SILVERTOWN TUNNEL

SUPPORTING TECHNICAL DOCUMENTATION

PRELIMINARY HEALTH IMPACT ASSESSMENT

October 2015

This Health Impact Assessment (HIA) assesses the Scheme's impact on human health and wellbeing, identifying issues which may harm or improve levels of health and wellbeing and ways of seeking to address these. The HIA seeks to recommend mitigation that may improve health and reduce inequalities in health.

MAYOR OF LONDON

TRANSPORT FOR LONDON
EVERY JOURNEY MATTERS

This report forms part of a suite of documents that support the statutory public consultation for Silvertown Tunnel in October – November 2015. This document should be read in conjunction with other documents in the suite that provide evidential inputs and/or rely on outputs or findings.

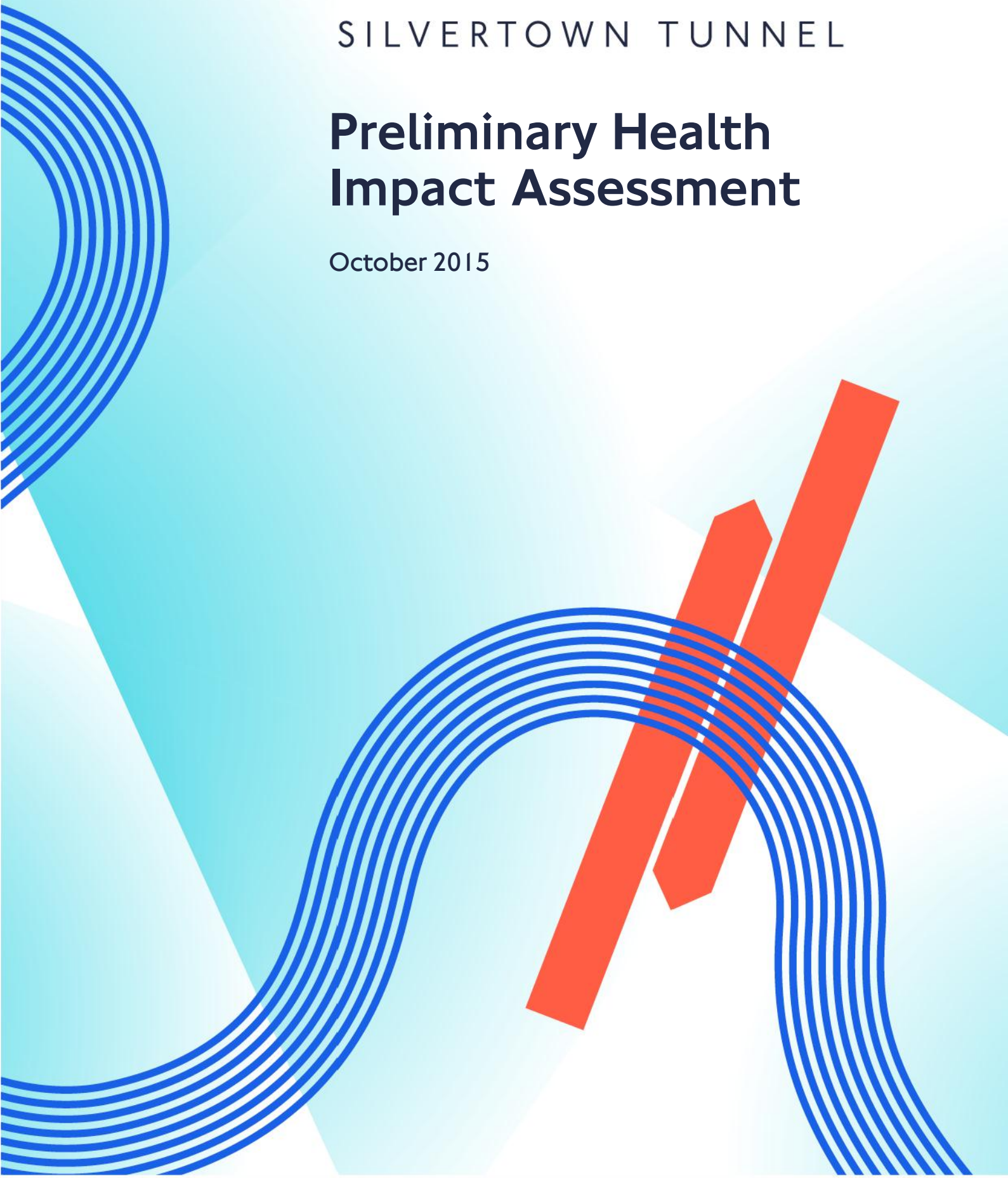
The suite of documents with brief descriptions is listed below:-

- **Preliminary Case for the Scheme**
    - Preliminary Monitoring and Mitigation Strategy
- **Preliminary Charging Report**
- **Preliminary Transport Assessment**
- **Preliminary Design and Access Statement**
- **Preliminary Engineering Report**
- **Preliminary Maps, Plans and Drawings**
- **Preliminary Environmental Information Report (PEIR)**
    - Preliminary Non Technical Summary
    - Preliminary Code of Construction Practice
    - Preliminary Site Waste Management Plan
    - Preliminary Energy Statement
- **Preliminary Sustainability Statement**
- **Preliminary Equality Impact Assessment**
- **Preliminary Health Impact Assessment**
- **Preliminary Outline Business Case**
    - Preliminary Distributional Impacts Appraisal
    - Preliminary Social Impacts Appraisal
    - Preliminary Economic Assessment Report
    - Preliminary Regeneration and Development Impact Assessment

SILVERTOWN TUNNEL

Preliminary Health Impact Assessment

October 2015



MAYOR OF LONDON

TRANSPORT FOR LONDON

EVERY JOURNEY MATTERS

THIS PAGE IS LEFT INTENTIONALLY BLANK

Silvertown Tunnel

Preliminary Health Impact Assessment

Planning Act 2008

Infrastructure Planning

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Document Reference: *ST150030-PLN-ZZZ-ZZ-RP-PC-0013*

Author: *Transport for London*

Rev.	Date	Approved By	Signature	Description
1	02/10/2015	David Rowe (TfL Lead Sponsor)		For Consultation
		Richard De Cani (TfL MD Planning)		

THIS PAGE IS LEFT INTENTIONALLY BLANK

Contents

List of Abbreviations

AQFAs	Air Quality Focus Areas
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ASLs	Advanced Stop Lines
CLoS	Cycling Level of Service assessment
EAL	Emirates Air Line
EIA	Environmental Impact Assessment
EqIA	Equality Impact Assessment
DoH	Department of Health
HIA	Health Impact Assessment
HUDU	Healthy Urban Development Unit
LCDS	London Cycling Design Standards
MTS	Mayor's Transport Strategy

NHS	National Health Service
NICE	National Institute of Health and Care Excellence
NSIP	Nationally Significant Infrastructure Project
PAC	Pre Application Consultation
PEIR	Preliminary Environmental Information Report
PERS	Pedestrian Environment Review System
PHE	Public Health England
PINS	Planning Inspectorate
RXHAM	River Crossings Highway Assignment Model
TfL	Transport for London
WHIASU	Wales Health Impact Assessment Support Unit
WHO	World Health Organization

Glossary of terms

Active travel	Travel and transport by physically active, human-powered modes as opposed to motorised ones, largely for functional reasons.
Equity or inequity	The term inequity has a moral and ethical dimension. It refers to differences which are unnecessary and avoidable but, in addition, are also considered unfair and unjust. So, in order to describe a certain situation as inequitable, the cause has to be examined and judged to be unfair in the context of what is going on in the rest of society.
Equality or inequality	Inequality in health indicates comparison and difference. The concept can refer to inequality in a statistical, sense.
Health	A state of complete physical, social and mental well-being, and not merely the absence of disease or infirmity.
Health Impact Assessment (HIA)	A combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, programme or project on both the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects.
Health inequity	Differences in health between social groups that are considered unfair and that are avoidable.
Public health	All organized efforts to improve population health through prevention and promotion activities. The focus of public health is the population and not the individual.
Reference Case	An assumed ‘future baseline’ scenario, which represents the circumstances and conditions that we would anticipate in the future year without the implementation of the Scheme, taking account of trends (for example in population and employment growth) and relevant developments (such as other committed transport schemes). The Reference Case is frequently used as a comparator for the ‘with scheme’ (Assessed) Case, to show the effect of the Scheme against the appropriate reference point.
Resilience	Resilience is a concept which operates at the level of the individual, the community and wider society. It also describes a dynamic process by which individuals, communities and/or societies adapt positively to adversity.

Resources	A supply of assets (e.g., money, materials, people) that can be used by a person or organization in order to achieve a particular objective.
Social determinants of health	The specific features of society and the pathways by which these societal conditions affect health are social determinants. The unequal distribution of power, income, goods and services mean that social factors (such as the circumstances in which people are born, grow up, live, work, and age) would determine health.
Social exclusion	Social exclusion is one dimension of poverty. Here the emphasis is on the process of marginalisation among specific groups. These processes of marginalization can be legal, economic, or social.
Well-being	A state in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community. Well-being incorporates economic, social and environment dimensions.

SUMMARY

1. This preliminary Health Impact Assessment (HIA) considers a new road tunnel linking the areas north and south of the Thames between the Greenwich Peninsula and Silvertown, hereinafter referred to as the Silvertown Tunnel (the Scheme).

2. The preliminary HIA is based on a snapshot part way through the development of the Scheme. The preliminary HIA analysis provides an opportunity for stakeholders, including the public, to respond to the potential impacts to health arising from the Scheme.

3. The Scheme – known as the Silvertown Tunnel – involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (London Borough of Greenwich) and the Tidal Basin Roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham. The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses.

4. The purpose of the HIA is to examine the links between health and wellbeing and the potential impacts (beneficial and adverse) of the Scheme. The HIA uses the World Health Organization (WHO) definition of health, which states that health is a 'state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity' (1). People's health and wellbeing is closely linked to the physical, social and economic environment. Negative changes to the local environment tend to be felt more keenly by low income, and other vulnerable, groups.

5. The geographic scope of the preliminary HIA covers the London boroughs of Newham and Tower Hamlets, and Royal Borough of Greenwich. The land immediately around the proposed tunnel portals, which would be the focus of construction activities, currently has a low population density. The wider residential context is one of high deprivation. The current population is therefore sensitive to changes in the environment. The population profile of the immediate area is expected to change. Residential development is expected to take place around the proposed tunnel portals. A residential population would therefore be closer to the Scheme. The profile of the future residents is uncertain, but it must be expected to include vulnerable groups. The future

population is therefore also considered sensitive to changes in the environment.

6. This work has drawn on the findings of other specialist assessments and modelling undertaken for this Preliminary Environmental Information Report (PEIR) stage. The preliminary HIA considers these results in the context of the scientific health literature and relevant health thresholds (provided as Appendix B). The approach is qualitative and descriptive in this preliminary HIA. The current findings are based on professional judgements. Further options for assessment would be considered for the final analysis.

7. The scope for the HIA was set out in the scoping report which is available as a background document on the TfL website. This was based on relevant HIA guidance (2-4). TfL sought comment on this scope and held a workshop with stakeholders. It was agreed that the HIA scope would focus on:

    - air quality (construction and operation);
    - noise (construction and operation);
    - road safety, accessibility and active travel (construction and operation)1;
    - access to work and training (construction and operation); and
    - Social cohesion and lifetime neighbourhoods (operation).

8. Each potential impact is considered and given a preliminary score ranging from adverse to positive. The way in which these scores are reached is described in the report.

9. With regard to air quality and noise impacts the construction phase of the Scheme would have some minor adverse impacts due to pollution and

[1] The way in which the Scheme changes access to healthcare services and other social infrastructure is considered important but it is subordinate to considerations of road safety, accessibility and active travel during construction and operation. Access to healthcare services and other social infrastructure is thus not considered separately.

disturbance. The Scheme includes standard and bespoke mitigation measures to minimise these impacts and the HIA recommends monitoring that allows EHOs and local public health teams to compare levels to WHO guide values as well as other statutory and construction based limit values. With regard to operational impacts on air quality and noise, based on initial data there would be a minor positive impact for the population in the area around the approaches to the Blackwall tunnel and a minor adverse impact for the population in the area around the approaches to the Silvertown Tunnel. This redistribution of emissions and disturbance is inherent to redistributing traffic from the congested Blackwall tunnel to the new Silvertown Tunnel. As with construction, monitoring that permits comparison with WHO guide values is recommended. Such monitoring data should be used to inform appropriate design of future residential development around the tunnel portals to achieve WHO guide levels for that future population wherever possible. Although adverse air quality and noise impacts are generally expected to be of minor significance during construction and operation a small number of receptors may experience greater impacts. For example the Hoola development of 360 apartments due for completion in 2016 is the closest residential receptor and some dwellings within this development (particularly lower floors) may experience moderate adverse impacts.

10. With regard to accessibility and active travel the construction phase would involve a minor adverse temporary impact due to disruption to routes and diversions. Where minor bus service diversions are required (such as the moving of bus stops) TfL commit to ensuring adequate information and signage is provided to notify of the changes well in advance and that there is no change in the level of accessibility.

11. The operational impacts to road safety, accessibility and active travel are complex. The Scheme would be designed to current standards and it takes road safety into account. It is estimated to reduce the number of traffic collisions (a reduction of 683 accidents over a 60 year period, or a reduction of 0.3% compared to the Reference Case).

12. The facilitation of enhanced cross river bus services that the Scheme provides is considered an important positive potential health impact and the preliminary HIA recommends that it is accompanied by bus stops close to the tunnel portals with active travel links to current (and future) residential areas.

13. With regard to active travel, the Silvertown Tunnel would not be accessible to pedestrians or cyclists. The Blackwall Tunnel would remain inaccessible to pedestrians and cyclists. Use of public transport, in general, and buses in particular also involve walking and are thus important contributors to physical

activity. Any beneficial effects on active travel are therefore due to the possibility of enhanced bus services and to pedestrian and cycling enhancements around the tunnel portals (e.g. the improved footway/cycleway Boord Street bridge).

14. Although the Silvertown Tunnel is an enhancement to a vehicle crossing, it forms part of a package of river crossings delivered by TfL the first of which was the Emirates Airline (EAL) a cross-river cable car link aimed at pedestrians and cyclists. Future crossing options under consideration include bridges at Gallions Reach and Belvedere.

