



South East Strategic Reservoir Option
Preliminary Environmental Information Report

Appendix 16.1 - Evidence review of health determinants

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1 Introduction

- 1.1.1 The document is an appendix to the Preliminary Environmental Information (PEI) Report submitted as part of the South East Strategic Reservoir Option (SESRO, referred hereafter as 'the Project') application for development consent to provide a strategic water resource to secure water supply for Thames Water, Affinity Water and Southern Water customers, through a reservoir and associated infrastructure (as described in Chapter 2: Project description of the PEI Report).
- 1.1.2 The Infrastructure Planning (Environmental Impact Assessment (EIA)) Regulations 2017 ('The EIA Regulations') require an EIA to describe and assess the direct and indirect significant effects on population and human health in an appropriate manner and report the findings in a PEI Report which has been published in support of the Statutory Consultation for the Project. Ongoing design, survey and assessment work, as well as feedback received during the Statutory Consultation and ongoing engagement, will be used to refine the Project and improve understanding of its potential effects on Human health, which will be reported in the Environmental Statement.
- 1.1.3 This document provides a review and summary on the links between the health determinants (environmental, social, and economic factors that influence health) and health and wellbeing outcomes. The purpose of the document is to provide an overview of the scientific consensus on the potential health outcomes associated with impacts on health determinants assessed in Chapter 16: Human health of the PEI Report, based on a review of available primary, secondary and grey literature. The evidence presented underpins the qualitative judgements on health outcomes made in the assessment.

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 outcomes associated with impacts on health determinants assessed in the health assessment presented in Chapter 16: Human health of this PEI Report. A literature search has reviewed relevant evidence published between 2008 and 2025.
- 2.1.2 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. Primary literature is referenced where secondary literature is not available.
- 2.1.3 The spatial scope of the search included collecting evidence from the UK and high-income/developed countries with a comparable public and environmental health legislative and regulatory context.
- 2.1.4 The review primarily focuses on health determinants and outcomes assessed in Chapter 16: Human health of this PEI Report. However, where evidence is limited, the review showcases links between health determinants and health outcomes more generally.

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 (Journal Storage)
 - National Institute for Health and Care Excellence (NICE) Evidence Search
 - PubMed
 - ScienceDirect
 - Scientific American

2.3 Search for evidence on health determinants

- 2.3.1 The aspects covered in this review correspond to the health determinants that have been assessed in Chapter 16: Human health of the PEI Report, as set out in the EIA Scoping Report. Further, under each health determinant, evidence for vulnerable groups relating to the corresponding determinant is provided, where relevant and where evidence is available.
1. Healthy lifestyles:
 - Active travel and physical activity
 - Open space, leisure and play
 2. Safe and cohesive communities:
 - Housing
 - Built environment
 - Transport

- Community safety
 - Community identity and cohesion
3. Socioeconomic conditions:
 - Education
 - Socioeconomic status
 - Health and social care services
 4. Environmental conditions:
 - Climate change
 - Air quality
 - Water
 - Soil
 - Noise
 - Radiation

2.3.2 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:

- a. physical activity / exercise / active travel / connectivity
- b. green space / open space / nature / play / leisure / recreation
- c. housing / flood risk / segregation / loss of existing housing / housing market impacts / private outside space / gardens
- d. built environment / neighbourhood design / community assets / spatial planning / land allocations
- e. transport / public transport / road safety / journey times / access to community services
- f. community safety / personal safety / anti-social behaviour / crime / fear of crime
- g. community identity / social cohesion / belonging
- h. education / school / adults' skills development
- i. socioeconomic status / employment / wider economic effects
- j. health and social care facilities / access / quality / capacity
- k. climate change / extreme weather events
- l. air quality / construction dust / vehicle emissions
- m. drinking water / bathing water / quality / quantity
- n. soil / historic pollution / risk of new ground contamination / food security
- o. noise / vibration / construction / construction traffic
- p. radiation / perceived risk of radiation / actual risk of radiation

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:** secondary evidence based on 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, with limited secondary evidence. The general 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.
- **Weak:** a few peer-reviewed/non-peer reviewed research studies to suggest an association, or studies showing conflicting findings.

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 suggests that there is less certainty in the assessment of the likely effect. Further, while different levels of evidence within the review are useful for the purpose of comparison, lower levels of evidence may still be valid and reliable. The strength of evidence should not be considered as indicating the importance of the health effect.

3 Summary of Evidence

3.1 Healthy lifestyles

Active travel and physical activity

- 3.1.1 The review found a large body of secondary evidence showing associations between physical activity and a wide range of health outcomes. A 2024 factsheet published by WHO states that in adults, physical activity contributes to prevention and management of noncommunicable diseases such as cardiovascular diseases, cancer and diabetes and reduces symptoms of depression and anxiety, enhances brain health, and can improve overall well-being. In children and adolescents, physical activity promotes bone health, encourages healthy growth and development of muscle, and improves motor and cognitive development. Further, WHO highlights the risks and poor health outcomes associated with sedentary behaviour such as poorer cardiometabolic health, increased adiposity and poorer social behaviour in children and adolescents and type-2 diabetes, increased all-cause mortality as well as cardiovascular disease and cancer mortalities in adults.
- 3.1.2 A 2020 systematic review of reviews and meta-analyses found that physically active older adults are at reduced risk of mortality from all causes, including cardiovascular diseases, breast and prostate cancer, fractures, recurrent falls, ADL disability, functional limitation and cognitive decline, dementia, Alzheimer's disease, and depression. Another systematic review and meta-analysis from 2020 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. A 2021 systematic review and meta-analysis 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.
- 3.1.3 A 2018 literature review of studies from various countries examining the relationship between physical activity and happiness reported positive associations between physical activity and happiness and showed that as little as 10 minutes of physical activity per week resulted in increased levels of happiness.
- 3.1.4 A cross-sectional and longitudinal 2019 study 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-analysis found a significant protective effect of objectively measured physical activity on prevalent and incident depression.
- 3.1.5 A 2014 population based, cross sectional study in the United Kingdom shows a robust, independent association between active commuting and two objective markers of obesity, BMI and percentage body fat. A 2019 study on walkable neighbourhoods and the incidence of diabetes found that people living in walkable neighbourhoods tend to be more physically active and less likely to be obese.
- 3.1.6 Data from a report by the National Obesity Observatory in 2011 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.

