuals are less likely to suffer from long term diseases, to report themselves in poor health, or to suffer from mental conditions such as depression or anxiety. Education provides knowledge and capabilities that contribute to mental, physical, and social wellbeing. Educational qualifications are also a determinant of an individual’s labour market position, which in turn influences income, housing and other material resources associated with health.’
- 3.2.3 An evidence review undertaken in the US in 2016¹³ stated that ‘education is critical to social and economic development and has a profound impact on population health.’ However, it

¹⁰ British Medical Association (2017), *Health at a price - Reducing the impact of poverty. A briefing from the board of science*. Available online at: <https://www.bma.org.uk/media/2084/health-at-a-price-2017.pdf>.

¹¹ Mental Health Foundation (2017), *Surviving or Thriving? The state of the UK’s mental health*. Available online at: <https://www.mentalhealth.org.uk/publications/surviving-or-thriving-state-uks-mental-health>.

¹² World Health Organization (2017), *Health Impact Assessment- The determinants of health*. Available online at: <http://www.who.int/hia/evidence/doh/en/>.

¹³ Zimmerman, E., Woolf, S. and Haley, A. (2016), *Understanding the Relationship Between Education and Health: A Review of the Evidence and an Examination of Community Perspectives*, AHRQ.

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goes on to note that 'the factors surrounding the relationship between education and health are the subject of research in different disciplines that are of uneven quality, and closing the many holes in the evidence is a research priority.'

- 3.2.4 A 2020 study comparing life-course trajectories of employment quality and health in the U.S.¹⁴ found that people who were less educated had poorer employment and worse self-rated health. The prevalence of poor/fair self-rated health and moderate mental illness was greatest among individuals who were minimally attached, returning to the labour force, and precariously employed. Another study used data from 26 Organisation for Economic Co-operation and Development (OECD) countries to assess associations between education and health indicators¹⁵. This found that adults with higher educational attainment had better health and lifespans compared to less educated adults.
- 3.2.5 Based on the criteria set out in Section 2.4, the evidence linking education to health and wellbeing is considered to be moderate.

3.3 Housing relocation

- 3.3.1 There is evidence linking housing quality and tenure with mental and physical health. According to the 2011/12 Subjective Well-being Annual UK Population Survey¹⁶, 80% of those who owned their property reported 'medium' or 'high' levels of life satisfaction, compared with 67.8% of those who rented. Of those in rented accommodation, 6 out of 10 reported 'low' satisfaction with life, compared with 1 in 5 of those who owned their accommodation outright or with a mortgage. The Annual Population Survey (APS) dataset covering the period between January 2014 to December 2016 shows that people reporting the poorest personal well-being are more likely to rent their home and less likely to have a mortgage¹⁷.
- 3.3.2 A systematic review in 2019¹⁸ suggested that prior exposure to housing disadvantage (overcrowding, mortgage delinquency, housing mobility, housing tenure, subjective perceptions of inadequate housing, eviction, and physical housing conditions) may impact mental health later in life.

¹⁴ Eisenberg-Guyot J., Peckham T., Andrea SB., Oddo V., Seixas N., Hajat A. (2020), *Life-course trajectories of employment quality and health in the U.S.: A multichannel sequence analysis*. Social Science & Medicine, Volume 264,113327,ISSN 0277-9536. Available online at: <https://doi.org/10.1016/j.socscimed.2020.113327>.

¹⁵ Raghupathi, V., Raghupathi, W. (2020), *The influence of education on health: an empirical assessment of OECD countries for the period 1995–2015*. Arch Public Health 78, 20. Available online at: <https://doi.org/10.1186/s13690-020-00402-5>.

¹⁶ Randall, C. (2012), *Measuring National Well-Being – Where we live*, Office for National Statistics.

¹⁷Office of National Statistics (July 2018), *Understanding well-being inequalities: Who has the poorest personal well-being*.

¹⁸ Singh, A. et al. (2019), *Housing Disadvantage and Poor Mental Health: A Systematic Review*, American Journal of Preventative Medicine: 57(2):262–272.

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- 3.3.3 A 2015 study of the effects of relocation at older age on cognitive function¹⁹ showed that involuntary residential relocation has a negative impact on wellbeing, including increased stress and isolation, particularly for older people.
- 3.3.4 Based on the criteria set out in Section 2.4, the evidence linking the status and condition of housing to health and wellbeing is considered to be moderate.