15. TfL has a vision for cycling in East London and is committed to working with the boroughs to develop active travel in the area. This commitment would endeavour to ensure the Scheme can:

    - facilitate use of existing active travel crossings (e.g. the Emirates Air Line, the Woolwich and Greenwich foot tunnels);
    - facilitate active travel through public transport links either side of the tunnel (notably the siting of bus stops and routes); and
    - improve walkways and cycleways along the river and to surrounding current (and future) residential areas in both Greenwich and Silvertown.

16. With regard to work and training the approximately 1,500 jobs associated with the Scheme's construction would bring benefits to the workforce and their dependants, as well as associated economic benefits. The preliminary HIA identifies the potential for a moderate positive temporary impact in this regard and recommends that the Scheme includes a formal apprenticeship and training scheme to support the construction workforce to progress to more senior and specialist roles. Direct employment during the operation of the Scheme's is small. However there is potential for the Scheme to provide long-term improved access to employment opportunities for a large population. The benefits are for both improved cross-river commuting and a general reduction in road congestion benefitting road travel generally. The preliminary HIA considers this a moderate positive impact.

17. Social cohesion and lifetime neighbourhood impacts focus on the potential for an inequitable impact from the charging scheme at the Silvertown and Blackwall tunnels on travel and living costs for local residents. The charging scheme is central to managing demand for, and thus controlling traffic flows through, the tunnel crossings (Blackwall and Silvertown). In the absence of a control mechanism to manage demand any improvements in road network

capacity and resilience that might be generated by the Scheme would be likely to be negated by induced traffic.

18. The introduction of the charges at the Silvertown and Blackwall tunnels would have a direct and tangible impact on the affordability of travel by car for some users. This should increase the viability of the bus for many. However it could also have an adverse effect for people who are on low incomes and for those who are reliant on private vehicles. Use of the tunnels would be free of charge for the Disabled vehicle tax class and with an 100% discount for blue badge holders. The improved accessibility of cross-river travel offered by the Scheme and the planned residential developments in east and south-east London may increase living costs in the area. A community fund would be available to the host boroughs which would provide resources to offset adverse social effects of the charging scheme. Work is ongoing to determine the mechanism by which the community fund would operate. This preliminary assessment is one component of the consultation stage and the details of the Community Fund are not yet decided. The HIA considers there would be a negligible impact on health from the charging scheme on the basis that the Community Fund would mitigate potential effects on social cohesion and lifetime neighbourhoods. The community fund would form part of the Health Action Plan (see page 118). More details on the Community Fund are set out in the Preliminary Case for the Scheme.

19. The preliminary HIA concludes that, based on the information available, the Scheme's improvements to accessibility and bus services are likely to have a positive impact on health and wellbeing. From a health and wellbeing perspective the Scheme's most important challenges are to ensure:

    - there is no adverse effect on decision making for active travel; and
    - the Scheme is fair and flexible and thus contributes to reducing health, and other social, inequalities.

20. The charges that would be levied for use of the Tunnels and the community fund are important in this respect. The HIA considers that, to date, these challenges are being addressed in the Scheme proposals.

21. The next steps would consider the options for further health impact assessment taking into account emerging data and consultation responses.

22. At this preliminary stage a number of key assumptions have been made about the feasibility and effectiveness of proposed mitigation. Further detail underpinning these assumptions would be worked up and incorporated into the final Scheme by TfL as part of the next steps. Important factors include:

- The shared long-term vision for active travel in the area to avoid adverse impacts on active travel decision making;
- Use of the community fund to fully offset social imbalances caused by the charging scheme;
- Continuing road safety modelling to ensure the Scheme has beneficial impact on the likelihood and severity of collisions, e.g. on the approaches to the Blackwall Tunnel; and
- The use of river barges to reduce movements of HGVs on the road network during the construction phase.
- The relationship between traffic flow and the charges that would be levied for use of the tunnels. This traffic modelling affects topics such as air quality, noise, distributional and equality effects as well as health and wellbeing.

1. INTRODUCTION

1.1 Preliminary Health Impact Assessment

1.1.1 This preliminary Health Impact Assessment (HIA) considers the potential effects on health and wellbeing of a new road tunnel linking the areas north and south of the River Thames between the Greenwich Peninsula and Silvertown. The Scheme is proposed in response to the three transport problems which exist at the Blackwall Tunnel: congestion, frequent closures and incidents, and a lack of resilience (owing to the lack of proximate alternative crossings).

1.1.2 This is a preliminary report. It forms part of a suite of preliminary documents for consultation and would be finalised at the DCO application stage in 2016. The preliminary HIA would remain subject to review in order for it to reflect changes as a result of the consultation process.

1.1.3 The preliminary HIA is based on a snapshot part way through the development of the Scheme. As such the report makes assumptions (which are stated as appropriate) and notes limitations after each preliminary analysis section.

1.2 What is a Health Impact Assessment?

1.2.1 HIA seeks to identify issues that may harm or improve, levels of health and wellbeing. It then seeks to address these issues and to adapt the Scheme so as to ensure that harm to health is avoided and that opportunities to improve health are taken. HIA also seeks to identify how health inequalities between population groups may be affected by the Scheme. At all times HIA seeks to recommend mitigation that may improve health and reduce inequalities in health.

1.2.2 Health Impact Assessment (HIA) is being undertaken to:

- identify the existing health levels of the communities most likely to be affected;
- identify any direct and indirect health effects during construction and operation; and
- identify measures to mitigate the negative effects, and to enhance the positive effects, on health and wellbeing and on inequalities in health.

1.2.3 This HIA draws together relevant information from the different impact assessment reports produced for the Scheme to inform specific health analysis of its potential impact on health and wellbeing. The HIA has been informed by dialogue with stakeholders in the local authority areas affected by the Scheme. The HIA's findings are based on the professional judgement of the HIA team with reference to the scientific evidence base, as well as the relevant legal and policy context.

1.2.4 The HIA has adopted a precautionary approach to the initial identification and assessment of impacts. Where there is uncertainty in design information, the assessment of impacts would be on the basis of realistic worst case scenarios. Where the assessment of the likely significant effects of the Scheme cannot be predicted with certainty the HIA team would base the assessment on limited modelling and/or professional judgement. Where significant uncertainty remains, this would be acknowledged.

1.3 Policy requirements for HIA

1.3.1 Amendments to the Environmental Impact Assessment (EIA) Directive 2011/92/EU have been made, and the new Environmental Impact Assessment (EIA) Directive (2014/52/EU) entered into force on 15 May 2014 (5). This is transposed into UK legislation in May 2017. TfL have regard to the changes of the new EIA Directive during the assessment of the Scheme. These changes include a revised Article 3 which specifically requires the identification, description and appropriate assessment of the direct and indirect significant impacts on population and human health.

1.3.2 The National Policy Statement for National Networks (6) requires consideration of impacts on health of road network infrastructure developments. It states the need to identify and set out the assessment of any likely significant adverse health impacts (4.81).

1.3.3 Under the Greater London Authority Act 2007 the Mayor of London is required to take into account the effect of all policies on the health of London's population (7). The Greater London Authority (GLA) have provided guidance on planning and health (8) and the London Plan requires consideration of the potential impact of development proposals on health and health inequalities within London (9).

1.4 Structure of the Preliminary HIA

1.4.1 This Preliminary HIA is structured as follows:

- Chapter 2 describes the assessment methodology that has been used and consultation that has been undertaken to date;
- Chapter 3 describes the Scheme;
- Chapter 4 sets out the scope of the HIA and how this was derived;
- Chapter 5 sets out the baseline health condition for each of the host boroughs;
- Chapter 6 provides an assessment relating to climate change and health;
- Chapter 7 provides an assessment of changes in road safety, accessibility and active travel;
- Chapter 8 provides an assessment of changes to local air quality;
- Chapter 9 is an assessment of changes in noise;
- Chapter 10 is an assessment of changes in access to work and training;
- Chapter 11 an assessment of changes in social cohesion and lifetime neighbourhoods; and
- Chapter 12 sets out a Health Action Plan.

2. METHODODLOGY

2.1 Guidance

2.1.1 The HIA has used the following guidance documents:

- NHS Healthy Urban Development Unit (HUDU) guidance (2);
- Wales Health Impact Assessment Support Unit (WHIASU) Health Impact Assessment: a practical guide (3); and
- The Mental Well-Being Impact Assessment Toolkit (4).

2.1.2 Policies and guidance relevant to specific health issues within the HIA scope are listed in Appendix A (see page 121).

2.1.3 The following sections provide an overview of the HIA approach.

2.2 Approach and definitions

2.2.1 Health impact assessment (HIA) is a systematic process used to identify the potential health effects arising from policies, plans, programmes and projects and to help reduce health inequalities. The International Association for Impact Assessment define HIA as (10):

> *'… a combination of procedures, methods and tools that systematically judges the potential, and sometimes unintended, effects of a policy, plan, programme or project on both the health of a population and the distribution of those effects within the population. HIA identifies appropriate actions to manage those effects.'*

2.2.2 The HIA uses the World Health Organization (WHO) definition of health, which states that health is a 'state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'(1).

2.2.3 A number of core values are implicit in HIA. These are shown in Table 2-1.

Table 2-1 Values implicit in HIA

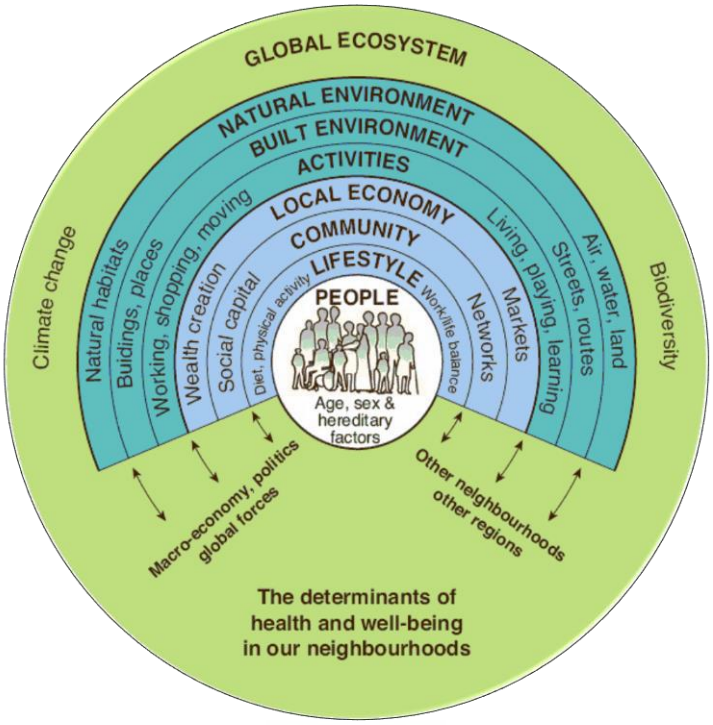
HIA value	Explanation
sustainability:	A commitment to current and to future generations;
democracy:	HIA aspires to offer people the opportunity to participate in a transparent and open process that contributes to decision-making;
equality:	HIA looks to achieve fair and appropriate outcomes for communities or populations affected by the proposal;
ethical use of evidence:	The HIA is careful to identify potential sources of bias about potential effects and suitable interventions;
comprehensive approach to health:	Emphasizing that physical, mental and social well-being is determined by a broad range of factors from all sectors of society (known as the wider determinants of health).

From World Health Organization Regional Office for Europe (11) and IAIA (10)

2.3 The determinants of health

2.3.1 Human health has a number of determinants that go beyond individual lifestyle choices. A model of the determinants of health is illustrated in Figure 2-1. The model shows how various factors can affect communities and/or individuals directly or indirectly. These include determinants that can improve and protect health as well as determinants which might harm health. Examining the ways in which the Scheme influences these determinants and the likely effects on the health of communities and individuals is a key role of HIA. These effects might be on physical health or on mental health.

Figure 2-1 Determinants of health and well-being



Source: Based on the Whitehead and Dahlgren (12) diagram as amended by Barton and Grant (13)

2.3.2 The effects would often be experienced differently by different population groups: population groups can be identified by factors including (but not limited to) age, gender, ethnicity, socio-economic status, place of residence or by dint of pre-existing health status. Public health policy seeks to reduce inequalities in health between population groups (14). HIA also seeks to enable the policy-maker to take steps to manage the potential effects.

2.3.3 The determinants of health are used as a framework during the scoping exercise and the assessment to systematically consider a broad range of potential influences on health that could arise from the Scheme. The NHS HUDU (2) list of determinants has been used. These are listed in Table 4-1 on page 42.

2.4 Stages of the HIA

2.4.1 Table 2-2 shows the different stages of the HIA as set out in the WHIASU guidance (3) and the way these have been conducted for the Scheme.

Table 2-2 HIA process, activities and outputs

Step	HIA activities	HIA outputs
Screening	Consider the potential effects on determinants of health Identify population groups that may be affected Record the decision	The London Plan requires consideration of the potential impact of development proposals on health and health inequalities within London (9).
Scoping	Describe the Scheme and timescales Identify the most important health effects Define the area of study Provide an overview of future work	HIA Scoping Report
Appraisal of Evidence	Review evidence on potential health effects Profile the potentially affected population and set out health baseline (including health inequalities) Stakeholder engagement Undertake assessment to identify potential health effects Identify measures to mitigate negative effects Identify measures to enhance positive effects	Incorporated into draft HIA Reports (Preliminary HIA for PEIR and PAC stage of application and full HIA for DCO stage of the application).
Reporting	Prepare documentation to communicate the results of the assessment	Preliminary HIA Report (draft) Preliminary HIA Report (final) Full HIA report (draft) Full HIA report (final).

2.4.2 The HIA forms part of a prospective process, which means that it is undertaken in advance of the implementation of the Scheme, thereby providing sufficient opportunity to enable 'constructive modifications' to be made to the Scheme should negative potential effects be identified and mitigations be required.

2.4.3 The HIA references analysis in assessments undertaken for the Preliminary Environmental Information Report (PEIR). The HIA identifies opportunities for mitigation and enhancement measures to further reduce adverse health impacts and to improve population health and to reduce health inequalities.

2.5 Governance

2.5.1 Ongoing engagement with the public health officers and other representatives from the respective local authorities has been sought to gain feedback on emerging issues and assessment findings.