Vulnerable groups

- 3.1.7 Evidence was found linking physical activity to health outcomes in vulnerable groups including children, older adults, people with disabilities and pregnant women.
- 3.1.8 A 2018 systematic review undertaken by the Department of Health and Human Services in the US, noted that higher amounts of physical activity are associated with more favourable indicators of bone health and with reduced risk for excessive increases in body weight and adiposity in children ages 3 to 6 years. It is important to note that the beneficial effects for adiposity and bone health are two health characteristics that are known to impact future health outcomes in adult life.
- 3.1.9 A Department of Transport evidence review 2019 found a negative impact on children's physical health from increased car use. It shows that a greater reliance on car-use has contributed to a reduction in the amount of physical activity children engage in. The review emphasises how engaging in active travel is a key component in children's physical health, where more car use means less active travel and reduced physical activity for children.
- 3.1.10 A 2023 systematic scoping review and strategic behavioural analysis on understanding active travel for older adults identified environmental context and resource (unsupportive built environment) as one of the key determinants that influenced adult active travel.
- 3.1.11 A global 2021 overview of the prevalence, benefits, and promotion policies for physical activity for people living with disabilities (PLWD) states that PLWD are 16–62% less likely to meet physical activity guidelines and are at higher risk of serious health problems related to inactivity than people without disabilities. Meta-analyses have shown that physical activity has beneficial effects on cardiovascular fitness, musculoskeletal fitness, cardiometabolic risk factors, and brain and mental health outcomes. These meta-analyses also show that health benefits can be achieved even with less than 150 min of physical activity per week, and suggest that some physical activity is better than none.
- 3.1.12 A 2019 study of 76 systematic reviews and meta-analyses shows strong evidence that moderate-intensity physical activity reduced the risk of excessive gestational weight gain, gestational diabetes, and symptoms of postpartum depression for pregnant women.

Strength of evidence

- 3.1.13 Based on the criteria set out in Section 2.4, the evidence linking active travel and physical activity to health and wellbeing is strong.

Open space, leisure and play (including access to green space and blue space and connectivity)

- 3.1.14 The review found a large body of literature showing associations between access to green and blue open spaces and a wide range of health outcomes. The Health Foundation 2024 states that access to green space can bring physical and mental health benefits by providing opportunities to meet and socialise, helping people to get together and building relationships and networks. Green spaces provide opportunities to exercise, and spending time in nature can relieve stress.
- 3.1.15 Further, the Health Foundation 2024 finds that people living in areas with less access to green space are more likely to be in poor health, as access to green space is lower in more

deprived areas, and deprivation is itself strongly associated with poor health. Neighbourhoods with greater access to green space tend to have higher life expectancy. Men's life expectancy in neighbourhoods with the highest access to green space is 81.2, compared with 78.2 in neighbourhoods with the lowest. Women's life expectancy in neighbourhoods with the highest access to green space is 84.7, compared with 82.8 in neighbourhoods with the lowest access.

- 3.1.16 A National Farmers' Union 2021 study reveals that visiting the countryside has improved the physical and mental health of people living in towns and cities across Britain over the past year. Furthermore, a 2021 Forest Research report shows that visits to the UK's woodlands boosts mental health and is estimated to save £185 million in treatment costs annually.
- 3.1.17 Additionally, World Health Organisation 2021 report on Green and Blue Spaces and Mental Health shows that besides green spaces, blue spaces can also positively influence mental as well as physical health. Blue spaces are: "outdoor environments – either natural or manmade – that prominently feature water and are accessible to humans either proximally (being in, on or near water) or distally/virtually (being able to see, hear or otherwise sense water)". Qualitative studies reviewed in the report highlighted unique and beneficial characteristics of blue spaces, including the visual openness of the space and fluidity of the water that provides a calming effect and the importance of safety perceptions.

Vulnerable groups

- 3.1.18 Evidence was found linking access to open space, including green and blue spaces, and associated leisure, play and physical activity to positive health outcomes for vulnerable groups such as children, older people and people with long term illnesses or chronic conditions. A 2024 study looking at the effects of playgrounds on children's health, analysed 247 studies and concluded that adding playground markings to schoolyards led to increased physical activity, also having positive effects on social and mental health.
- 3.1.19 A 2024 systematic review of quantitative review by Kilgour et al., states that physical activity in older people can reduce the incidence of sarcopenia, frequency of falls, cardiovascular disease, days spent in hospital, and all-cause mortality, even in frail older adults. The study reported barriers for older adults to physical activity, including safety concerns, lack of facilities, transport and equipment. It also reported outside facilities or green spaces near home as a key motivator for physical activity. A 2024 systematic review on the impact of outdoor blue spaces on the health of the elderly finds that blue spaces promote potential health and wellbeing benefits by relieving stress, stimulating physical activity and enhancing social connection.
- 3.1.20 A Lancet Public Health 2025 study confirms the association between leisure-time physical activity and increased disease-free years across population subgroups, showing that health benefits are often more pronounced among individuals with pre-existing health risks or disadvantaged backgrounds than in those with more favourable risk factor profiles. This suggests that enhancing population-wide physical activity initiatives and access to leisure could help reduce health disparities.