3.4 Transport

- 3.4.1 This section focuses on traveller stress and road safety. Transport can also affect other health determinants such as noise and air emissions, accessibility, social capital, active travel, employment and economic effects, and evidence relating to these health determinants is reviewed elsewhere in this document.

Traveller stress

- 3.4.2 The Government's Transport Appraisal Guidance²⁰ identifies journey quality as 'a measure of the real and perceived physical and social environment experienced while travelling'. The guidance states that 'Travellers don't normally travel for its own sake. Travel is a derived demand that arises from people's desire to engage in activities. Therefore a high quality journey, when experienced, is often taken for granted. However, a poor journey quality, when experienced, can be easily recognised.' Journey ambience comprises three factors, one of which is traveller stress. Three causes of traveller stress are identified: frustration (e.g. due to road layout or ability to make good progress along the route), fear of accidents (e.g. due to presence of other vehicles, pedestrians and sight distances) and route uncertainty (e.g. signage and familiarity with route).
- 3.4.3 A study undertaken in 2017 by the University of the West of England²¹, examined the impacts of commuting on the wellbeing of over 26,000 employed people in England between 2009/10 and 2014/15 as part of 'The Commuting and Wellbeing Study'. The study found that for every extra minute of commute time, job satisfaction and leisure time reduced and stress was increased.
- 3.4.4 Based on the criteria set out in Section 2.4, the evidence linking traveller stress to health and wellbeing is considered to be weak.

¹⁹ Wu, Y., Prina, A., Barnes, L., Matthews, F. and Brayne, C. (2015), *Relocation at older age: results from the cognitive function and aging study*, Journal of Public Health.

²⁰ Department for Transport (2020), TAG UNIT A4.1, *Social Impact Appraisal*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/940958/tag-a4-1-social-impact-appraisal.pdf.

²¹ Chatterjee, K., Clark, B., Martin, A. & Davis, A. (2017), *The Commuting and Wellbeing Study: Understanding the Impact of Commuting on People's Lives*. UWE Bristol, UK. Available online at: <https://travelbehaviour.files.wordpress.com/2017/10/caw-summaryreport-onlineedition.pdf>.

Road safety

- 3.4.5 According to a DfT report²², there were 1,752 reported road deaths in 2019, similar to the level seen since 2012, which followed a period of substantial reduction in fatalities from 2006 to 2010. Accounting for change in traffic, the rate of fatalities per billion vehicle miles fell by 4% from 5.06 in 2018 to 4.87 fatalities per billion vehicle miles in 2019. The report identifies vulnerable road users (pedestrians, cyclists and motorcyclists) as having much higher casualty rates per mile travelled in comparison with the other road user groups. Casualty rates per billion passenger miles for these groups are 1,640, 4,891 and 5,015 respectively, compared with 195 and 45 for car and heavy goods vehicle (HGV) occupants. The report states that overall goods vehicle casualties decreased by 2% from 5,071 in 2018 to 4,985 in 2019. Recent data on the number of vulnerable road user casualties involving HGV were not found in this review.
- 3.4.6 DfT figures from 2017²³ show there were 6,037 accidents in 2015 involving at least one HGV, with 8,344 casualties of which 284 were fatal. There were around 78 fatal or serious accidents involving HGV per billion vehicle miles in 2015, which was lower than the rate for all vehicles in 2015 (117) and had decreased from a figure of 118 for HGV in 2004. According to the Government's Transport Analysis Guidance, fear of accidents is highest when speed, flow and the HGV content are high. However, the rate of fatal or serious accidents involving HGV is reducing significantly due to improved awareness and safety measures.
- 3.4.7 Based on the criteria set out in Section 2.4, the evidence linking road safety to health and wellbeing is considered to be strong.

3.5 Social capital

- 3.5.1 A 2014 Office for National Statistics (ONS) paper, Measuring Social Capital²⁴, provides the following definition of social capital 'In general terms, social capital represents social connections and all the benefits they generate. The benefits for people having these social connections can occur either at an individual level (for example, through family support) or at a wider collective level (for example, through volunteering). Social capital is also associated with values such as tolerance, solidarity or trust. These are beneficial to society and are important for people to be able to cooperate.'

²² Department for Transport (2020), *Reported road casualties in Great Britain: 2019 annual report*. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922717/reported-road-casualties-annual-report-2019.pdf.