2.6 Sources of qualitative and quantitative data

2.6.1 The HIA has used the following data sources:

- The Scheme description (Volume 1, Chapter 4 of the PEIR);
- Qualitative and quantitative data from the PEIR assessments. Where appropriate the methodologies, assumptions and interpretation of data has been discussed with relevant EIA technical specialists;
- Consultation responses from the Scheme's community engagement;
- Feedback from the public health officers and other representatives from the respective local authorities;
- Supporting technical assessments undertaken for the Scheme; and
- Reference to the scientific literature (see Appendix B).

2.7 Assessment of impacts

2.7.1 The assessment stage includes activities to investigate, appraise, and qualitatively and quantitatively measure impacts both positive and negative, that the Scheme is likely to have on health and wellbeing. The range of potential health impacts, their relative importance and the level at which they are expected to occur is determined in this stage.

2.7.2 The assessment of any health impact is based upon a consideration of:

- the sensitivity of the affected population to individual impacts, taking into account factors such as the specific needs or characteristics of that population group;
- the magnitude of impact - an assessment of whether the scale of the impact is minor, moderate or major (this may depend on factors such as the geographic extent of the area affected or alternatively the potential number of people affected); and
- the significance or importance of that effect - the significance of impacts is assessed based on the magnitude of the impact and the sensitivity of the receptor.

2.7.3 The way in which potential effects have been assessed, and the significance of the effects, is described in more detail below.

2.7.4 The assessment stage includes the key activities to investigate, appraise, and qualitatively or quantitatively consider both the positive and negative impacts the Scheme is likely to have on health and wellbeing. The spectrum of potential impacts, their relative importance and the level at which they are expected to occur is determined in this stage.

2.7.5 Key activities of this stage include:

- Detailed description of risks and potential attribution/causation;
- Assessment of impacts, including consideration of: understanding of risks by potentially affected communities; nature of risk (direct, indirect or cumulative); timing; and duration; and
- Risk ranking, including consideration of: sensitivity, magnitude and significance.

Assessing sensitivity

2.7.6 As health impacts may or may not be evenly distributed across the population, the assessment has considered the distribution of impacts. Vulnerability and resilience are key considerations within the general discussion of social, environmental, and institutional determinants of health.

2.7.7 In many cases, certain subgroups (for example, children, women and the elderly) may be disproportionately affected. Populations exhibit varying

levels of resilience (adaptability, coping strategies) which potentially reduce the level of inherent sensitivity that might otherwise be expected.

2.7.8 Human health and wellbeing is a multifaceted topic that affects, and is affected by, many other topics. Table 2-3 describes how the HIA has defined criteria used to score the sensitivity of community receptors. It is acknowledged that these are not rigidly defined and that some of the criteria overlap. The way in which the score is awarded for each population is informed by the review of evidence (see Appendix B on page 126) but it is ultimately based on professional judgement. The assessment would thus be strengthened through the consultation and debate that is part of the PEIR process.

Table 2-3 Receptor Sensitivity Criteria for Community Health and Wellbeing

Sensitivity	HIA specific criteria
High	People who are very young, very old, people with pre-existing conditions or those who are disabled are vulnerable to changes in environmental health determinants, such as air quality and noise levels. People who have lower socioeconomic status have less access to financial, social and political resources. This includes access to health care. It also includes access to, and familiarity with, representatives and advocates and formal complaint procedures. People who share resources constantly with the Scheme. This could include users of roads and access to the River Thames. It could also include those who live adjacent to a Scheme component, for example a road that would be affected during the construction phase. It could include cyclists and pedestrians sharing roads with construction vehicles on a daily basis. Some people may anticipate risks to their health and wellbeing and express high levels of anxiety. They are likely to be aware of, and thus affected by, actual changes and to the possibility of change.
Medium	People who are likely to experience temporary inconvenience as a result of changes in environmental or social determinants of health. They may share resources occasionally with the Scheme or they may express some concerns and anxieties about the impact of the Scheme on their wellbeing.
Low	Communities with sufficient coping strategies who feel little or no change to their wellbeing as a result of Scheme activities. They may share resources with the Scheme occasionally and broadly understand the hazards, and the attendant risks, associated with Scheme components. Most drivers of private vehicles are in this category.
Negligible	Communities who do not share resources used by the Scheme and have not raised concerns about potential impacts. They are generally not inconvenienced by Scheme Activities or exposed to Scheme-related hazards.

Assessing magnitude

2.7.9 In the case of community health, it is assumed that a wide range of illnesses and disabilities are already present in the population and this is the baseline prevalence rate. There is a risk that the Scheme causes, or is attributed to cause, an increase in the incidence and hence prevalence rate of some of the existing conditions. For example, changes in air quality associated with construction machinery could exacerbate respiratory diseases. As people value their health, even a small increase in the prevalence rate of a disease or disability that is attributable to the Scheme is classed as a high magnitude event. Table 2-4 classifies event magnitude for Community Health and Wellbeing.

Table 2-4 Impact Magnitude Criteria for Community Health and Wellbeing

Magnitude	HIA specific criteria
High	Extent (within a defined community): <10% additional morbidity. Duration: chronic disease > 1 month or death; or ongoing disturbance = more than 1 year. Reversibility: longer term or irreversible / permanent. Frequency: frequent.
Medium	Extent (within a defined community): >10% additional morbidity. Duration: acute illness <1 month; or long term disturbance = 6 months to 1 year. Reversibility: illness from which recovery can be expected. Frequency: occasional.
Low	Extent (within a defined community): >1% additional cases of morbidity. Duration: cannot work for <24 hours; or medium term disturbance = 1 month to 6 months. Reversibility: minor illness from which full recovery can be expected. Frequency: rare.
Negligible	Extent (within a defined community): no additional illness attributable to Scheme. Duration: no time lost to illness or injury; or short term disturbance = less than 1 month. Reversibility: no illness or injury. Frequency: never.

Assessing significance/importance

2.7.10 The significance of effects can be viewed as a function of the magnitude of the impact and the sensitivity of the receptor. Table 2-5 sets out a guide to the way in which the significance of effect has been determined. Where appropriate the decision on significance has been moderated using professional judgement.

2.7.11 A significant impact is considered to be one sufficient for the consenting authority to reasonably consider it to be a reason for refusal, or for applying a planning condition / requirement or legal agreement to the consent to reduce or overcome the effect.

2.7.12 The HIA considers all impacts of 'minor' or above to be significant.

Table 2-5 Assessing Significance of Effect

		Magnitude			
		High	**Medium**	**Low**	**Negligible**
Sensitivity	**High**	Major	Major /moderate	Moderate /minor	Minor
	Medium	Major /moderate	Moderate	Minor	Minor /negligible
	Low	Moderate	Moderate /minor	Minor /negligible	Negligible
	Negligible	Minor	Minor /negligible	Negligible	Negligible

2.8 Mitigation hierarchy

2.8.1 The conventional impact mitigation hierarchy uses terminology such as: avoid, abate, attenuate, remedy and compensate. These terms may not have obvious meanings in a health context. Table 2-6 provides additional clarification and alternative terminology for health and wellbeing. When advocating mitigation, the highest possible level in the hierarchy should be chosen. For example, there should generally be no obligation for the community to change their own behaviour as a result of the Scheme in order to remain safe and healthy.

Table 2-6 The mitigation hierarchy defined for Community Health and Wellbeing

Hierarchy	Examples
Legislation	Standards for noise, air/water quality
Avoid or eliminate	Design out, e.g. Avoid road traffic injuries through design of built environment and promotion of active transport as well as design of roads, signage, speed limits, pedestrian crossings
Reduce through engineering controls	Design in, e.g. provide double glazing to receptor
Reduce through management controls	Prevent night time driving of Scheme vehicles, grievance mechanisms
Change community behaviour	Apply evidence based health and safety promotion techniques
Repair	Medical care
Compensate	Financial compensation, rehabilitation

2.8.2 Any mitigation measures should be technically sound, socially acceptable and economically feasible (10).

2.8.3 The HIA takes as its starting point the 'residual' impacts reported by EIA chapters for the Scheme. This allows the health assessment to focus on any outstanding issues that have a bearing on community and population health and safety and avoids duplication and restatement.

2.8.4 The HIA assumes the successful implementation of mitigation measures described in the EIA chapters. The mitigations proposed in the EIA chapters are therefore important to minimising potential health issues and many issues have been scoped out on the basis that those mitigations adequately address any potential impact to community and population health.

2.8.5 The mitigation measures presented in the HIA are therefore in addition to, and not alternatives to, the measures presented in the EIA chapters and all measures work together in order to achieve the impact rankings presented for residual impacts.

2.8.6 The HIA recommends the use of Best Available Techniques (BAT) to minimise potential health impacts:

'Best Available Techniques' means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and where that is not practicable, to reduce emissions and the impact on the environment as a whole.

(a) "technique(s)" includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

(b) "available" techniques means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;

(c) "best" means most effective in achieving a high general level of protection of the environment as a whole

UK technical guidance and BREF guidance notes indicate what is meant by BAT for different industries. BREF stands for Best Available Techniques (BAT) reference.'

Adapted from (15,16).

2.9 Assumptions and limitations

2.9.1 This report includes recommendations which are based on information available at the time of this preliminary assessment. If the scope of the Scheme, or its implications for populations or other policies, plans, programmes or projects, changes the recommendations would be reviewed as appropriate.

Mitigation

2.9.2 Mitigation measures are required in order to ensure that the potential beneficial effects of the Scheme are realised. Mitigation may also be required to prevent, reduce or offset any significant adverse effects. A number of these measures are already embedded within the design for the Scheme. Other mitigation measures may be necessary to counter adverse effects experienced during the construction or operational phases

of the Scheme. Mitigation measures are considered in individual chapters where impacts are identified.

Geographic scope

2.9.3 The study area for the HIA has been identified as being the geographical area covered by the following local authorities:

- Royal Borough of Greenwich;
- LB Newham;
- LB Tower Hamlets.

2.9.4 The spatial scope of the assessment is influenced by the geographic extent of the potential health effects being assessed. The study areas within the spatial scope would be different for different types of effect. For example, effects related to noise and air quality are experienced close to the Scheme whereas those related to socio-economic issues would be expected to be experienced over a wider area. Table 2-7 defines the geographic areas over which the HIA addresses the potential effects of the Scheme on health and wellbeing.

Table 2-7 Geographic area of distribution of effect

Distribution	Geographic area
Core area	Effects experienced at or in the vicinity of the tunnel (includes the Limit of Land to be Acquired or Used (LLAU) by the Scheme). This currently has a business population and no residential population.
Noise and Air Quality Assessment Study Area	The study areas used in the air quality and noise studies are defined in Chapters 6 and 14 respectively of Volume 1 of the PEIR. This study area include key routes and examines expected changes at Blackwall Tunnel.
Community Facilities Assessment Study Area	A study area extending a distance of 1km from the LLAU. This corresponds with the study areas used in Volume 1 of the Community and Private Assets chapter (PEIR, Chapter 7).
Local area	Includes the three host boroughs of Newham, Tower Hamlets and Greenwich.
Sub-regional area	The London Boroughs of Barking & Dagenham, Bexley, Hackney, Lewisham, Redbridge, Southwark and Waltham Forest (similar to the Distributional Impact Appraisal).

Temporal scope

2.9.5 The Scheme is predicted to open in 2022/23. The future assessment year is 2036. The scope covers both the construction and the operation of the Scheme and the likely duration of the impacts would be identified within the assessment.

2.9.6 The temporal scope of the HIA is consistent with other relevant assessments such as the EIA and the Equalities Impact Assessment (EqIA).

2.9.7 GLA forecasts are that London would grow by around 1.2m people between 2011 and 2031. The boroughs in the east and south east sub-regions are expected to account for 37% of this growth, and the three Silvertown tunnel host boroughs plus Barking and Dagenham, to account for 23% of London's growth. This is expected to have a significant impact on travel across the river. This, in turn, is expected to exacerbate problems currently associated with the Blackwall Tunnel. These include poor air quality and congestion from use of the crossing which exceeds its capacity.

Base case

2.9.8 The assessment includes a Base Case to ensure that all relevant assessments conducted for the Scheme to take planned development into account. The Base Case sets out those developments that are programmed to be completed and become partially (if built out in phases) or fully operational during construction of the Scheme.

2.10 PEIR approach

2.10.1 For the PEIR the preliminary HIA provides the following content based on available information:

- the issues raised on the HIA scope by the PEIR reports/chapters;
- the receptors identified and how they relate to HIA sensitivity definitions;
- potential health impacts identified and how they are to be measured by reference to HIA magnitude definitions;
- a preliminary assessment of the significance of likely health effects; and
- preliminary recommendations on mitigation of adverse health impacts.

2.11 Consultation on the Scheme

2.11.1 In 2012 TfL ran a four week consultation with members of the public and stakeholders on proposals to enhance highway river crossings in east and south-east London, which included a crossing at Silvertown to ease congestion and provide additional resilience at Blackwall. Information about the proposals was made available online, including an online questionnaire; the consultation was promoted in a range of local and pan-London press titles, via social media and via emails direct to stakeholders and members of the public who had registered to receive email updates. The outcome of the consultation demonstrated that there was widespread support for TfL to continue to develop a road crossing at Silvertown which was then taken forward.

2.11.2 A further round of formal consultation took place between October 2012 and February 2013 which sought the views of the public and stakeholders on a number of issues relating to river crossings, including the introduction of a new tunnel at Silvertown. The consultation included the issue of nearly 200,000 information letters to local addresses, two separate emails

to approximately 350,000 customers in TfL's customer services database, and advertising in London-wide and local press titles and on the Docklands Light Railway (DLR) network. Twelve consultation roadshow events were held at locations around the affected areas. The consultation was publicised to a large number of stakeholders, including relevant local authorities, political representatives and transport campaign groups.

2.11.3 Public and stakeholder consultation was undertaken in relation to the Scheme in late 2014 which provided initial detail about the Scheme and the potential effects arising from it. Consultation roadshow events took place at local venues. Since that time there has been engagement with local authorities, regulators and other stakeholders. Where possible, consultation responses have been taken into account in developing the Scheme; for example, measures to improve public transport provision in the vicinity of the Scheme. Further details of the consultation are documented in Silvertown Tunnel Public Consultation Analysis Report.

2.12 Consultation undertaken on the HIA

2.12.1 A scoping report was produced for the HIA in June 2015, which identified key baseline data, study areas, potential impacts and assessment methodologies. The Scoping Report was distributed to key stakeholders with a four week period provided for receipt of comments/feedback. The scoping consultees are listed in Appendix D.