Strength of evidence

- 3.1.21 Based on the criteria set out in Section 2.4, the evidence linking access to open space (including green and blue spaces), leisure and play to health and wellbeing is moderate.

3.2 Safe and cohesive communities

Housing (Flood risk, residential segregation, loss of existing housing, housing market impacts)

- 3.2.1 Much of the evidence relating to housing demolitions and involuntary relocation relates to situations not relevant to this review (e.g. displacement of people by wars and natural disasters). In the UK, most research on housing and health is focused on housing quality and tenure. According to English Housing Survey 2022 to 2023, overall owner occupiers were more likely to be satisfied (94%) than all other tenures (82% for private renters and 74% for social renters). The Annual Population Survey 2018 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 mortgage.
- 3.2.2 A systematic review in 2019 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.
- 3.2.3 Rolfe et al.'s (2020) paper analysing quantitative data from a mixed methods and longitudinal study of tenants from three housing organisations, demonstrates that housing service provision, tenants' experience of property quality and aspects of neighbourhood are all significantly correlated with measures of health and wellbeing.
- 3.2.4 Stanke et al. (2012) concluded that the studies analysed in the report clearly identify that experiencing impacts on housing from flooding is very stressful and that the stress continues for a long time after the water has receded. Flooding affects people of all ages and it can herald bereavement, economic problems for families, behavioural problems in children, increased substance use and/or misuse, increased domestic violence, as well as exacerbating, precipitating or provoking people's existing problems with their mental health.
- 3.2.5 A 2024 systematic review found that changes in housing prices were associated with physical and mental health outcomes, with multiple mechanisms contributing to both positive and negative health outcomes. Income-level and home-ownership status were identified as key moderators, with lower-income individuals and renters experience negative health consequences from rising housing prices, likely from increased stress and financial strain.

Vulnerable groups

- 3.2.6 Evidence was found linking housing to health outcomes in vulnerable groups such as people from low-income groups, deprived areas and older people.

- 3.2.7 The Health Foundation 2025 finds that young people who have moved house more frequently are more likely to report poorer health. One in eight 17-year-olds who had moved house more than 3 times said their health was either 'fair' or 'poor' compared with 1 in 17 with no house moves. Moving home matters for health, as instability at an early age can interrupt education and social participation, which can negatively affect people later in life. Moving home in childhood has been associated with lower socio-emotional well-being at ages five and ten.
- 3.2.8 According to English Housing Survey 2022 to 2023 overall, households with a white household reference person (HRP) were more likely to report being satisfied with their current accommodation (90%) compared to households with an ethnic minority HRP (79%). This trend was also observed among owner occupiers, social renters and private renters. Similarly, there was a higher proportion of ethnic minority households who reported feeling dissatisfied (12%) compared with white households (6%).
- 3.2.9 A 2015 study of the effects of relocation at older age on cognitive function showed that involuntary residential relocation has a negative impact on wellbeing, including increased stress and isolation, particularly for older people.

Strength of evidence

- 3.2.10 Based on the criteria set out in Section 2.4, the evidence linking housing quality and tenure to health and wellbeing is moderate. However, evidence relating to involuntary relocation of homeowners and/or changes to local housing market conditions is weak.

Built environment (neighbourhood design, community assets, spatial planning/land allocations)

- 3.2.11 The evidence review finds a range of literature showing associations between the built environment and health outcomes. Evidence for the impact of traffic on people's experience of the built environment is reviewed under Transport, and Active travel and physical activity. Public Health England's Spatial Planning for Health 2017 evidence resource shows how the design of a neighbourhood can contribute to the health and wellbeing of people. It emphasises the importance of walkable neighbourhoods through improved street connectivity, mixed land use and compact residential design which can encourage active travel and promote physical activity for all age groups, reducing risk of cardiovascular diseases, obesity, type 2 diabetes and mental health problems. Further, it suggests that neighbourhood design that include long distance trips for travel or recreation and steep inclines have been identified as having a negative impact on walking and cycling. The provision of green spaces in neighbourhood design also contributes to positive health outcomes. This is covered in Section 3.1 under the health determinant of 'Open space, leisure and play'.
- 3.2.12 Additionally, Public Health England's 2017 evidence resource shows that public realm improvements such as provision of street lighting in residential areas can prevent road traffic collisions (RTCs) and increase pedestrian activity. General environmental improvements in neighbourhoods have the potential to reduce fear of crime. This would result in increased social interaction, physical activity and improved mental wellbeing for residents.

Vulnerable groups

- 3.2.13 Evidence was found linking built environment to health outcomes for vulnerable groups such as older people, children and people with disabilities. Public Health England's Spatial Planning for Health 2017 evidence resource shows that improving neighbourhood walkability, and access to recreational and non-recreational destination (such as grocery stores, schools and other amenities) can also impact positively upon social interaction among older adults.
- 3.2.14 A systematic review from 2023 concluded the positive associations between children's quality of life, including physical and mental wellbeing and features of built environment including green space and neighbourhood satisfaction.
- 3.2.15 A 2014 study explored the associations between community and neighbourhood land uses and community participation among adults with acquired physical disability, looking at cross-sectional data from 508 community-living, chronically disabled adults in New Jersey. They found that living in neighbourhoods with large portions of open space was positively associated with the likelihood of reporting full physical, occupational, and social participation, suggesting that the overall living conditions of the built environment are relevant to social inclusion for persons with physical disabilities.

Strength of evidence

- 3.2.16 Based on the criteria set out in Section 2.4, the evidence linking built environment to health and wellbeing is moderate.