²³ Department for Transport (2016), *Domestic Road Freight Statistics*. Available online at: <https://www.gov.uk/government/collections/road-freight-domestic-and-international-statistics>.

²⁴ Siegler, V. and Office for National Statistics (2014), *Measuring Social Capital*, Office for National Statistics.

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- 3.5.2 The ONS has looked at social capital as part of its Measuring National Well-being (MNW) programme. This programme identifies four aspects of social capital, based on work undertaken by Scrivens et al. in 2013 for the Organisation for Economic Co-operation and Development (OECD)²⁵. These aspects are:
- personal relationships;
 - social network support;
 - civic engagement and trust; and
 - cooperative norms.
- 3.5.3 The 2014 ONS paper includes a review of academic studies on social capital and its effects on health. The evidence suggests that social capital makes a positive contribution to a range of well-being aspects such as personal well-being, health and crime rates, and that these benefits occur at individual, community, regional and national level. In the same paper, the ONS cites evidence to suggest that ‘people with a good range and frequency of social contact report higher levels of life satisfaction and happiness, but also better mental health. However, people with poorer health, particularly mental health, have been reported to have significantly smaller social networks. Personal relationships are important for individual well-being but can also have positive outcomes for firms and organisations, and at a community level’. The evidence also suggests that ‘more socially isolated people are more at risk of risky behaviours such as smoking, drinking, physical inactivity and poor diet’.
- 3.5.4 A systematic review²⁶ on social capital and multiple health outcomes carried out in 2019 found evidence to suggest a positive correlation between social capital and mental and physical health, and that social capital contributes to lower mortality. The analysis found that it was difficult to assess whether an increase in health outcome was due to an increase in social capital, which limits the ability to understand whether and how social capital interventions can improve health. Another 2019 systematic review²⁷ of studies assessing social capital and physical health (most frequently self-reported health and mortality) identified mixed findings. The study suggested that social capital may be an important protective factor for some physical health outcomes, but that more research is needed to draw conclusions on the associations.

²⁵ Scrivens, K. and Smith, C. (2013), *Four interpretations of social capital: an agenda for measurement*, OEDC.

²⁶ Ehsan, A., et al. (2019), *Social capital and health: A systematic review of systematic reviews*, SSM Population Health, doi:10.1016/j.ssmph.2019.100425.

²⁷ Rodgers J., Valuev AV., Hswen Y., Subramanian S.V. (2019), *Social capital and physical health: An updated review of the literature for 2007–2018*. Social Science & Medicine, Volume 236, 112360, ISSN 0277-9536. Available online at: <https://doi.org/10.1016/j.socscimed.2019.112360>.

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- 3.5.5 A systematic review conducted in 2020²⁸ found positive associations between social cohesion and several population health outcomes including physical activity, health weight and depression. A 2020 meta-analysis of studies into the relationship between social capital and health²⁹ found significant positive associations between social capital types (cognitive, structural, bonding, bridging, linking) and health outcomes such as mortality, disease/illness and depression. It was noted that, although significant, the effects were consistently very small.
- 3.5.6 A publication on the health of rural communities by the Local Government Association and Public Health England (2017)³⁰ identifies 'Community support, isolation and social exclusion' as a key factor in determining health. This document notes that: 'Rural social networks are breaking down with a consequent increase in social isolation and loneliness, especially among older people. The fact that social isolation influences health outcomes in its own right suggests that this and the emotional and mental wellbeing of people in rural areas is an important and hitherto neglected area in the promotion of public health.'
- 3.5.7 Based on the criteria set out in Section 2.4, the evidence linking social capital to health and wellbeing is considered to be moderate.

3.6 Neighbourhood quality

- 3.6.1 In the health assessment presented in Volumes 2, 3 and 5 of the ES neighbourhood quality refers to the physical environment in which people live their day to day lives, which is influenced by visual amenity, air quality, traffic (including HGV movements) and noise.

Visual amenity

- 3.6.2 A study in 2015³¹ sought to quantify the relationship between environmental aesthetics and human health by comparing geographic data against self-rated health. This found that 'inhabitants of more scenic environments report better health, across urban, suburban and rural areas, even when taking core socioeconomic indicators of deprivation into account, such as income, employment and access to services.'

²⁸ Pérez E, Braën C, Boyer G, Mercille G, Rehany É, Deslauriers V, Bilodeau A, Potvin L. (2020), *Neighbourhood community life and health: A systematic review of reviews*. Health Place. 61:102238. doi: 10.1016/j.healthplace.2019.102238. Epub 2019 Nov 14. PMID: 31735517.