2.12.2 In addition, a joint HIA/EqIA workshop was held in July 2015 for representatives of the host boroughs and other organisations in order to discuss and agree the content of the Scoping Reports for each assessment. The scope of the HIA was adapted as a result of stakeholder comment to ensure that all potentially relevant areas would be covered by the assessment. The outcomes of the workshop are set out in Appendix C. The Scoping Report is available on the Silvertown Tunnel website as a Background Document.

2.12.3 Key stakeholders and representatives of health organisations would be invited to attend the pre-Application consultation and make comment on the preliminary HIA.

2.13 Assumptions

2.13.1 At this preliminary stage a number of assumptions have been made about the feasibility and effectiveness of proposed mitigation. The assumptions upon which the findings of this HIA are based are listed below:

- The shared long-term vision for active travel in the area. This would realise the potential for long-term benefits to health arising from increased active-travel and it would mitigate any adverse impact on active travel decision making;
- Use of the community fund to offset any social imbalance caused by the charging scheme;
- Additional analysis of road safety modelling to determine whether the Scheme has an impact on the likelihood and severity of collisions, e.g. on the approaches to the Blackwall tunnel; and
- The PEIR examines a worst case scenario and it has assumed that all movements would be by road. River barges would be used, where possible, and this is expected to avoid the need for in excess of 178,000 HGV movements on the road network during the construction phase.
- The modelling for traffic flow is based on charges that would be levied for use of the tunnels. This traffic modelling in turn affects topics such as air quality, noise, distributional and equality effects as well as health and wellbeing.

2.14 Next steps

2.14.1 This preliminary analysis looks at the impacts on health, the determinants of health and health inequalities that arise during the construction and operation phases of the Scheme.

2.14.2 The Preliminary HIA report is the first part of the appraisal of evidence stage. This report is largely descriptive and is based on professional judgement.

2.14.3 The PEIR provides an opportunity for stakeholders, including the public, to respond to this preliminary analysis.

2.14.4 Following PEIR this preliminary analysis would be reviewed and options would be considered for conducting further assessment taking into account emerging data and consultation responses.

2.14.5 The detail underpinning these assumptions would be worked up and incorporated into the final Scheme by TfL as part of the next steps.

3. SCHEME DESCRIPTION

3.1 The Scheme

3.1.1 The Scheme – known as the Silvertown Tunnel – involves the construction of a twin bore road tunnel providing a new connection between the A102 Blackwall Tunnel Approach on Greenwich Peninsula (London Borough of Greenwich) and the Tidal Basin Roundabout junction on the A1020 Lower Lea Crossing/Silvertown Way (London Borough of Newham. The Silvertown Tunnel would be approximately 1.4km long and would be able to accommodate large vehicles including double-deck buses.

3.1.2 On the north side, the tunnel approach road connects to the Tidal Basin Roundabout, which would be altered to create a new signal-controlled roundabout linking the Silvertown Way, Dock Road and the Lower Lea Crossing. Dock Road would be realigned to accommodate the new tunnel and approach road. On the south side, the A102 would be widened to create new slip-road links to the Silvertown Tunnel. A new flyover would be built to take southbound traffic exiting the Blackwall Tunnel over the northbound approach to the Silvertown Tunnel. The Boord Street footbridge over the A102 would be replaced with a pedestrian and cycle bridge.

3.1.3 New portal buildings would be located close to each portal to house the plant and equipment necessary to operate the tunnel, including ventilation equipment.

3.1.4 The introduction of free-flow user charging on both the Blackwall and Silvertown Tunnels would play a fundamental part in managing traffic demand and support the financing of the construction and operation of the Silvertown Tunnel. The design of the tunnel would include a dedicated bus/coach and HGV lane in each direction, which would provide opportunities for TfL to provide additional cross-river bus routes.

3.1.5 Main construction works would likely commence in 2018 and would last approximately 4 years with the new tunnel opening in 2022/23. A Tunnel Boring Machine (TBM) would be used to bore the main tunnel sections under the river with shorter sections of cut and cover tunnel at either end linking to the portals. The proposal is to erect and launch the TBM from a specially constructed chambers at Silvertown and Greenwich Peninsula where the bored and cut and cover sections connect.

3.1.6 The main site construction compound would be located at Silvertown to enable the utilisation, if reasonably practicable, of the Thames Wharf to facilitate the removal of spoil and delivery of materials by river. A secondary site compound would be located adjacent to the alignment of the proposed cut and cover tunnel on the Greenwich peninsula.

4. HIA SCOPE

4.1.1 The scope for the preliminary was based on relevant HIA guidance (2-4) and it is set out in the scoping report which is available on the TfL website as a background document.. TfL sought comment on this scope and held a workshop with stakeholders. It was agreed that the HIA scope would focus on:

- air quality (construction and operation);
- noise (construction and operation);
- road safety, accessibility and active travel (construction and operation);
- access to work and training (construction and operation); and
- social cohesion and lifetime neighbourhoods (operation).

4.1.2 In line with discussion at the HIA/EqIA workshop the HIA does not model the ways in which the Scheme would affect travel to healthcare services and other social infrastructure facilities. The HIA concentrates instead on ensuring that the Scheme, in the construction and the operation phases, enables travel by a range of transport modes and that people are encouraged to use active travel (public transport, walking, cycling) as well as motorised transport. The way in which the Scheme changes access to healthcare services and other social infrastructure is thus considered important but it is subordinate to considerations of road safety, accessibility and active travel during construction and operation. Access to healthcare services and other social infrastructure is thus not considered separately.

4.1.3 The scoping report stated that climate change would not be considered as a topic in its own right in this assessment. The reasoning was as follows:

- climate is an important determinant of health and wellbeing and there are co-benefits to health from climate change mitigation in the transport sector (17); and
- each of the components of transport-related climate change mitigation is considered elsewhere in the assessment e.g.: active transport including public transport; reducing emissions to air; access to social infrastructure; access to jobs, goods and services.

4.1.4 Stakeholders requested that the HIA includes a statement acknowledging the importance of climate change to human health and wellbeing. This is made in Chapter 6 of this report.

4.1.5 In responses to consultation stakeholders commented on the fact that the HIA would not look at the use of resources. The proximate availability of resources is important for minimising the footprint of the Scheme and reducing carbon emissions. This is, however, scoped out of this HIA as it is recognised that while this is important for health, the issue is covered elsewhere in the Preliminary Environmental Information Report (PEIR) documents and an analysis from a health perspective would not add to the understanding of the impacts of accessing resources to build the Scheme. The use of resources in the Scheme is covered in the Sustainability Statement and the PEIR chapter on Material Resources and Waste.

4.1.6 Table 4-1 summarises the HIA scope as identified in the scoping report. Table 4-1 also shows how the scope that was set out in that report has been adapted as a result of stakeholder comment and how the analysis is presented in this report.

Table 4-1 Scoping the HIA: summary: construction & operation

Determinant of health	Construction	Operation
Housing and quality design	Out	Out
Access to healthcare services & other social infrastructure*	In (after discussion in workshop – maintain focus on walkability of neighbourhoods)	In (after discussion in workshop – maintain focus on walkability of neighbourhoods)
Access to open space and nature	Out	Out
Air quality	In	In
Noise	In	In
Accessibility and active travel	In	In
Crime reduction and community safety	In (only in relation to road traffic safety)**	In (only in relation to road traffic safety)**
Access to healthy food	Out	Out
Access to work and training	In	In
Social cohesion and lifetime neighbourhoods	Out	In
Minimising the use of resources	Out	Out
Climate change	Out	Out (statement concerning importance of climate change for health to be made in main HIA)

* Access to healthcare services & other social infrastructure is considered to be dependent on road safety, accessibility and active travel and is covered within that chapter. It is not examined separately.

** Road traffic safety is considered in Chapter 7 road safety, accessibility and active travel.

Determinants of health are adapted from NHS HUDU (2).

5. HEALTH BASELINE

5.1 Study area

5.1.1 This chapter defines the timescale, geographic location and population being described and assessed in the HIA. Further detailed information on population demographics is presented in the EIA.

5.1.2 The location of the Scheme is shown on Drawing 4.1 Limit of Land to be Acquired and Used (LLAU) in Volume 2 of the PEIR and also in Volume 3, Appendix 4.C.

5.1.3 The northern portal lies in the London Borough of Newham. Mixed residential and recreational land uses predominate around the perimeter of the Royal Victoria Docks and light industrial and commercial uses to the south of the elevated Silvertown Way and the Docklands Light Railway (DLR). There are a number of businesses within the Dock Road/Thames Wharf area, including scrap metal dealers, waste recycling and management businesses and an aggregates supplier. There is a small area of derelict land that is entirely surrounded by the aggregates business and through which the DLR passes.

5.1.4 The southern tunnel portal sits on the Greenwich Peninsula in the Royal Borough of Greenwich. On the southern side of the River Thames, the land use is predominantly car parking associated with the O2. The entrance to the Emirates Air Line (EAL) is accessed from the western side of the Peninsula. There is a small quantity of industrial/commercial land at the eastern extent of the safeguarded area, in the vicinity of Tunnel Avenue. The majority of the land on the Peninsula is owned by the GLA. A gas holder (approximately 75m in diameter) is currently situated between Millennium Way and the Blackwall Tunnel Southern Approach on the western boundary of the Scheme (to be decommissioned before construction works of the tunnel commence). There is a footbridge which crosses the Blackwall Tunnel Approach in the vicinity of Boord Street.

5.1.5 The tunnel portal and the link roads from the southern junction encompass an area of derelict land that appears to be heavily overgrown with a mixture of small trees and scrub. It is bound by paved areas including the Blackwall Tunnel Approach to the west, Millennium Way to the east, the Gasometer site to the south and an industrial site to the north.

5.2 Geographic scope

5.2.1 The study area for the HIA has been identified as being the geographical area covered by the following local authorities:

- RB Greenwich;
- LB Newham; and
- LB Tower Hamlets.

5.2.2 Public Health England prepare local health profiles. These are summarised in Table 5-1. which contains a list of indicators for each area. Table 5-1shows which indicators are significantly worse than the England average. This provides a general overview of relevant to health and well-being that are of importance for each borough. It should be noted that this comparison is made with the England average and that comparisons with the London average may give a different picture.

Table 5-1 Summary indicators noted, by PHE, as being significantly worse than the England average

	Tower Hamlets	**Newham**	**Greenwich**
deprivation	Yes	Yes	Yes
child poverty	Yes	Yes	Yes
violent crime	Yes	Yes	Yes
homelessness	Yes	Yes	-
long term unemployment	Yes	Yes	Yes
child obesity	Yes	Yes	Yes
drug use	Yes	Yes	Yes
TB incidence	Yes	Yes	Yes
diabetes	Yes	Yes	-
life expectancy	Yes*****	Yes	Yes*****
smoking	Yes	-	Yes
cardiovascular disease	Yes	Yes	Yes
STIs incidence	Yes	Yes	Yes

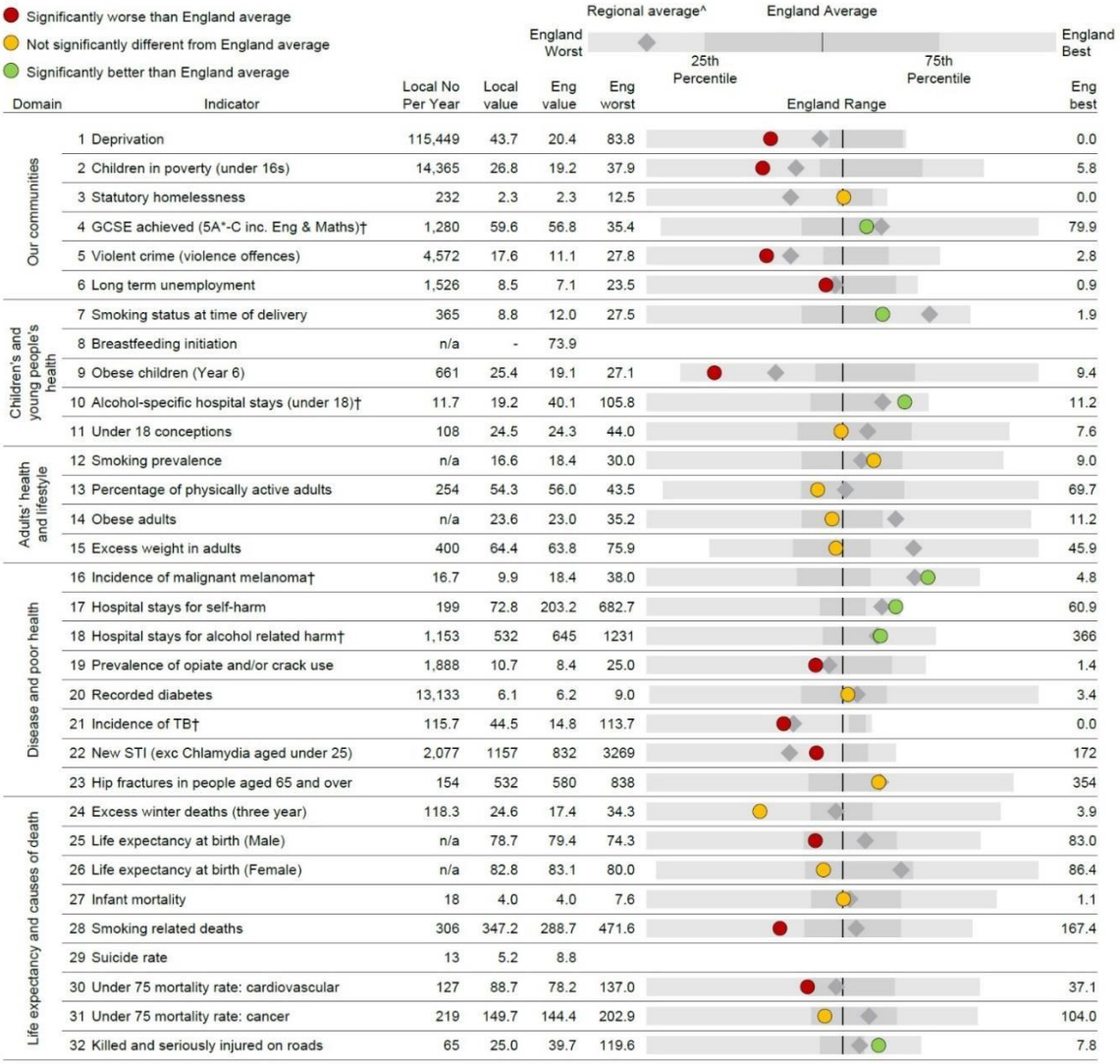
	Tower Hamlets	Newham	Greenwich
adult physical activity	-	Yes	-
cancer	Yes	-	-
road accidents	Yes	-	-

***** *particularly for men*

Royal Borough of Greenwich

5.2.3 Detailed health information for Greenwich is set out in its Joint Strategic Needs Assessment (JSNA) (18), the implementation of which is detailed in the Greenwich Health and Wellbeing 2015-2018 Strategy (19). Public Health England's 2015 summary of the health profile is shown in Figure 5-1 and below.