Transport (health impacts related to road safety, public transport, journey times, emergency response times and community services)

- 3.2.17 There is a wide range of literature showing associations between transport and health outcomes. The Marmot Review: Implications for Spatial Planning shows that the relationships between transport and health are multiple and complex, and transport also provides access to work, education, social networks and services, which can improve people's opportunities. It shows that there is strong evidence that traffic interventions reduce road accidents, while there is some inconclusive evidence that they improve physical activity. The impact of transport on health inequalities is greatest when looking at deaths from road traffic injuries, especially for children, as they are four times more likely to be hit by a car in the 10 per cent most deprived wards than in the least deprived wards. Fatal accidents on the road are also particularly high among children of parents classified as never having worked or as long-term unemployed. Increased road traffic, particularly increase in HGVs associated with construction, can impact road safety and conditions for all.
- 3.2.18 The Transport, health and wellbeing evidence review for the Department of Transport 2019 finds that there are positive benefits of transport include improving access to employment and education opportunities, as well as recreation and exercise, which leads to better health outcomes. However, transport can be health damaging when there is inequitable access to health services, for example, as well as health consequences due to accidents, noise, and air pollution. In general, healthy and affluent groups are more likely to experience positive impacts whereas those on lower incomes, young, and older people are

more likely to experience negative impacts. Increased traffic impacts levels of air and noise pollution in local areas, as well as journey times to essential services like healthcare, education and employment. Disruption to public transport routes, e.g. due to diversions associated with construction projects, impacts access to services like healthcare, education, employment as well as community assets for social interactions.

Vulnerable groups

- 3.2.19 Evidence was found linking transport to health outcomes for vulnerable groups such as older people, people with disabilities, people from low-income backgrounds and those living in rural areas, particularly those without access to a private car.
- 3.2.20 The Department of Transport 2019 review shows a clear link between transport and physical health, such as in facilitating people's access to health services such as GP surgeries, hospitals or dentist surgeries. This is particularly important for older people and disabled people, especially those living in rural areas, as public transport may be their only means of accessing services. The review shows that car ownership can have a positive impact on health status by enabling people to access leisure facilities or healthy food providers more easily than they would be able to through public transport. Those without access to a car are therefore more vulnerable to social isolation, particularly in areas with poor public transport provision (such as rural locations). Additionally, transport also has an impact on vulnerable people's mental health and wellbeing. It allows people to connect and maintain relationships with others, access work opportunities, education or leisure activities outside their homes, and to be more autonomous. It enables older people to keep active lifestyles and be involved in their communities.
- 3.2.21 The Journal of Transport and Health 2024 overview shows that more than one-third of people live in rural areas and experience additional transport issues. Distances and public transport routes are longer, more time-consuming and more expensive. Smaller population mean fewer passengers, increasing prices further. Higher costs and smaller revenues result in fewer services. Facilities for walking and cycling are often absent, even in countries where pavements are routinely present in built-up areas. Hence, those without private vehicles suffer increasing isolation and lack of access to education, work, shops, or healthcare. The 2020 DfT review suggests that about 10-15% of older adults are at risk of functional impairments and other medical problems, such as poor vision, that can impede their ability to drive. Being unable to drive or use public transport can lead to a loss of independence and a decline into dependency.
- 3.2.22 A 2018 report by Public Health England notes that the need to maintain, improve and adapt the pedestrian environment to meet the needs of older people who are likely to be more vulnerable as pedestrians but need the ability to venture outside both for their physical and mental health and wellbeing. The report cites evidence that many older adults may not feel comfortable negotiating street crossing, and surveys suggesting that motor traffic control measures are one of the most important environmental issues to address in order to improve levels of accessibility and physical activity.
- 3.2.23 A 2024 study in the journal Transportation Research found examined factors affecting children's accessibility, including actual and perceived traffic danger. The study estimated children's (aged 8–12) walking accessibility to child-relevant destinations with and without the influence of traffic danger. This found that children's independent mobility was significantly impacted by limitations due to traffic danger. Based on surveys of children's

local destinations and road characteristics, it was shown that traffic danger reduces the number of accessible destinations for children on average by 75%.

- 3.2.24 A 2020 survey of public opinion undertaken for the Department of Transport showed that 'heavy traffic', 'traffic fumes' and 'a lot of lorries' were among the issues considered by communities to be a 'serious problem in residential and local high streets'. The perceived adverse effects were greater for high streets than for residential streets.
- 3.2.25 Heavy goods vehicles (HGVs) are statistically more dangerous to pedestrians than other vehicle types. Research carried out for the Campaign for Better Transport found that HGVs are five times more likely than cars to be involved in fatal accidents on local roads. Cycling UK (n.d) reports that HGVs, accounting for only about 4% of non-motorway traffic, are involved in around 13% of pedestrian deaths, making them a disproportionate threat and that collisions with HGVs are more likely to prove fatal than serious or slight.

Strength of evidence

- 3.2.26 Based on the criteria set out in Section 2.4, the evidence linking transport to health and wellbeing is strong.

Community safety (personal safety, opportunities for anti-social behaviour, crime and fear of crime, emergency response times)

- 3.2.27 The evidence review finds a range of literature showing associations between community safety and health outcomes. Evidence for community safety issues relating to road traffic are reviewed under Transport, and Active travel and physical activity.
- 3.2.28 The Health Foundation 2024 highlights that living in areas with high levels of crime can affect people's health negatively. In addition to the direct health effects of being the victim of violent crime, fear of crime can also have an indirect detrimental impact on health. Research shows that fear of crime results in people exercising less, as well as reducing how often people socialise, resulting in poorer mental and physical health.
- 3.2.29 BioMed Central (BMC) Public Health's 2019 cross-sectional study on the association between criminality in neighbourhoods and self-reported health finds that living in unsafe neighbourhoods has repeatedly been shown to be associated with poor mental and physical health and lower well-being of the residents. Crime, but also fear of crime and general feelings of safety have been associated with worse self-perceived health, higher levels of stress, more depressive symptoms and worse mental health, increased risk of coronary heart disease, less physical activity and even adverse birth outcomes.