²⁹ Xue, XW, Reed, R., Menclova A. (2020), *Social capital and health: a meta-analysis*, Journal of Health Economics, Volume 72, 102317, ISSN 0167-6296. Available online at: <https://doi.org/10.1016/j.jhealeco.2020.102317>.

³⁰ Local Government Association, Public Health England (2017), *Health and wellbeing in rural areas*. Available online at: <https://www.local.gov.uk/publications/health-and-wellbeing-rural-areas>.

³¹ Seresinhe, C., Preis, T. and Moat, H. (2015), *Quantifying the Impact of Scenic Environments on Health*, Scientific Reports.

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- 3.6.3 A Position Statement published by the Landscape Institute in 2013³² looked at evidence linking the quality of places with health and wellbeing across a range of environmental, social and lifestyle determinants. This document cited evidence to suggest that health and wellbeing are influenced positively by a variety of factors including the perceived attractiveness of the environment.
- 3.6.4 A 2020 literature review³³ assessed the association between neighbourhood aesthetics and childhood obesity (body mass index, obesity/overweight status), physical activity and active transport to school in individuals aged <18 years from 25 studies. Two thirds (75%) of studies reported non-significant associations between neighbourhood aesthetics and physical activity and weight whereas half (50%) of studies showed that neighbourhood aesthetics is associated with active transport to schools. This suggests that the findings are mixed, and more research is needed to understand the epidemiological relationship.
- 3.6.5 A literature review³⁴ assessing the association between the built environment and physical activity in the elderly found that aesthetically pleasing scenery such as greenery is positively associated with physical activity in the individuals over 65 years of age.
- 3.6.6 Based on the criteria set out in Section 2.4, the evidence linking visual amenity to health and wellbeing is considered to be weak.

Air quality

- 3.6.7 The WHO recognises outdoor air pollution as a major environmental health problem for all countries including high-income countries³⁵. Guidance from Public Health England states that epidemiological studies have shown that long-term exposure to air pollution (over years or a lifetime) reduces life expectancy, due to cardiovascular and respiratory diseases and lung cancer. Short-term exposure (over hours or days) to increased levels of air pollution can also have a range of health effects, including effects on lung function, asthma, as well as increases in respiratory and cardiovascular hospital admissions, and mortality³⁶.

³² Landscape Institute (2013), *Public Health and Landscape – Creating healthy places*. Available online at: https://www.landscapeinstitute.org/PDF/Contribute/PublicHealthandLandscape_CreatingHealthyPlaces_FIN AL.pdf.

³³ Qu, P, Luo, M, Wu, Y, et al. (2020), Association between neighborhood aesthetics and childhood obesity. *Obesity Reviews*. 1– 19. Available online at: <https://doi.org/10.1111/obr.13079>.

³⁴ Bonaccorsi G., Manzi F., Del Riccio M., Setola N., Naldi E., Milani C., Giorgetti D., Dellisanti C. and Lorini C. (2020), *Impact of the Built Environment and the Neighborhood in Promoting the Physical Activity and the Healthy Aging in Older People: An Umbrella Review*. *International Journal of Environmental Research and Public Health*. 17(17):6127. Available online at: <https://doi.org/10.3390/ijerph17176127>.

³⁵ WHO Topic Sheet (2018), *Ambient (outdoor) air quality and health*. Available online at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health).

³⁶ Public Health England (2018), *Guidance: Health Matters: air pollution*. Available at: <https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution>.

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- 3.6.8 A Public Health England review³⁷ of interventions to improve outdoor air quality and public health found evidence that air pollution is the largest environmental risk to the health of the public in the UK. The review found that:
- it is estimated that between 28,000 and 36,000 deaths each year are attributed to human-made air pollution;
 - there is a close association with cardiovascular and respiratory disease, including lung cancer;
 - there is emerging evidence that other organs may also be affected, with possible effects on dementia, low birth weight and diabetes; and
 - it concluded that the most impactful interventions would be those that reduce emissions of air pollution at source.
- 3.6.9 According to the Lancet Commission on pollution and health³⁸ children are at high risk of pollution related disease and even extremely low-dose exposures to pollutants during windows of vulnerability in utero and in early infancy can result in disease, disability, and death in childhood and across their lifespan. Research has shown that exposure to particulate matter affects children's lung development, including reversible deficits in lung function as well as chronically reduced lung growth rate and a deficit in long-term lung function.
- 3.6.10 Based on the criteria set out in Section 2.4, the evidence linking air quality to health and wellbeing is considered to be strong.