Figure 5-1 Greenwich summary health indicators



Domain		Indicator	Local No Per Year	Local value	Eng value	Eng worst	Eng best
Our communities	1	Deprivation	115,449	43.7	20.4	83.8	0.0
	2	Children in poverty (under 16s)	14,365	26.8	19.2	37.9	5.8
	3	Statutory homelessness	232	2.3	2.3	12.5	0.0
	4	GCSE achieved (5A*-C inc. Eng & Maths)†	1,280	59.6	56.8	35.4	79.9
	5	Violent crime (violence offences)	4,572	17.6	11.1	27.8	2.8
	6	Long term unemployment	1,526	8.5	7.1	23.5	0.9
Children's and young people's health	7	Smoking status at time of delivery	365	8.8	12.0	27.5	1.9
	8	Breastfeeding initiation	n/a	-	73.9		
	9	Obese children (Year 6)	661	25.4	19.1	27.1	9.4
	10	Alcohol-specific hospital stays (under 18)†	11.7	19.2	40.1	105.8	11.2
	11	Under 18 conceptions	108	24.5	24.3	44.0	7.6
Adults' health and lifestyle	12	Smoking prevalence	n/a	16.6	18.4	30.0	9.0
	13	Percentage of physically active adults	254	54.3	56.0	43.5	69.7
	14	Obese adults	n/a	23.6	23.0	35.2	11.2
	15	Excess weight in adults	400	64.4	63.8	75.9	45.9
Disease and poor health	16	Incidence of malignant melanoma†	16.7	9.9	18.4	38.0	4.8
	17	Hospital stays for self-harm	199	72.8	203.2	682.7	60.9
	18	Hospital stays for alcohol related harm†	1,153	532	645	1231	366
	19	Prevalence of opiate and/or crack use	1,888	10.7	8.4	25.0	1.4
	20	Recorded diabetes	13,133	6.1	6.2	9.0	3.4
	21	Incidence of TB†	115.7	44.5	14.8	113.7	0.0
	22	New STI (exc Chlamydia aged under 25)	2,077	1157	832	3269	172
	23	Hip fractures in people aged 65 and over	154	532	580	838	354
Life expectancy and causes of death	24	Excess winter deaths (three year)	118.3	24.6	17.4	34.3	3.9
	25	Life expectancy at birth (Male)	n/a	78.7	79.4	74.3	83.0
	26	Life expectancy at birth (Female)	n/a	82.8	83.1	80.0	86.4
	27	Infant mortality	18	4.0	4.0	7.6	1.1
	28	Smoking related deaths	306	347.2	288.7	471.6	167.4
	29	Suicide rate	13	5.2	8.8		
	30	Under 75 mortality rate: cardiovascular	127	88.7	78.2	137.0	37.1
	31	Under 75 mortality rate: cancer	219	149.7	144.4	202.9	104.0
	32	Killed and seriously injured on roads	65	25.0	39.7	119.6	7.8

From Public Health England. Health Profiles 2015 (20).

Health in summary

5.2.4 The health of people in Greenwich is varied compared with the England average. Deprivation is higher than average and about 26.8% (14,400) children live in poverty. Life expectancy for men in the Borough is lower than the England average.

Living longer

5.2.5 Life expectancy is 4.8 years lower for men and 5.9 years lower for women in the most deprived areas of Greenwich than in the least deprived areas.

Child health

5.2.6 In Year 6, 25.4% (661) of children are classified as obese, worse than the average for England. The rate of alcohol-specific hospital stays among those under 18 was 19.2 per 100,000 population, better than the average for England. This represents 12 stays per year. Levels of GCSE attainment and maternal smoking at time of delivery (*ie* birth of baby) are better than the England average.

Adult health

5.2.7 In 2012, 23.6% of adults are classified as obese. The rate of alcohol related harm hospital stays was 532 per 100,000 population, better than the average for England. This represents 1,153 stays per year. The rate of self-harm hospital stays was 72.8 per 100,000 population, better than the average for England. This represents 199 stays per year. The rate of smoking related deaths was 347 per 100,000 population, worse than the average for England. This represents 306 deaths per year. Rates of sexually transmitted infections and TB are worse than average. The rate of people killed and seriously injured on roads is lower than the average across England.

Local priorities

5.2.8 Health related priorities in Greenwich include embedding a 'make every contact count' approach across council, health and third sector organisations, addressing the continuing rise in child and adult obesity, and improving mental health. Greenwich Borough population projections are set out in Table 5-2.

Table 5-2 Greenwich population projections

Year	Population	Year	Population	Year	Population
2015	269,000	2023	293,000	2031	314,000
2016	272,000	2024	296,000	2032	317,000
2017	275,000	2025	299,000	2033	319,000
2018	279,000	2026	301,000	2034	321,000
2019	282,000	2027	304,000	2035	324,000
2020	285,000	2028	307,000	2036	326,000
2021	287,000	2029	309,000	2037	328,000

Year	Population
2022	290,000

Year	Population
2030	312,000

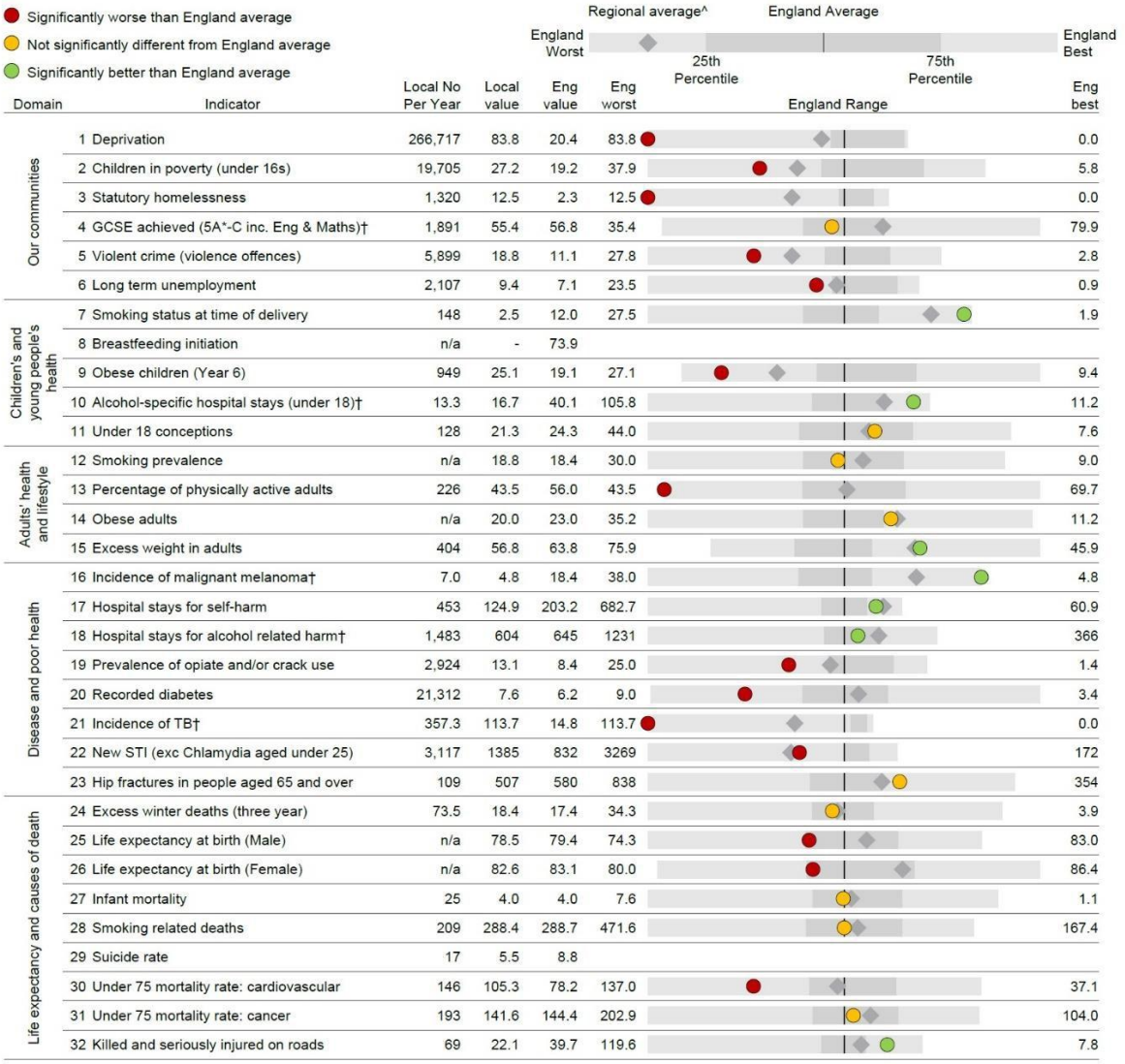
Year	Population

From ONS. Subnational Population Projections, 2012-based projections (21)

LB Newham

5.2.9 Detailed health information for Newham is set out in its Joint Strategic Needs Assessment (JSNA) (22), the implementation of which is spelt out in the Newham Health and Wellbeing Strategy (23). Public Health England's 2015 health profile for Newham is shown in Figure 5-2.

Figure 5-2 Newham summary health indicators



Domain		Indicator	Local No Per Year	Local value	Eng value	Eng worst	Eng best
Our communities	1	Deprivation	266,717	83.8	20.4	83.8	0.0
	2	Children in poverty (under 16s)	19,705	27.2	19.2	37.9	5.8
	3	Statutory homelessness	1,320	12.5	2.3	12.5	0.0
	4	GCSE achieved (5A*-C inc. Eng & Maths)†	1,891	55.4	56.8	35.4	79.9
	5	Violent crime (violence offences)	5,899	18.8	11.1	27.8	2.8
	6	Long term unemployment	2,107	9.4	7.1	23.5	0.9
Children's and young people's health	7	Smoking status at time of delivery	148	2.5	12.0	27.5	1.9
	8	Breastfeeding initiation	n/a	-	73.9		
	9	Obese children (Year 6)	949	25.1	19.1	27.1	9.4
	10	Alcohol-specific hospital stays (under 18)†	13.3	16.7	40.1	105.8	11.2
	11	Under 18 conceptions	128	21.3	24.3	44.0	7.6
Adults' health and lifestyle	12	Smoking prevalence	n/a	18.8	18.4	30.0	9.0
	13	Percentage of physically active adults	226	43.5	56.0	43.5	69.7
	14	Obese adults	n/a	20.0	23.0	35.2	11.2
	15	Excess weight in adults	404	56.8	63.8	75.9	45.9
Disease and poor health	16	Incidence of malignant melanoma†	7.0	4.8	18.4	38.0	4.8
	17	Hospital stays for self-harm	453	124.9	203.2	682.7	60.9
	18	Hospital stays for alcohol related harm†	1,483	604	645	1231	366
	19	Prevalence of opiate and/or crack use	2,924	13.1	8.4	25.0	1.4
	20	Recorded diabetes	21,312	7.6	6.2	9.0	3.4
	21	Incidence of TB†	357.3	113.7	14.8	113.7	0.0
	22	New STI (exc Chlamydia aged under 25)	3,117	1385	832	3269	172
	23	Hip fractures in people aged 65 and over	109	507	580	838	354
Life expectancy and causes of death	24	Excess winter deaths (three year)	73.5	18.4	17.4	34.3	3.9
	25	Life expectancy at birth (Male)	n/a	78.5	79.4	74.3	83.0
	26	Life expectancy at birth (Female)	n/a	82.6	83.1	80.0	86.4
	27	Infant mortality	25	4.0	4.0	7.6	1.1
	28	Smoking related deaths	209	288.4	288.7	471.6	167.4
	29	Suicide rate	17	5.5	8.8		
	30	Under 75 mortality rate: cardiovascular	146	105.3	78.2	137.0	37.1
	31	Under 75 mortality rate: cancer	193	141.6	144.4	202.9	104.0
	32	Killed and seriously injured on roads	69	22.1	39.7	119.6	7.8

From Public Health England. Health Profiles 2015 (20).

Health in Newham

5.2.10 The overall health of people in Newham varies from the England average. Deprivation is higher than average and about 27.2% (19,700) children live in poverty. Life expectancy for both men and women is lower than the England average.

Living longer

5.2.11 Life expectancy is 6.9 years lower for men and 6.7 years lower for women in the most deprived areas of Newham than in the least deprived areas.

Child health

5.2.12 In Year 6, 25.1% (949) of children are classified as obese in the Borough, worse than the average for England. The rate of alcohol-specific hospital stays among those under 18 was 16.7 per 100,000 population, better than the average for England. This represents 13 stays per year. Levels of maternal smoking at time of delivery are better than the England average.

Adult health

5.2.13 In 2012, 20.0% of adults were classified as obese. The rate of alcohol related harm hospital stays was 604 per 100,000 population, better than the average for England. This represents 1,483 stays per year. The rate of self-harm hospital stays was 124.9 per 100,000 population, better than the average for England. This represents 453 stays per year. The rate of smoking related deaths was 288 per 100,000 population. This represents 209 deaths per year. Estimated levels of adult physical activity are worse than the England average. Estimated levels of adult excess weight are better than the England average. Rates of sexually transmitted infections and TB are worse than average. The rate of people killed and seriously injured on roads is lower than the average across England.

Local priorities

5.2.14 Priorities in Newham include improving healthy life expectancy, increasing levels of physical activity, and reducing smoking. Newham population projections are set out in Table 5-3.