Vulnerable groups

- 3.2.30 Evidence was found linking community safety to health outcomes for vulnerable groups. While crime and violence can affect anyone, certain groups of people are more likely to be exposed, including ethnic minority groups, children and adolescents, low-income neighbourhoods, women and older people.
- 3.2.31 The Crime survey for England and Wales 2023 reveals that the odds of being a victim were approximately 1.5 times greater for disabled people and single compared with non-

disabled people and those living in a household with no children, respectively, after adjusting for a range of other factors.

- 3.2.32 Additionally, UK Government's 2017 facts and figures on fear of crime show that Asian people and those from the other ethnic groups had the highest levels of fear of crime.

Strength of evidence

- 3.2.33 Based on the criteria set out in Section 2.4, the evidence linking community safety to health and wellbeing is moderate.

Community identity and cohesion (residential segregation, in-migration, social networks, effects of visual and landscape impacts on sense of place, social networks/ opportunities for social and cultural activities)

- 3.2.34 The evidence review finds a range of literature showing associations between community identity and cohesion and health outcomes. The Health Foundation 2024 highlights that our connections within our communities can have an important influence on our health. Experiencing a feeling of belonging to our community has a positive association with health, particularly mental health, as people living in neighbourhoods with higher levels of social cohesion experience better mental health.
- 3.2.35 The Marmot Review: Implications for Spatial Planning shows that community capital differs in areas of deprivation, with less volunteering and unpaid work, less socialising and less trust in others, in the neighbourhoods that are perceived to be less safe. Evidence of the association between social capital and health is significant and improving in many communities facing multiple deprivation, stress, isolation and depression are all very common, and low levels of social integration, and loneliness, significantly increase mortality. Social participation acts as a protective factor against dementia and cognitive decline over the age of 65 and also have an impact on the risk of mortality by aiding recovery when becoming ill. Furthermore, there is some evidence that increasing community empowerment may result in communities acting to change their social, material and political environments.

Vulnerable groups

- 3.2.36 Evidence was found linking community identity and cohesion to health outcomes for vulnerable groups such as older people, people with disabilities, deprived communities and people with dependents/caring responsibilities. The Marmot Review: Implications for Spatial Planning shows that social isolation can cause stress and depression, particularly for those with young children and older people. 19% of people in the most deprived areas of England have a severe lack of social support compared to 12% in the least deprived quintile.
- 3.2.37 Additionally, The Marmot Review indicates that in some cases, social isolation is heightened by the physical environment, especially for elderly and disabled people. Fear of crime in public spaces and fear of traffic often stops elderly people from reaching services and community groups, and taking advantage of interaction with neighbours and local retailer in public spaces and shops.

- 3.2.38 A 2020 study in the Journal of Positive Psychology and Wellbeing shows the negative impact of discrimination experiences on wellbeing and social cohesion, including identities based on ethnicity, disability, sexual orientation, marital status, education, employment, income and religion.

Strength of evidence

- 3.2.39 Based on the criteria set out in Section 2.4, the evidence linking community identity and cohesion to health and wellbeing is moderate.

3.3 Socioeconomic conditions

Education (schools, colleges and educational facilities)

- 3.3.1 The evidence review finds a range of literature showing associations between education and health outcomes.
- 3.3.2 Health Action Research Group's 2021 research finds that due to inadequate funding for skills training programmes in the UK, research suggests that adults who left school before the age of 16 have less than a 50% chance of getting involved in education again when compared with those who stayed in full time education until the age of 21. This effectively reinforces educational and thereby, health inequalities.
- 3.3.3 Public Health England's 2021 research on education, schooling and health finds that people with less education are more likely to be obese, to smoke, and to experience alcohol-related harm. It further shows that higher levels of education are associated with a range of health benefits, including greater social mobility, fewer co-morbidities and longer life expectancy.
- 3.3.4 BMC's 2020 empirical assessment of the influence of education on health in the Organisation for Economic Co-Operation and Development (OECD) countries shows that adults with higher educational attainment have better health and lifespans compared to their less-educated peers. It also highlights that tertiary education, particularly, is critical in influencing infant mortality, life expectancy, child vaccination, and enrolment rates.

Vulnerable groups

- 3.3.5 Evidence was found linking education to health outcomes for vulnerable groups such as deprived communities, low-income communities and people with special educational needs and disabilities as well as gendered differences in health outcomes. Public Health England's 2021 research also shows that sleep patterns and diets have been shown to be worse when children are out of schools, with children that receive free school meals being disproportionately impacted.
- 3.3.6 The research further discusses the importance of schools in supporting the mental wellbeing of children, finding that girls are more likely to experience mental health problems than boys. They also found that young people from low-income families and those with special educational needs and disabilities faced particular challenges with mental health and wellbeing.

Strength of evidence

- 3.3.7 Based on the criteria set out in Section 2.4, the evidence linking education to health and wellbeing is moderate.