Noise environment

- 3.6.11 According to the WHO³⁹, 'excessive noise seriously harms human health and interferes with people's daily activities at school, at work, at home and during leisure time. It can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour.'
- 3.6.12 The 2018 WHO guidelines on Environmental Noise for the European Region⁴⁰ undertook a series of systematic reviews synthesising exposure and associated impacts on health to develop a set of guidelines to protect human health. Recommendations were formulated

³⁷ Public Health England (2019), *Review of interventions to improve outdoor air quality and public health*. Available online at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/795185/Review_of_interventions_to_improve_air_quality.pdf.

³⁸ Landrigan, P.J., et al. (2018), *The Lancet Commission on pollution and health*. The Lancet 391:462-512.

³⁹ World Health Organization (2017), *Noise*. Available online at: <http://www.euro.who.int/en/health-topics/environment-and-health/noise>.

⁴⁰ World Health Organisation Regional Office for Europe (2018), *Environmental Noise Guidelines for the European Region*. Available online at: http://www.euro.who.int/_data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf.

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based on the strength of evidence from various noise sources including road traffic, railway, aircraft, wind turbine and leisure noise. The systematic reviews concluded that there was evidence for an association between railway noise and cardiovascular disease (CVD), sleep disturbance, annoyance and cognitive impairment, with suggestive but weaker evidence (often due to lack of studies) for effects on mental health and birth weight.

- 3.6.13 An evidence review of social inequalities in environmental noise exposure in the WHO European region⁴¹ found higher noise exposures in groups with lower socio-economic status. A study in London⁴², looking to quantify socioeconomic and ethnic inequalities, found that 'odds of living within a 50dB contour of rail noise were 19% higher for black compared to white individuals.'
- 3.6.14 A European Commission publication in 2015⁴³ cited evidence that 'living in a quiet area has a positive impact on health. A study assessed quality of life for people living in quiet and noisy locations and found that those who lived in quiet locations - particularly in rural area - had a better quality of life.'
- 3.6.15 A review commissioned in 2020 by Department of Environment, Food and Rural Affairs (Defra)⁴⁴ considered how evidence has changed since the publication of the WHO Environmental Noise Guidelines. This found associations between noise and medication use and interview measures of depression and anxiety. Associations with some cancer outcomes were also observed, although the quality of evidence across studies remains low for these outcomes.
- 3.6.16 Further details on the effects of noise on health, in particular regarding high-speed railway noise, is provided in Volume 5, Appendix: SV-001-00000, Sound noise and vibration methodology assumptions and assessment – Annex H Health evidence base.
- 3.6.17 Based on the criteria set out in Section 2.4, the evidence linking noise to health and wellbeing is considered to be strong.

⁴¹ Dreger, S., Schüle, S. A., Hilz, L. K. and Bolte, G. (2019), *Social Inequalities in Environmental Noise Exposure: A Review of Evidence in the WHO European Region*. International Journal of Environmental Research and Public Health. 16(6), 1011. Available online at: <https://doi.org/10.3390/ijerph16061011>.

⁴² Tonne C., Milà C., Fecht D. et al. (2018), *Socioeconomic and Ethnic Inequalities in Exposure to Air and Noise Pollution in London*. Environ Int.115:170 - 179. Available online at: <https://pubmed.ncbi.nlm.nih.gov/29574337/>

⁴³ European Commission, Science for Environment Policy (2015), *Thematic issues: Noise impacts on health*. Available online at: <http://ec.europa.eu/environment/integration/research/newsalert/pdf/47si.pdf>.

⁴⁴ Clark, C., Crumpler, C., & Notley, A. H. (2020), *Evidence for Environmental Noise Effects on Health for the United Kingdom Policy Context: A Systematic Review of the Effects of Environmental Noise on Mental Health, Wellbeing, Quality of Life, Cancer, Dementia, Birth, Reproductive Outcomes, and Cognition*. International journal of environmental research and public health, 17(2), 393. Available online at: <https://doi.org/10.3390/ijerph17020393>.