Table 5-3 Newham population projections

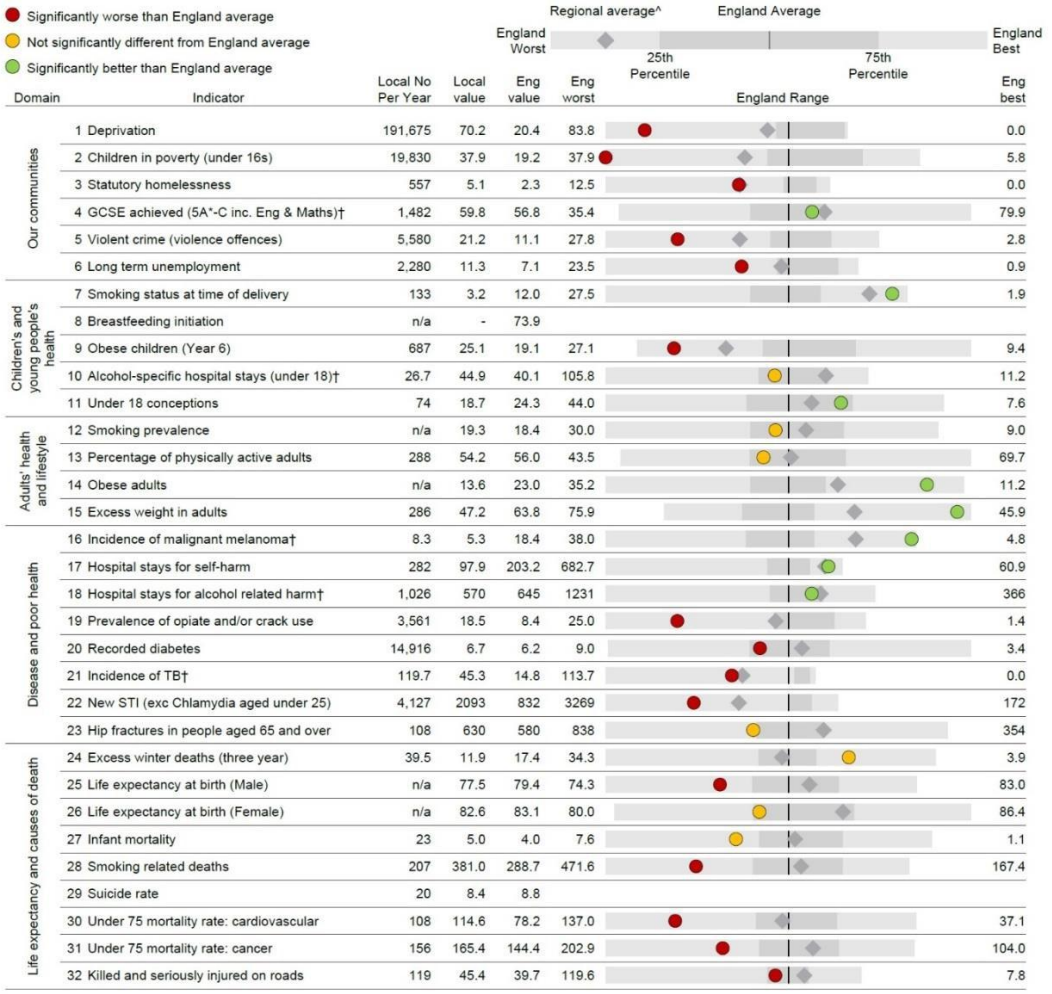
Year	Population	Year	Population	Year	Population
2015	330,000	2023	368,000	2031	397,000
2016	336,000	2024	372,000	2032	400,000
2017	341,000	2025	376,000	2033	403,000
2018	346,000	2026	379,000	2034	406,000
2019	351,000	2027	383,000	2035	409,000
2020	355,000	2028	386,000	2036	412,000
2021	360,000	2029	390,000	2037	416,000
2022	364,000	2030	393,000		

From ONS. Subnational Population Projections, 2012-based projections (21)

Tower Hamlets

5.2.15 Detailed health information for Tower Hamlets is set out in its JSNA (24), the implementation of which is laid out in the Tower Hamlets Health and Wellbeing Strategy (24,25). Public Health England's 2015 summary of the health profile is shown in Figure 5-3.

Figure 5-3 Tower Hamlets summary health indicators



Domain		Indicator	Local No Per Year	Local value	Eng value	Eng worst	Eng best
Our communities	1	Deprivation	191,675	70.2	20.4	83.8	0.0
	2	Children in poverty (under 16s)	19,830	37.9	19.2	37.9	5.8
	3	Statutory homelessness	557	5.1	2.3	12.5	0.0
	4	GCSE achieved (5A*-C inc. Eng & Maths)†	1,482	59.8	56.8	35.4	79.9
	5	Violent crime (violence offences)	5,580	21.2	11.1	27.8	2.8
	6	Long term unemployment	2,280	11.3	7.1	23.5	0.9
Children's and young people's health	7	Smoking status at time of delivery	133	3.2	12.0	27.5	1.9
	8	Breastfeeding initiation	n/a	-	73.9		
	9	Obese children (Year 6)	687	25.1	19.1	27.1	9.4
	10	Alcohol-specific hospital stays (under 18)†	26.7	44.9	40.1	105.8	11.2
	11	Under 18 conceptions	74	18.7	24.3	44.0	7.6
Adults' health and lifestyle	12	Smoking prevalence	n/a	19.3	18.4	30.0	9.0
	13	Percentage of physically active adults	288	54.2	56.0	43.5	69.7
	14	Obese adults	n/a	13.6	23.0	35.2	11.2
	15	Excess weight in adults	286	47.2	63.8	75.9	45.9
Disease and poor health	16	Incidence of malignant melanoma†	8.3	5.3	18.4	38.0	4.8
	17	Hospital stays for self-harm	282	97.9	203.2	682.7	60.9
	18	Hospital stays for alcohol related harm†	1,026	570	645	1231	366
	19	Prevalence of opiate and/or crack use	3,561	18.5	8.4	25.0	1.4
	20	Recorded diabetes	14,916	6.7	6.2	9.0	3.4
	21	Incidence of TB†	119.7	45.3	14.8	113.7	0.0
	22	New STI (exc Chlamydia aged under 25)	4,127	2093	832	3269	172
	23	Hip fractures in people aged 65 and over	108	630	580	838	354
Life expectancy and causes of death	24	Excess winter deaths (three year)	39.5	11.9	17.4	34.3	3.9
	25	Life expectancy at birth (Male)	n/a	77.5	79.4	74.3	83.0
	26	Life expectancy at birth (Female)	n/a	82.6	83.1	80.0	86.4
	27	Infant mortality	23	5.0	4.0	7.6	1.1
	28	Smoking related deaths	207	381.0	288.7	471.6	167.4
	29	Suicide rate	20	8.4	8.8		
	30	Under 75 mortality rate: cardiovascular	108	114.6	78.2	137.0	37.1
	31	Under 75 mortality rate: cancer	156	165.4	144.4	202.9	104.0
	32	Killed and seriously injured on roads	119	45.4	39.7	119.6	7.8

From Public Health England. Health Profiles 2015 (20).

Health in Tower Hamlets

5.2.16 The health of people in Tower Hamlets varies compared with the England average. Deprivation is higher than average and about 37.9% (19,800) children live in poverty. Life expectancy for men is lower than the England average.

Living longer

5.2.17 Life expectancy is 8.8 years lower for men and 3.9 years lower for women in the most deprived areas of Tower Hamlets than in the least deprived areas.

Child health

5.2.18 In Year 6, 25.1% (687) of children are classified as obese, worse than the average for England. The rate of alcohol-specific hospital stays among those under 18 was 44.9 per 100,000 population. This represents 27 stays per year. Levels of teenage pregnancy, GCSE attainment and maternal smoking at time of delivery are better than the England average.

Adult health

5.2.19 In 2012, 13.6% of adults are classified as obese, better than the average for England. The rate of alcohol related harm hospital stays was 570 per 100,000 population, better than the average for England. This represents 1,026 stays per year. The rate of self-harm hospital stays was 97.9 per 100,000 population, better than the average for England. This represents 282 stays per year. The rate of smoking related deaths was 381 per 100,000 population, worse than the average for England. This represents 207 deaths per year. Estimated levels of adult excess weight are better than the England average. Rates of sexually transmitted infections, people killed and seriously injured on roads and TB are worse than average.

Local priorities

5.2.20 Priorities in Tower Hamlets include maternity and early years health care, healthy lives, long term conditions (cancer and integrated care), and mental health. The population projections for Tower Hamlets are shown in Table 5-4.

Table 5-4 Tower Hamlets population projections

Year	Population	Year	Population	Year	Population
2015	283,000	2023	326,000	2031	357,000
2016	289,000	2024	330,000	2032	361,000
2017	295,000	2025	334,000	2033	365,000
2018	301,000	2026	338,000	2034	368,000
2019	306,000	2027	342,000	2035	372,000
2020	312,000	2028	346,000	2036	376,000
2021	316,000	2029	350,000	2037	379,000
2022	321,000	2030	354,000		

From ONS. Subnational Population Projections, 2012-based projections (21)

Age in the host boroughs

5.2.21 Table 5-5 sets out a summary of the age profiles for each of the three host Boroughs, together with comparative information for London and England. Table 5-5 shows that the three host Boroughs have a higher proportion of their population in all age groups from 0-45 than is the case for England as a whole. From 45-49 onwards the host boroughs have smaller proportions of their population than the England average. Both Newham and Tower Hamlets show higher proportions of their resident population within the 20-35 age range than the London average. Although a rise is projected across all age groups for the Greater London area, the rise is not uniform, with the largest rise predicted within the 65+ age groups (predicted to rise by 63.9% compared with the overall growth rate of 23% projected for the total population (GLA 2014).

Table 5-5 Age Profile of Host Boroughs (all usual residents)

Area	LB Newham	LB Tower Hamlets	RB Greenwich	London	England
Total number Age	*307,984*	*254,096*	*254,557*	*8,173,941*	*53,012,456*
0 to 4	8.24%	7.38%	8.23%	7.24%	6.26%
5 to 9	6.76%	6.11%	6.41%	5.91%	5.61%
10 to 14	6.36%	5.20%	5.89%	5.59%	5.81%
15 to 19	6.63%	5.75%	6.31%	5.77%	6.30%
20 to 24	10.58%	12.13%	7.85%	7.71%	6.78%
25 to 29	13.13%	15.80%	8.69%	10.19%	6.89%
30 to 34	10.36%	13.00%	9.90%	9.75%	6.62%
35 to 39	7.63%	8.48%	8.35%	8.12%	6.69%
40 to 44	6.89%	6.17%	7.51%	7.46%	7.33%
45 to 49	5.68%	4.64%	6.73%	6.81%	7.32%
50 to 54	4.78%	3.83%	5.52%	5.64%	6.41%
55 to 59	3.51%	3.08%	4.35%	4.55%	5.65%
60 to 64	2.77%	2.31%	4.00%	4.19%	5.98%
65 to 69	1.95%	1.63%	2.94%	3.14%	4.73%
70 to 74	1.78%	1.59%	2.43%	2.65%	3.86%
75 to 79	1.32%	1.26%	1.94%	2.16%	3.15%
80 to 84	0.89%	0.95%	1.47%	1.61%	2.37%
85 to 89	0.51%	0.49%	0.96%	0.99%	1.46%
90 to 100+	0.25%	0.21%	0.51%	0.52%	0.76%

From ONS. Census 2011 Population by Age, UK Districts (26)

Deprivation in the host boroughs

5.2.22 Figure 5-4 shows areas with high levels of deprivation close to the Scheme, as measured by the Index of Multiple Deprivation (IoMD) 2010. There are several areas close to the Scheme that fall within the top 20% most deprived areas in England and Wales; these include most of LB Newham and large areas in LB Tower Hamlets and RB Greenwich.

5.2.23 Figure 5-5 shows how the areas close to the Scheme rank on the IoMD income domain score. Large parts of Newham to the north east of the tunnel are among the most income deprived areas in England and Wales.