Socio-economic status (employment opportunities, wider economic effects)

- 3.3.8 The evidence review finds a wide range of literature showing associations between socioeconomic status and health outcomes. A 2017 systematic review and meta-analysis finds that income inequality negatively affects mental health, but the effect sizes are small and there is marked heterogeneity among studies.
- 3.3.9 The American Journal of Public Health's 2011 research on socioeconomic status and health finds that there is a strong and consistent relationship between socioeconomic measures of education, income and occupation and risks factors for cardiovascular disease. The highest level of risk was associated with lower levels of education, suggesting higher education as an appropriate predictor of good health.
- 3.3.10 The World Travel & Tourism Council's Travel & Tourism Economic Impact Research (EIR) shows that tourism is an important source of employment and in 2024, the sector supported a total of 357 million jobs globally. This suggests positive wider economic and employment benefits in areas with tourist attractions.

Vulnerable groups

- 3.3.11 Evidence was found linking socioeconomic status to health outcomes for vulnerable groups such as ethnic minorities, children and young adults in foster care and low-income groups. According to the Health Action Research Group's 2021 research, White ethnic groups are more likely to be promoted than BAME groups, even if they are less qualified and people with Indian or Pakistani-sounding names are 28% less likely to be invited to an interview than similarly qualified candidates with English-sounding names. The current BAME employment rate stands at 62.8%, while White ethnic groups have an employment rate of 75.6%.
- 3.3.12 Public Health England's 2019 guidance on health and work states that there is clear evidence that unemployment is bad for health and wellbeing, as it is associated with increased risk of mortality and morbidity. Particularly, for those with long-term conditions such as mental health problems, musculoskeletal (MSK) conditions and disabilities, health issues can be a barrier to gaining and retaining employment.
- 3.3.13 Institute of Health Equity's 2020 report shows states that the more deprived the area, the shorter the life expectancy. This social gradient has become steeper over the last decade, and it is women in the most deprived 10% of areas for whom life expectancy fell from 2010-12 and 2016-18.

Strength of evidence

- 3.3.14 Based on the criteria set out in Section 2.4, the evidence linking socioeconomic status to health and wellbeing is strong.

Health and social care services (access, quality, capacity)

- 3.3.15 The evidence review finds literature showing associations between health and social care services and health outcomes. The Care Quality Commission's 2024 research on primary and community care shows that the number of people waiting more than 2 weeks for a GP practice appointment increased by 18% from 4.2 million in February 2020 to 5 million in March 2024. Additionally, the 2 services that people had the most difficulty accessing were GP services (59% of survey respondents) and dental services (23% of survey respondents).
- 3.3.16 According to a 2018 report by OECD, World Health Organization (WHO) and the World Bank, poor quality health services are holding back progress on improving health in countries at all income levels. Additionally, the report indicates that around 15 percent of hospital expenditure in high-income countries is due to mistakes in care or patients being infected while in hospitals.

Vulnerable groups

- 3.3.17 Evidence was found linking health and social care services to health outcomes for vulnerable groups such as people living in deprived areas, children particularly in deprived areas and people living in rural areas. The Care Quality Commission's primary and community care 2024 research shows that the 10 integrated care system areas with the highest proportions of patients waiting over 2 weeks for a GP appointment were in comparatively rural areas – with half of these in the South West.
- 3.3.18 The Care Quality Commission's primary and community care 2024 research also shows that people in the most deprived areas of England were nearly 3 times more likely to be admitted to hospital for treatment that could potentially be avoided with timely and effective care in the community. Furthermore, school children living in the most deprived areas were more than twice as likely to experience tooth decay than those living in the least deprived areas.
- 3.3.19 The Care Quality Commission's adult social care 2024 research shows that in April 2024, waits for care home beds and home-based care accounted for 45% of delays in discharging people who had been in an acute hospital for 14 days or more, with nearly 4,000 people delayed on an average day.
- 3.3.20 The Care Quality Commission's mental health 2024 research shows that access to mental health services remains a challenge for many people. Research from the Strategy Unit shows that people who live in deprived areas, women, and people from 'other' ethnic minority groups (global ethnic majorities, including Asian, Black, Arab, Hispanic among others) with mental health needs are more likely to attend urgent and emergency care departments.

Strength of evidence

- 3.3.21 Based on the criteria set out in Section 2.4, the evidence linking health and social care services to health and wellbeing is moderate.

3.4 Environmental conditions

Climate change (public health vulnerabilities to climate change including extreme weather events during construction/operation)

- 3.4.1 The evidence review finds a range of literature showing associations between climate change and health outcomes. World Health Organization 2023 research shows that 3.6 billion people already live in areas highly susceptible to climate change. Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, from undernutrition, malaria, diarrhea and heat stress alone.
- 3.4.2 A 2021 overview of 94 systematic reviews suggests that climate change is associated with worse human health.
- 3.4.3 According to UK Health Security Agency (UKHSA) 2023 Health Effects of Climate Change (HECC) report, climate change can increase risks to health directly through greater severity and frequency of extreme weather events such as flooding, drought, heatwaves or wildfires. Heatwaves have already led to excess deaths in England and they can increase burden on health and care services, increase strain on water, energy and transportation infrastructure and can have implications such as crop loss and reduced air quality that can also impact health.
- 3.4.4 Further the UKHSA's HECC 2023 report also indicates that with warmer temperatures, there is an increased risk of new and emerging infectious diseases in the UK, including those transmitted through mosquito and tick bites. The impact of climate change on individuals will vary, with the worst effects on disadvantaged and vulnerable populations, which could widen health inequalities further.