3.7 Access to green space

- 3.7.1 A review by Public Health England⁴⁵ concluded that ‘living in a greener environment can promote and protect good health, and aid in recovery from illness and help with managing poor health. People who have greater exposure to greenspace have a range of more favourable physiological outcomes. Greener environments are also associated with better mental health and wellbeing outcomes including reduced levels of depression, anxiety, and fatigue, and enhanced quality of life for both children and adults. Greenspace can help to bind communities together, reduce loneliness, and mitigate the negative effects of air pollution, excessive noise, heat and flooding. Disadvantaged groups appear to gain a larger health benefit and have reduced socioeconomic-related inequalities in health when living in greener communities.’
- 3.7.2 An evidence review by the World Health Organisation (WHO)⁴⁶ in 2016 showed that urban green spaces (parks, vegetation, and street trees) have beneficial effects on health, such as improved mental health, reduced cardiovascular morbidity, obesity and risk of type 2 diabetes, and improved pregnancy outcomes. Natural spaces also support and facilitate social interaction, providing indirect benefits for mental health by increased sense of community belonging⁴⁷.
- 3.7.3 A systematic review in 2020, based on fourteen studies, found that there was a positive association between exposure to green space and mental health and wellbeing in adolescents⁴⁸. A 2017 review of literature examining the association between access to green space and the mental wellbeing of children concluded that access to green spaces promoted attention and memory, fostered supportive social groups and self-discipline and improved symptoms of attention deficit hyperactivity disorder⁴⁹.
- 3.7.4 A 2017 study found a positive relationship between access to green spaces and mental wellbeing, including in places with a nature focus and spaces designed for recreational and

⁴⁵ Public Health England (2020), *Improving access to greenspace - A new review for 2020*.

⁴⁶ World Health Organization (2016), *Urban green spaces and health – a review of evidence*. Available online at: <https://www.euro.who.int/en/health-topics/environment-and-health/urban-health/publications/2016/urban-green-spaces-and-health-a-review-of-evidence-2016>.

⁴⁷ Rugel, E.J. et al. (2019), *Exposure to natural space, sense of community belonging, and adverse mental health outcomes across an urban region*. Environmental Research.

⁴⁸ Zhang Y., Mavoja S., Zhao J., Raphael D. and Smith M. (2020), *The Association between Green Space and Adolescents' Mental Well-Being: A Systematic Review*. Int J Environ Res Public Health. Sep 11;17(18):6640. doi: 10.3390/ijerph17186640. PMID: 32932996; PMCID: PMC7557737.

⁴⁹ McCormick, R. (2017), *Does Access to Green Space Impact the Mental Well-being of Children: A Systematic Review*. Vol 37 pages 3-7.

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sporting activity⁵⁰. A 2019 study⁵¹ showed that an increase in one hectare of greenspace within 300m of residents was associated with a statistically significant increase in life satisfaction, worth and happiness.

- 3.7.5 An evidence review by Natural England⁵² showed that access to natural environments promotes physical activity, and that people with poorer health tend to benefit more from physical activity in natural environments. A study in 2020⁵³ found a positive association between access to green space and physical activity.
- 3.7.6 An evidence review by Natural England⁵⁴ found evidence that people with poorer health tend to benefit more from physical activity in natural environments.
- 3.7.7 Based on the criteria set out in Section 2.4, the evidence linking access to green space to health and wellbeing is considered to be strong.

3.8 Physical activity

- 3.8.1 A factsheet published by the WHO⁵⁵ states that 'physical activity has significant health benefits and contributes to the prevention of non-communicable diseases.' These benefits are identified as reduced risk of hypertension, coronary heart disease, stroke, diabetes, breast and colon cancer, depression and the risk of falls, improved bone and functional health, and weight control. The WHO also states that 'beyond exercise, any other physical activity that is done during leisure time, for transport to get to and from places, or as part of a person's work, has a health benefit. Further, both moderate- and vigorous-intensity physical activity improve health.'
- 3.8.2 A 2020 systematic review of reviews and meta-analyses⁵⁶ found that physically active older adults are at reduced risk of all cause and cardiovascular mortality, breast and prostate cancer, fractures, recurrent falls, ADL disability and functional limitation and cognitive decline, dementia, Alzheimer's disease and depression. Another systematic review and

⁵⁰ Wood. L et al. (2017), *Public green spaces and positive mental health – investigating the relationship between access, quantity and types of parks and mental wellbeing*. Health and Place 48:63-71.

⁵¹ Houlden V. et al. (2019), *A spatial analysis of proximate greenspace and mental wellbeing in London*. Applied Geography 109:102036.