Figure 5-4 Levels of overall deprivation close to the Scheme

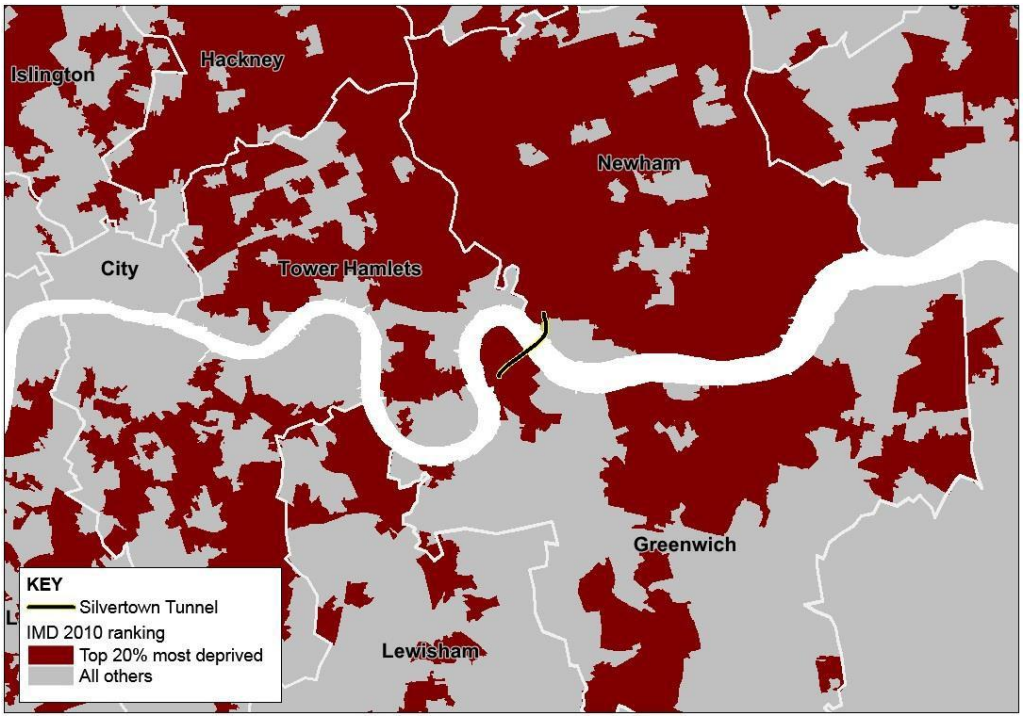


Figure from the Distributional Impact Assessment

Figure 5-5 Levels of income deprivation close to the Scheme

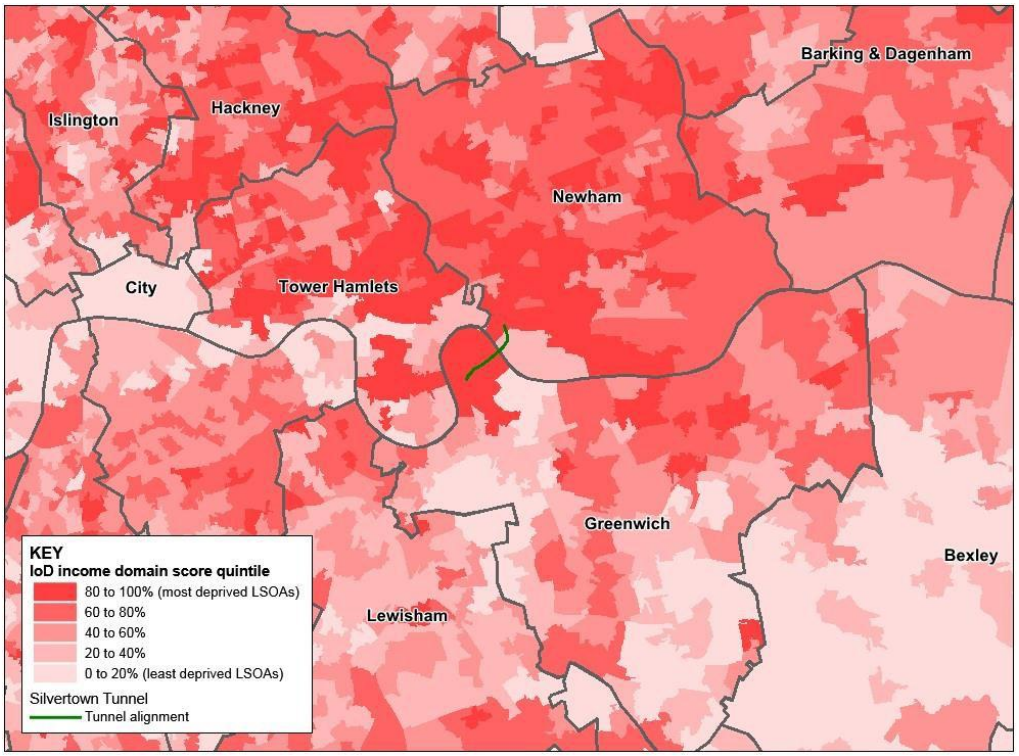


Figure from the Distributional Impact Assessment

5.2.24 Generally car ownership rates are lower among low income households. Figure 5-6 shows the average proportion of households without a car in each income quintile, for the whole of London, based on census 2011 data.

Figure 5-6 Households in London with no access to a car or van, by income group

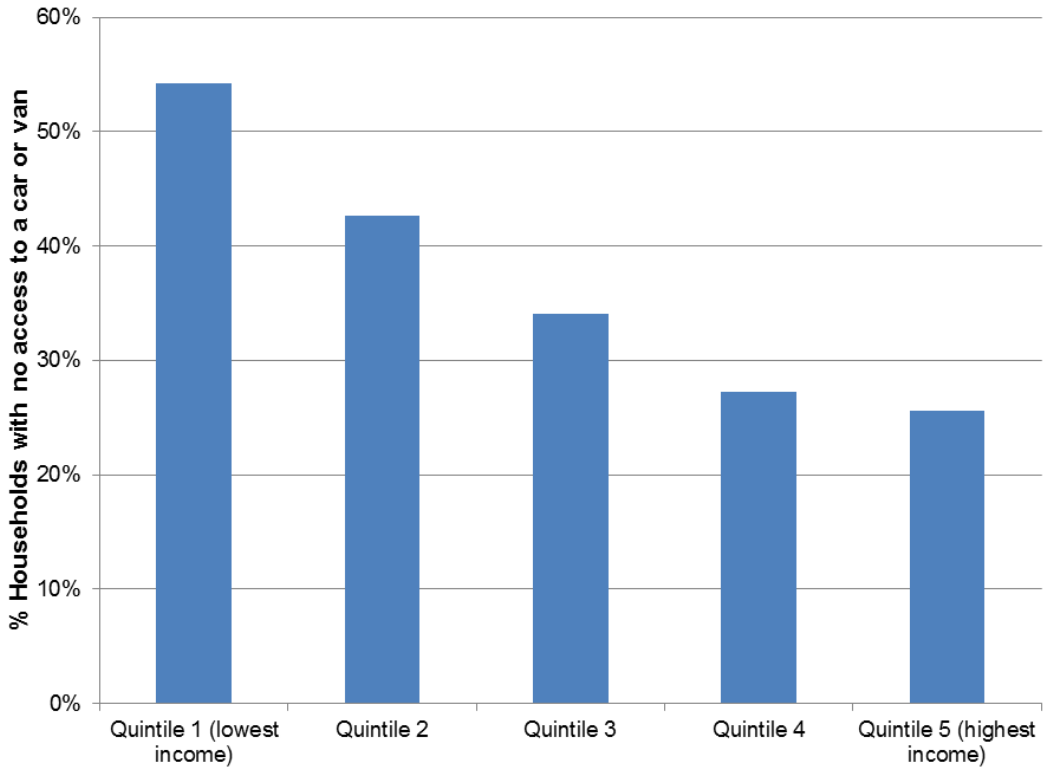


Figure from the Distributional Impact Assessment

5.2.25 Table 5-6 shows the concentrations of selected social groups, based on census 2011 data, in the three host boroughs of the proposed Scheme: RB Greenwich, LB Newham and LB Tower Hamlets.

Table 5-6 Concentrations of key social groups

Values	RB Greenwich	LB Newham	LB Tower Hamlets	Average across all three boroughs
Children under 16 (% all usual residents)	22	23	20	21
Young people aged 16-25 (% all usual residents)	15	19	20	18
Older people aged 70+ (% all usual residents)	7	5	4	5
Disabled people (% all usual residents)	15	14	14	14

Values	RB Greenwich	LB Newham	LB Tower Hamlets	Average across all three boroughs
Black, Asian and Minority Ethnic (% all usual residents)	38	71	55	56
Households with no car (% households)	42	52	63	52
Households with one or more dependent children (% households)	34	39	27	33

Figure from the Distributional Impact Assessment

6. CLIMATE CHANGE AND HEALTH

6.1.1 The importance of climate as a determinant of health and wellbeing and the effects of a changing climate on human health and wellbeing has been shown in a range of reports (27-30).

6.1.2 Adaptation to and mitigation of climate change effects are important to the promotion of health and well-being. There are co-benefits to health from climate change mitigation generally and specifically mitigation of effects in the transport sector. Policies to increase the acceptability, appeal, and safety of active urban travel, and discourage travel in private motor vehicles would provide larger health benefits than policies that focus solely on lower-emission motor vehicles (31).

6.1.3 The WHO (17) state that the overarching goals of healthy transport include:

- increasing equity through better access to goods and services;
- increasing physical activity through safe walking and bicycling;
- increasing safety and physical activity and reducing air pollution through use of mass transit/public transport; and
- reducing deaths and diseases from pollution (noise, air, water) and traffic injuries.

6.1.4 The WHO advise that these can be achieved through four main strategies:

- land use systems that increase density and diversity of uses;
- investment in and provision of transport network space for pedestrian and bicycle infrastructure;
- investment in and provision of transport network space for rapid transit/public transport; and
- engineering and speed reduction measures to moderate the leading hazards of motorized transport.

6.1.5 To this end the HIA focusses on ways in which the Scheme can increase the acceptability, appeal, and safety of active urban travel, and discourage travel in private motor vehicles. Active urban travel requires pedestrian and bicycle infrastructure and transport network space for public transport.

7. CHANGES IN ROAD SAFETY, ACCESSIBILITY AND ACTIVE TRAVEL

7.1 Introduction

7.1.1 The ways in which the movement of people and vehicles would be influenced by the Scheme is of central importance to meeting the Scheme's objectives and to the significance of its effects on a range of environmental factors including health and wellbeing. The links between health and transport are summarised in the points below from Thomson et al (32) and are addressed in greater detail in the Evidence Base on pages 126-166.

> *'The primary function of transport is the movement of people and goods between places, enabling access to employment, economic, and social opportunities as well as to essential services. Transport needs would depend on many local contextual factors e.g. existing public transport, as well as individual factors, e.g. mobility. But transport which is affordable and accessible may be viewed as an important determinant of health by facilitating access to key socio-economic opportunities.*
>
> *Inadequate transport provision may add to social exclusion among already vulnerable groups, i.e. those who are unemployed, elderly, sick, on low incomes, and women, presenting a barrier to jobs, health services, education, shops and other services.*
>
> *Lack of access to a car may contribute to transport related social exclusion. In the UK, car ownership is strongly associated with income, yet the association between car ownership and improved health is independent of income and social class. This may be partly explained by the improved access that a car provides.*
>
> *Physical injury and death are the most direct and acute health impacts of motorised transport. More indirect and chronic impacts include changes to: physical activity and obesity; mental health; air quality and cardiorespiratory health; social exclusion and inequalities; and environmental impacts related to fuel emissions and climate change. Injuries and deaths caused by motor-vehicles are indisputable and already closely monitored with some interventions in place to minimise this harm eg speed limits, traffic regulations, and police enforcement.'*

7.1.2 This chapter considers changes to road safety, accessibility and active travel (including physical activity). Reported road casualties have been used over recent decades as a proxy for road safety. However, road safety has been defined as the freedom from the fear of harm or injury in and around the highway and not just by reference to collisions and personal injury. Road safety is therefore viewed through this broader lens and sustainable and health promoting modes of travel are encouraged in line with TfL policy. The following Source-Pathway-Receptor model summarises the relation between these issues and changes in health.

- **Source**: motorised vehicles on the road network: volume, velocity, distribution; location of community, residential, commercial or amenity services;
- **Pathway**: safety; interaction between different modes of transport (including severance effects on communities and suppression of active travel modes due to road safety fears); design of the built environment; journey times; journey costs/affordability; and
- **Receptor**: residents and employees living and working in the vicinity of the Scheme; road (and ferry) users, including users of public transport, pedestrians, cyclists and people using motor vehicles.

7.1.3 The findings from this chapter inform the analyses relating to:

- Change in access to work and training (see page 91); and
- Change in social cohesion and lifetime neighbourhoods (see page 108).

7.1.4 The chapter looks first at the construction phase and then at the operational phase.

7.2 Construction: preliminary analysis

7.2.1 The following sections address the potential for further mitigation or enhancement to support people who live or work near the tunnel portals and who are reliant on road network access during the construction phases. As the effects that the Scheme would have on health and wellbeing would differ according to the way in which people travel the assessment considers the effects on the following groups in turn:

- car drivers and other users of motorised vehicles;

- active travel: pedestrians and cyclists; and
- public transport.

7.2.2 For each group the preliminary HIA provides a concise summary of the analysis made in the preliminary Transport Assessment (TA). The reader is referred to the preliminary TA for further information.

Car drivers and other users of motorised vehicles

7.2.3 Active or multi-modal forms of travel are desirable, from a public health perspective, as they increase levels of physical activity (33) and they are associated with lower emissions of greenhouse gases (31). Some groups are, however, more dependent on car use than the general population, for example:

- small businesses; and
- people with limited mobility.

7.2.4 For these groups any disruption of road networks is likely to be challenging due to the potential for adverse impact on economic activity and on access to goods and services. Either the reality of increased congestion and disruption, or the possibility that it might occur, could be a cause of stress and anxiety (low level mental health conditions) during the four year construction period.

7.2.5 The TA notes that the Silvertown works would cause some disruption to the local road network around the tunnel portals. There would be road closures (including temporary weekend or overnight closures), diversions, and changes to parking arrangements at the O2. The preliminary TA describes the predicted degree of disruption that local road networks are likely to experience. The tunnel works sites at Greenwich and Silvertown would lead to some localised impacts i.e. disruption to accesses to residences and businesses in the immediate area. In general the preliminary TA concludes the impacts on the surrounding networks for all transport modes would be relatively small for a scheme of this size. All routes would still be accessible albeit subject to minor diversions.

7.2.6 A range of mitigation measures have been identified to mitigate these impacts. These include

- reducing the number of HGVs on the road network; and
- liaising with the local community and businesses.

7.2.7 The number of HGVs on the road network would be minimised through use of the river to transport construction materials and waste. The TA assumes a worst case scenario whereby all construction activities use the road network. It is estimated this would require approximately 226,800 HGV movements over the four year construction period. The Transport Assessment notes that use of river barges would reduce this number of construction-related HGV movements to approximately 48,800 over the four year construction period.

7.2.8 The TA describes how the Construction Management Plan (CMP) would set out a business engagement strategy to ensure that local businesses can be actively involved in minimising the impact of construction activities on their businesses.' In accordance with TfL's standard practice, all diversions and restrictions would be communicated to the local community and businesses in advance.

7.2.9 **Assessment:** Due to the potential for adverse effects on physical and mental health during the construction period the HIA classifies the sensitivity of the affected population as 'medium'.

7.2.10 The magnitude of the impact on car drivers and other users of motorised vehicles is considered to be 'low' as despite the relatively long period of potential disruption for some locations (four years), alternative routes are provided and HGV traffic is expected to be minimised by use of river transport. Minor diversions would be necessary but TfL would ensure that access for local residents and businesses is preserved. TfL would keep the local community and businesses informed about diversions and restrictions.

7.2.11 Taking all the above into account the HIA identifies the significance of effect as a **Minor Adverse** health impact on car drivers and other users of motorised vehicles. This impact is considered temporary as it relates only to the construction period.