Vulnerable groups

- 3.4.5 Evidence was found linking climate change to health outcomes for vulnerable groups such as deprived communities, children, older people, people with disabilities or long-term health conditions, ethnic minorities and people experiencing homelessness. UKHSA's HECC 2023 report indicates that climate risks will be differential, with risks such as sea-level rise and flooding, greatly impacting coastal towns, low-lying areas, and in or near floodplains while urban areas may be particularly affected by extreme heat due to the urban heat island effect. There is very strong evidence that older adults (over 65 years) and people with pre-existing health conditions will be at greatest risk from rising temperatures. Those less able to control their environment, adapt their behaviours, or respond to new risks will be particularly vulnerable, including children, people with disabilities, people experiencing homelessness, and people in certain settings such as prisons, schools and social care will be disproportionately vulnerable to the health impacts of climate change.
- 3.4.6 The British Medical Journal's (BMJ) 2025 report shows that the UKHSA finds that people from more deprived areas were disproportionately affected by radiation, chemical, climate, and environmental hazards that have direct health effects as well as exacerbating existing medical conditions. Areas with high deprivation typically have higher levels of air pollution than less deprived and less ethnically diverse areas.

- 3.4.7 The BMJ 2025 report further highlights how poor infectious disease outcomes are unevenly distributed across ethnic groups. For example, emergency hospital admission rates for tuberculosis were 29 times as high among people classed as “Asian other,” 27 times as high in the Indian group, and 15 times as high in the Black African group, when compared with the White British group.

Strength of evidence

- 3.4.8 Based on the criteria set out in Section 2.4, the evidence linking climate change to health and wellbeing is moderate.

Air quality (impacts to human health that are related to construction dust, plant, process, vehicle emissions and odour and plant, process, vehicle emissions and odour)

- 3.4.9 The evidence review finds a range of literature showing associations between air quality and health outcomes. According to the World Health Organization 2024, exposure to high levels of air pollution can cause various health outcomes. Increased health risks with exposure to air pollution include respiratory infections, heart disease, stroke, and lung cancer, which can severely affect people who are already ill, such as children, the elderly, and poor people. Furthermore, poor air quality increases the risk of stillbirth, miscarriage, and neurological conditions such as cognitive impairment and dementia.
- 3.4.10 A 2023 review identifies that numerous scientific studies have linked construction dust exposure to a variety of health impacts, including the increased risk and mortality from various respiratory and cardiovascular diseases, as well as the increased cancer risk.
- 3.4.11 Public Health England’s Health Matters: Air pollution 2018 guidance highlights that poor air quality is the largest environmental risk to public health in the UK, as long-term exposure to air pollution can reduce life expectancy due to cardiovascular and respiratory diseases and short term exposure can lead to effects on lung function, exacerbation of asthma and increases in cardiovascular and respiratory admissions and mortality. Emerging evidence also associates air pollution with early life effects such as low birth weight and later life effects like dementia and cognitive decline. .

Vulnerable groups

- 3.4.12 Evidence was found linking air quality to health outcomes for vulnerable groups such as children, pregnant women, older people, people living in deprived areas, people with existing illnesses as well as people living in urban/industrial areas. With regards to early childhood, pregnancy and infancy, Public Health England’s Health Matters: Air pollution 2018 guidance indicates that factors that adversely affect human development, including air pollution, can have both immediate and long-lasting effects on a person’s health, and some health impacts may only emerge later in life. In addition to potential effects on foetal growth, air pollution exposure is also associated with low birth weight and premature
- 3.4.13 UK Health Security Agency 2025 research shows that traffic-related air pollution is linked to adverse health effects, disproportionately affecting children and contributing to health inequalities. Children travelling to school are particularly vulnerable to high levels of traffic-

related pollution. This can also reduce active travel and impact levels of physical exercise, road safety and socialising among children. birth.

- 3.4.14 Environment Agency's 2023 research analysis has shown that areas of highest deprivation and those with high proportions of ethnic minorities are disproportionately affected by high levels of air pollution. In 2016, nitrogen dioxide exceeded legal limits in the nearest play spaces for 14% of under 16 year olds in Greater London. Two-thirds of these children lived in deprived areas.

Strength of evidence

- 3.4.15 Based on the criteria set out in Section 2.4, the evidence linking air quality to health and wellbeing is strong.

Water (bathing water quality, drinking water quality and quantity)

- 3.4.16 The evidence review finds a range of literature showing associations between water quality and quantity, and health outcomes. A 2015 systematic review shows a positive association between water quantity and health outcomes, but the effect depended on how the water was used. Increased water usage for personal hygiene was generally associated with improved trachoma outcomes, while increased water consumption was generally associated with reduced gastrointestinal infection and diarrheal disease and improved growth outcomes.
- 3.4.17 A 2019 International Journal of Environmental Research and Public Health report finds that among other diseases, waterborne infections cause diarrhoea, which kills nearly one million people every year, with most being children under the age of five. Exposure to chemicals in drinking water may lead to a range of chronic diseases (e.g., cancer and cardiovascular disease), adverse reproductive outcomes and effects on children's health (e.g., neurodevelopment), among other health effects.
- 3.4.18 According to United Nations Environmental Programme, water is contaminated in a number of other ways that can threaten human health. The toxic compound arsenic is widely present in groundwater and can lead to skin, vascular and nervous system disorders, and cancer. Recent estimates show that 94, 220 million people are exposed to high arsenic concentrations in groundwater.

Vulnerable groups

- 3.4.19 Evidence was found linking water quality and quantity to health outcomes for vulnerable groups such as people from low-income and deprived areas, people with existing illnesses. Wiley Interdisciplinary Review (WIRE) on water 2023 highlights that extreme dehydration and thirst detrimentally affect children's health, as well as impact water coping strategies. Children—especially younger children—are one of the most vulnerable groups to extreme heat and dehydration due to higher body water volume and higher body surface area to mass along with lower sweat rates and acclimatization to heat which allows for greater insensible water loss to occur.
- 3.4.20 Further, the WIRE 2023 review shows that water insecurity may also undermine children's experiences of play. Play is critical to child development as children use play to explore their environment, develop relationships, foster creative problem solving, and gain cultural

competence. However, play may bring them into contact with contaminated water, placing them at significant risk of exposure to pollutants and disease-causing pathogens.