⁵² Natural England (2016), *Links between natural environments and physical activity: evidence briefing*. Access to Evidence Information Note EIN019.

⁵³ Jia, P., Cao, X., Yang, H, et al. (2020), *Green space access in the neighbourhood and childhood obesity*. Obesity Reviews. 1– 12. Available online at: <https://doi.org/10.1111/obr.13100>.

⁵⁴ Natural England (2016), *Links between natural environments and physical activity: evidence briefing*. Access to Evidence Information Note EIN019.

⁵⁵ World Health Organization (2017), *Physical activity*. Available online at: <http://www.who.int/mediacentre/factsheets/fs385/en/>.

⁵⁶ Cunningham C., O' Sullivan R., Caserotti P. and Tully MA. (2020), *Consequences of physical inactivity in older adults: A systematic review of reviews and meta-analyses*. Scand J Med Sci Sports. 30(5):816-827. doi: 10.1111/sms.13616. Feb 4. PMID: 32020713.

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meta-analysis⁵⁷ of 150 Cochrane systematic reviews published between 2000 and 2019 found physical activity was associated with a 13% reduction in mortality and an improvement in quality of life. Another systematic review and meta-analysis⁵⁸ assessing objective physical activity found a 40% decreased risk for mortality in individuals in the highest category of light, moderate to vigorous and total physical activity compared to the lowest.

- 3.8.3 A literature review of studies from various countries examining the relationship between physical activity and happiness showed that as little as 10 minutes of physical activity per week resulted in increased levels of happiness. A systematic review undertaken by the Department of Health and Human Services in the US, noted that a major finding of the evidence was that regular physical activity reduced the risk of clinical depression and depressive symptoms among people both with and without clinical depression. Physical activity was also found to reduce the severity of those symptoms irrespective of number of depressive symptoms. The review also found that perceived quality of life is improved by regular physical activity.
- 3.8.4 A cross-sectional and longitudinal study⁵⁹ found that walking had positive associations with psychological and social wellbeing, strolling in nature with emotional and social wellbeing and endurance training with subjective health. A systematic review and meta-analysis⁶⁰ of 42 studies including 37,408 individuals found a significant protective effect of physical activity on depression.
- 3.8.5 A 2013 literature review focused on the health benefits of active travel by Saunders et al.⁶¹ determined that, although there is no clear evidence in the effectiveness of active travel in reducing obesity, there has been a rise in the prevalence of obesity which has occurred in parallel with a decline in active travel in the past 30-40 years. Data from a report by the

⁵⁷ Posadzki, P., Pieper, D., Bajpai, R. et al. (2020), *Exercise/physical activity and health outcomes: an overview of Cochrane systematic reviews*. BMC Public Health 20, 1724. Available online at: <https://doi.org/10.1186/s12889-020-09855-3>.

⁵⁸ Ramakrishnan R., He JR., Ponsonby AL., Woodward M., Rahimi K., Blair SN., Dwyer T. (2021), *Objectively measured physical activity and all-cause mortality: A systematic review and meta-analysis*, Preventive Medicine, Volume 143,106356,ISSN 0091-7435. Available online at: <https://doi.org/10.1016/j.ypmed.2020.106356>.

⁵⁹ Kekäläinen, T. et al. (2019), *Cross-Sectional and Longitudinal Associations between Leisure Time Physical Activity, Mental Well-Being and Subjective Health in Middle Adulthood*, Applied Research Quality Life, doi.org/10.1007/s11482-019-09721-4.

⁶⁰ Gianfredi V., Blandi L., Cacitti S., Minelli M., Signorelli C., Amerio A. and Odone A. (2020), *Depression and Objectively Measured Physical Activity: A Systematic Review and Meta-Analysis*. International Journal of Environmental Research and Public Health. 17(10):3738. Available online at: <https://doi.org/10.3390/ijerph17103738>.

⁶¹ Saunders, L., Green, J., Petticrew, M., Steinback, R. and Roberts, H. (2013), *What are the health benefits of active travel? A systematic review of trials and cohort studies*, PLoS ONE.

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National Obesity Observatory in 2011⁶² suggests a number of factors impact active travel including access to fitness facilities, distance to destinations, land use, urban walkability scores, safety, availability of equipment and the provision of footpaths.

- 3.8.6 A 2014 study commissioned by the Royal Society for the Prevention of Accidents⁶³ suggested that road safety inventions can encourage physical activity by reducing the level of risk posed to vulnerable road users. The study noted that that 'road safety has a much wider impact on health than just preventing injuries. This is because some forms of travel (i.e. walking and cycling), and the provision for them, bring more health benefits for individuals and society than others. However, the way that people travel is influenced by concerns about actual or perceived safety; effective intervention to reduce road danger can encourage more people to travel by these active, health-promoting modes.' A 2019 study on walkable neighbourhoods and the incidence of diabetes⁶⁴ found that people living in walkable neighbourhoods tend to be more physically active and less likely to be obese.
- 3.8.7 Based on the criteria set out in Section 2.4, the evidence linking physical activity to health and wellbeing is considered to be strong.

3.9 Access to local services

- 3.9.1 Access to services and community facilities can affect health and wellbeing through access to treatment and care, basic needs such as food retail and banking, and access to social networks. This is often referred to as social infrastructure, defined in the Draft London Plan⁶⁵ as 'a range of services and facilities that meet local and strategic needs and contribute towards a good quality of life. It includes health provision, education, community, play, youth, recreation, sports, faith, and emergency facilities.' The London Health Urban Development Unit⁶⁶ has identified access to public services and social infrastructure as a key determinant of health and wellbeing.

⁶² NHS, National Obesity Observatory (2011), *Data sources: environmental influences on physical activity and diet*. Available online at: https://khub.net/c/document_library/get_file?uuid=68b8960e-4145-4ed2-b9f8-1ce767f1d2ff&groupId=31798783.

⁶³ Vernon, D. (2014), *Road Safety and Public Health*. Royal Society for the Prevention of Accidents (RoSPA).

⁶⁴ Booth G.L., Creatore M.I., Luo J. et al. (2019), *Neighbourhood walkability and the incidence of diabetes: an inverse probability of treatment weighting analysis*. J Epidemiol Community Health Published Online First: 29 January 2019. Available online at: <https://pubmed.ncbi.nlm.nih.gov/30696690/>.

⁶⁵ Greater London Authority (2017), *The Draft London Plan, Chapter 5 – Social Infrastructure*. Available online at: https://www.london.gov.uk/sites/default/files/draft_london_plan_chapter_5.pdf.

⁶⁶ NHS, Healthy Urban Development Unit (2013), *HUUDU Planning for Health- Rapid Health Impact Assessment Tool*. Available online at: <http://www.healthyurbandevelopment.nhs.uk/wp-content/uploads/2013/12/HUUDU-Rapid-HIA-Tool-Jan-2013-Final.pdf>.

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- 3.9.2 A publication on the health of rural communities by the Local Government Association and Public Health England (2017)⁶⁷ stated that 'Many of the factors contributing to health risks in rural communities relate to the wider social determinants of health as well as to access to health and care services.' This document notes that rural areas have worse access in terms of distance to health, public health and care services, and that service use decreases with increasing distance.
- 3.9.3 A 2018 Australian study⁶⁸ compared spatial data on social infrastructure with subjective wellbeing (assessed using the Personal Wellbeing Index⁶⁹) in over 7,000 residents and found evidence that increases in both the accessibility and mix of social infrastructure were associated with better health and wellbeing outcomes. The types of infrastructure considered in the study included community centres, sports, recreation and leisure centres, places of culture such as cinemas, libraries, museums and art galleries, educational establishments and early year and out of school childcare facilities, and a range of health and social care amenity centres.
- 3.9.4 Based on the criteria set out in Section 2.4, the evidence linking access to services to health and wellbeing is considered to be weak.

⁶⁷ Local Government Association, Public Health England (2017), *Health and wellbeing in rural areas*. Available online at: <https://www.local.gov.uk/publications/health-and-wellbeing-rural-areas>.

⁶⁸ Davern M., Gunn L., Whitzman C., Higgs C., Corti B., Simons K., Villanueva K., Mavoia S., Roberts R., Badland H. (2017), *Using spatial measures to test a conceptual model of social infrastructure that supports health and wellbeing*, *Cities & Health*, 1:2, 194-209. Available online at: <https://www.tandfonline.com/doi/full/10.1080/23748834.2018.1443620>.

⁶⁹ International Wellbeing Group (2013), *Personal Wellbeing Index: 5th Edition*. Melbourne: Australian Centre on Quality of Life, Deakin University. Available online at: <http://www.acqol.com.au/instruments#measures>.

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