Strength of evidence

- 3.4.21 Based on the criteria set out in Section 2.4, the evidence linking water to health and wellbeing is strong.

Soil (impacts to human health that are related to the mobilisation of historic pollution, risk of new ground contamination, and food security (agricultural land availability))

- 3.4.22 The evidence review finds a range of literature showing associations between soil and health outcomes. A 2019 overview on soils' impact on health indicates that soils that affect human health can include natural soil, which usually has little anthropogenic contamination, and soils in agroecosystems, urban areas, mines, oil and gas extraction areas, landfill sites and other locations where anthropogenic contamination is more likely. Further, a 2020 study on soil and human health highlights that risks to health with exposure to soil contaminants such as heavy metals, which in high concentrations can affect several systems including the blood, liver, brain, kidneys, and lungs. Long-term exposure to even low levels of heavy metals can result in neurological and physical degenerative processes (e.g., Parkinson disease and Alzheimer disease) and cancer.
- 3.4.23 The UK Health Alliance on Climate Change shows that growing global demand for easy access to affordable, calorie-rich and resource-intensive foods. This further aggravates environmental degradation and has poor health impacts manifesting as obesity and related diseases. According to the Lancet, in May 2022, the Food Foundation charity estimated that in the previous month 4.7 million adults in the UK had experienced food insecurity, defined as having cut back on or gone without food because they could not afford or access it. Decreased agricultural land availability, in the context of climate change and cost of living crisis, results in more individuals experiencing food insecurity, particularly those from low-income and deprived households.

Vulnerable groups

- 3.4.24 Evidence was found linking soil to health outcomes for vulnerable groups such as children, older people and people with existing illnesses. The 2020 study on soil and human health highlights the risks of inhalation of soil particles that occur as a consequence of dust transport by wind. Dust transport has been recognized to have an impact on diseases such as pulmonary fibrosis, chronic obstructive pulmonary disease, sarcoidosis, and asthma. This especially affects people with weak or compromised immune systems, such as children, older people, and people already suffering from cardiopulmonary chronic diseases.

Strength of evidence

- 3.4.25 Based on the criteria set out in Section 2.4, the evidence linking soil to health and wellbeing is moderate.

Noise (impacts to human health related to noise and vibration from construction/operational activities and traffic movements)

- 3.4.26 The evidence review finds a range of literature showing associations between noise and health outcomes. A 2023 systematic reviews and meta-analysis shows that environmental noise exposure was more likely to result in a series of adverse outcomes. High noise exposure from different sources was associated with an increased risk of cardiovascular disease and its mortality, elevated blood pressure, diabetes and adverse reproductive outcomes. It also shows that the risk of diabetes, ischemic heart disease (IHD), cardiovascular (CV) mortality, stroke, anxiety and depression increases with increasing noise exposure.
- 3.4.27 A 2024 review on noise and mental health shows that annoyance and sleep disturbance due to noise are proposed as key drivers of noise-associated non-communicable disease (NCD) onset and progression including both physical and mental health conditions. Noise exposure has been implicated in a wide range of major NCDs including cardiovascular disease, metabolic disease, cancer, and respiratory disease.

Vulnerable groups

- 3.4.28 Evidence was found linking noise to health outcomes for vulnerable groups such as children, older people and people with mental health issues. The 2024 review on noise and mental health also shows that exposure to noise, particularly from sources such as traffic, can potentially impact the central nervous system. These harms of noise increase the susceptibility to mental health conditions such as depression, anxiety, suicide, and behavioural problems in children and adolescents.
- 3.4.29 BMC Public Health's 2021 cross-sectional investigation on road traffic noise and cognitive function in older adults shows that long term exposure to road traffic noise may be negatively associated with executive function (mental skills that support with everyday tasks, including planning, problem solving and adaptability) among older adults.

Strength of evidence

- 3.4.30 Based on the criteria set out in Section 2.4, the evidence linking noise to health and wellbeing is strong.

Radiation (perception of risk and actual risk from electromagnetic fields from overhead powerlines)

- 3.4.31 The evidence review finds a range of literature showing associations between radiation and health outcomes. A 2023 review on health effects of radiation highlights that the health effects of radiation exposure span a spectrum of acute and long-term consequences. Acute effects, such as radiation sickness or Acute Radiation Syndrome (ARS), manifest shortly after high-dose exposures and may include nausea, vomiting, diarrhoea, and bone marrow suppression. Long-term effects, notably cancer induction, hereditary effects, and cataract formation, may occur following chronic or cumulative exposure to lower doses of radiation over an extended period.

- 3.4.32 A 2023 review on psychological consequences of perceived and actual ionizing radiation exposure shows that perceived radiation exposure is associated with increased levels of anxiety and depression. Both actual ionized radiation effects and psychological stress effects on cognitive function share common mediators such as vascular inflammation, neuroinflammation, and decreased neurogenesis.

Vulnerable groups

- 3.4.33 Evidence was found linking radiation to health outcomes for vulnerable groups such as children and pregnant women. A 2016 study highlights children are at a greater risk than adults to develop cancer after being exposed to radiation. There is strong evidence showing increases in the rates of leukaemia and thyroid cancers associated with childhood exposure to radiation from A-bomb explosions, nuclear power plant explosions, and medical procedures.
- 3.4.34 A 2023 systematic review and meta-analysis showed that the risk of miscarriage in pregnant women who were exposed to electromagnetic fields was 1.69 times higher than the risk for women who were not exposed.

Strength of evidence

- 3.4.35 Based on the criteria set out in Section 2.4, the evidence linking radiation to health and wellbeing is strong.

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