Active travel: pedestrians and cyclists

7.2.12 Section 4.4 of the TA reviews the walking and cycling network. Further information and analysis is in the appendices to the TA:

- Appendix G of the TA refers to a Pedestrian Environment Review System (PERS) audit that was undertaken in a study area including the proposed sites of the two Silvertown Tunnel portals; and

- Appendix H of the TA provides the findings from a Cycling Level of Service (CLoS) assessment,

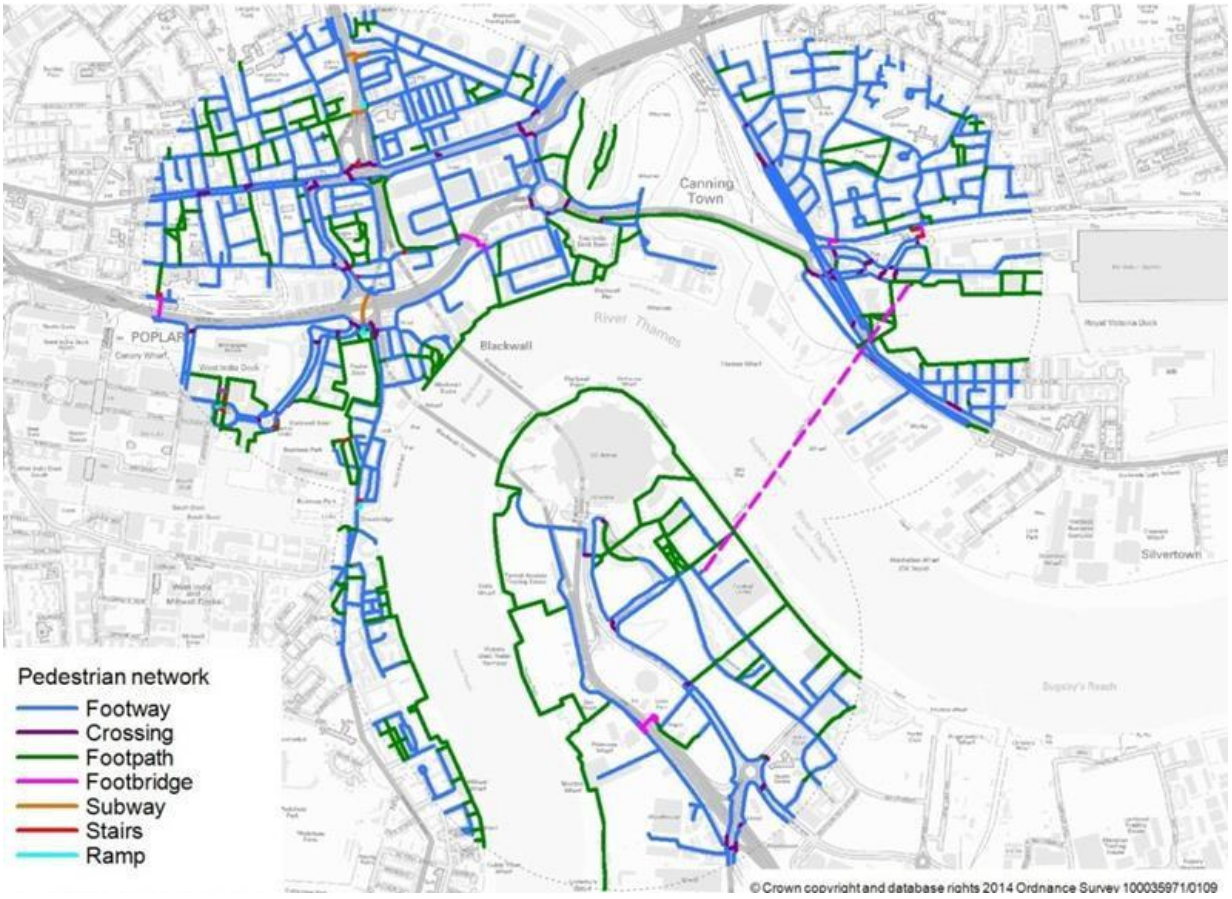
7.2.13 Walking: The current walking network up to 800 metres (or about a 10-minute walk) from the existing Blackwall and proposed Silvertown tunnel portals is shown in Figure 7-1, with the Emirates Air Line link shown in a dashed pink line.

7.2.14 The PERS audit was not conducted in the Blackwall Tunnel portals. It was conducted in the vicinity of the proposed Silvertown Tunnel portals. The PERS audit found some examples of pleasant environments that cater well for pedestrians. The audit also notes many opportunities for improvement:

> *'… the overall pedestrian environment in the vicinity of the site would benefit from the maintenance or installation of tactile paving and dropped kerbs. These improvements would potentially help people with mobility impairments (e.g. wheelchair users). In addition, footway surface could be improved by maintenance. For some links, permeability was negatively affected because of traffic volumes (especially HGV traffic) and guardrailing. Litter, debris (from moving HGV traffic) was also found to negatively impact the pedestrian environment. [Links to the] east of Silvertown Way and along Boord Street; Tunnel ; Avenue; and A2203 Blackwall Lane would benefit from better safety measures, especially CCTV and better lighting. The environment along these links is car dominated and hostile to pedestrians. [From PERS Audit Appendix G, Transport Assessment]'*

7.2.15 These opportunities for improvement relate to the design of the pedestrian environment and also to the way in which existing controls are enforced, for example even in areas noted as good by the audit there were parked cars encroaching in the pedestrian area.

Figure 7-1 Existing walking network within 800m of the Blackwall and proposed Silvertown tunnel portals



From Transport Assessment: *Local walking network* - OS Inegrated Transport Layer (ITN) 2014

7.2.16 **Cycling:** The CLoS assessment finds that cycling facilities and conditions for cycling vary considerably in the North Greenwich side of the study area and on the Silvertown side. On the Silvertown side there are some cycle tracks, shared use footways, Advanced Stop Lines (ASLs) and signed routes. However, on neither side of the river is the infrastructure for cycling of the standard specified in the London Cycling Design Standards (LCDS) (34) and the Mayor's 'Vision for Cycling' document (35). Levels of cycling are relatively low but cyclists are present: for example, the CLoS found that Dock Road, in Newham, appeared to attract a relatively high level of cycling.

7.2.17 The TA concludes the following in relation to active travel:

- Construction works would result in some disruption to pedestrians and cyclists due to route diversions and closures. Mitigation proposals are

planned to provide alternative access. Taking into account such mitigation it is concluded that impacts to pedestrians and cyclists are 'neutral' in effect. Some potential is noted for marginal benefits to active travel from improvements at Boord Street and Tidal Basin Roundabout.

- The TA includes a Scheme requirement for the Silvertown Tunnel to ensure that all pedestrian and cycling routes in the vicinity of the tunnel portals are re-instated or replaced with a direct, safe and comfortable alternative route. The TA specifically notes that the cycling infrastructure implemented around the northern portal at the Tidal Basin Roundabout would play a key role in ensuring cycle access is provided to the new residential and employment sites in the Royal Docks. TfL would ensure that safe and direct cycling routes between Canning Town, the Lower Lea Crossing and the Royal Docks are maintained.'

7.2.18 There are no direct benefits for pedestrians or cyclists from the Scheme. It is recognised nevertheless that construction activities should create the smallest possible disincentive to the use of active modes of travel such as walking and cycling.

7.2.19 **Assessment:** The number of pedestrians and cyclists using parts of the road network around the proposed Tunnel portal is estimated in the TA. The numbers are small in total and in comparison to motorised transport. This can increase the risk that any one pedestrian or cyclist faces from HGV and other traffic. It may also deter pedestrians and cyclists from using the road network that is affected by the construction traffic. The sensitivity of the affected population is thus classified as 'medium'.

7.2.20 The construction period would last for 4 years. As noted above the impacts of construction traffic on the local population are expected to be minimised by use of the river corridor. There would, nevertheless, be disruption to active travel and hazards from construction traffic (notably HGVs).

7.2.21 Collisions between HGVs and pedestrians and cyclists often result in death or serious injury. TfL would reduce the risk posed by construction traffic by ensuring that the road environment is safe for pedestrians and cyclists: this includes minimum road and pavement widths, provision for separate routes, where appropriate, and safe, clearly signalled pedestrian crossings. Consideration would be given to the condition of the surface of roads and pavements. This is important to minimise the potential for

collisions, and with regard to pedestrians, cyclists and other two-wheeled road users, to minimise the potential for falls.

7.2.22 TfL would ensure that walking and cycling routes around the tunnel portals (at Greenwich and Silvertown) during the construction phase ensure permeability through local areas to encourage active modes of travel by improving directness of routes. The environment would be safe for pedestrians and cyclists in order not to deter the use of these modes by current users. Links to public transport facilities would, at the minimum be maintained, but TfL would look to make improvements in this connectivity.

7.2.23 TfL would consider ways in which improvements can be made to the active travel environment around the tunnel portals during the construction phase. Consideration would be given both to travel across the river and lateral movement along its banks. During the construction phase the road network would:

- be repaired if damaged by construction traffic;
- be well lit;
- be signposted;
- be cleaned regularly;
- separate motorised and non-motorised travellers;
- give priority to non-motorised travellers; and
- allow lateral movement along the river.

7.2.24 On the basis of the implementation of this mitigation the preliminary HIA classifies the magnitude of the potential impact as ‘low’.

7.2.25 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA identifies the potential for a **Minor Adverse** significance of effect. This impact is temporary as it is relates only to the construction period. This score takes account of the mitigation proposed.

Active travel: Public transport

7.2.26 The TA concludes the following in relation to active travel: public transport construction impacts:

- The Silvertown Tunnel works would not impact upon the operation of DLR services or the Emirates Air Line. Although key public transport access routes would remain open for the duration of the construction works, there would be some minor disruption to bus services due to bus stop closures and diversions. The affected buses include the route 108 service which is the only cross river service in the area.
- During the construction phases, there would be some minor impacts on public transport users through the need to re-route buses and temporarily change access routes to North Greenwich interchange and to bus stops. The operation of North Greenwich bus station would not be affected. These impacts can be mitigated through a coordinated information campaign targeting the affected routes, stations and stops. TfL would employ its Travel Information communications channels to deliver this campaign.
- There is potential for disruptions to bus services and for some impact on pedestrian access routes to nearby stations. The chapter concludes overall that there is likely to be a 'neutral' significance of effect on public transport during construction.'

7.2.27 The frequency and reliability of local bus services, particularly route 108 for river crossings, would be important to maintain throughout the construction phase.

7.2.28 The following sections address the potential for further mitigation or enhancement of bus services around the tunnel portals during the construction phases.

7.2.29 Public transport is an important component of multi-modal transport choice. The availability and efficiency of public transport therefore has an important impact on decisions to engage in active travel (e.g. walking to and from bus stops). Public transport also provides important connectivity for those who do not own or use private vehicles. Within public transport some forms are more affordable, with more affluent users being able to pay a premium for an enhanced service or use of fast connections with limited capacity (e.g. commuter trains).

7.2.30 Due to road network disruption associated with development at the tunnel portals, bus services would be affected (e.g. bus stop relocation) by construction. There would be minimal impacts on other forms of public transport. Those in socio-economic groups who rely on the bus services rather than train or the EAL services are considered sensitive to these changes. Older members of the community who rely on public transport are also included in this group. Change during construction could have a disproportionate impact on access to public transport for older people in comparison to the general population.[2] The route 108 is the only cross river bus service in the area and is thus particularly sensitive to disruption. Taking this potential impact into consideration and considering the capacity of the population to adapt to the disruption (e.g. starting journeys earlier) the HIA classifies the sensitivity of the affected population as 'medium'.

7.2.31 Bus service disruption would be kept to a minimum (temporary changes to two bus stop locations) and a communications campaign would ensure local residents are informed well in advance of the changes. Despite the relatively long period of potential disruption for some locations (four years), alternative routes can be provided. The magnitude of the impact on bus public transport is therefore considered to be 'low'.

7.2.32 Based on the sensitivity of the affected population, the magnitude of the potential impact and taking into account the mitigation proposed as part of the Scheme, the HIA concludes that there is the potential for a **Minor Adverse** significance of effect caused by disruption to bus services. This effect is temporary as it relates only to the construction period.

7.2.33 **Table 7-1** summarises the health and well being impacts likely to be experienced by vehicle users, pedestrians and cyclists and public transport users during the construction of the Scheme.

[2] Table 5-5 on page 57 notes that across the host boroughs the concentration of older people is lower than the average for London. The Distributional Impact Assessment (para 2.3.5) observes that there is a relatively high concentration of older people close to the Silvertown Tunnel north portal.

Table 7-1 Road safety, accessibility and active travel: summary of construction health impacts

Receptor	Car and other vehicle road	Pedestrians and cyclists	Public transport users
Pathway	Road congestion and parking	Pedestrian and cycle path	Bus service disruption
Source of impact	HGV movements and route diversions	HGV movements and route diversions	HGV movements and route diversions
Sensitivity	Medium	Medium	Medium
Magnitude	Low	Low	Low
Significance	Minor adverse	Minor adverse	Minor adverse (temporary)
Further Mitigation	Committed strategies to preserve viable access for local residents and businesses dependant on road vehicle access around the portals.	Committed prioritisation of high quality, safe, well signposted active travel routes around the portals.	Ensure adequate communications campaign to inform residents of any changes and ensure no significant change in accessibility.

7.3 Operation: preliminary analysis

7.3.1 Based on data and analysis undertaken by TfL for the PEIR, the following sections set out the likely operational impacts for: road safety; pedestrians and cyclists; public transport; and car and other vehicle road users.

7.3.2 The preliminary TA notes that the operation of the Scheme would have few impacts on movement by pedestrians and cyclists, a moderate impact on public transport users, in particular bus users, and a major impact on road traffic.

7.3.3 The potential health effects of the charging policy that would be applied to the Silvertown and Blackwall tunnels are considered in the section *Changes to social cohesion and lifetime neighbourhoods* (on page 108).

Road safety: Summary

7.3.4 Road collisions[3] are associated with serious injury and fatalities as well as longer-term post-traumatic stress. The effects of a collision are visited upon those directly involved and upon their wider network of family and friends. The effects are both immediate and long-lasting. Road safety is not just about reported collisions. Use of active travel modes is suppressed due to fear of harm or injury in and around the highway due to the speed and volume of motorised traffic and its proximity to active travel users.

7.3.5 A Cost and Benefit to Accidents - Light Touch (COBA-LT) analysis was undertaken for the Scheme. The analysis takes into account the change in motorised traffic volumes due to the introduction of the additional tunnel at Silvertown and the increases in average motorised traffic speeds due to the improved queueing and merging system at Blackwall Tunnel. This uses accident records, forecast traffic flows (derived from River Crossings Highway Assignment Model (RXHAM)) and road types to calculate accident rates with the Scheme in place. As traffic volumes in the Assessed Case are forecast to reduce overall, the COBA-LT analysis found that the Scheme would be expected to have a marginal positive impact on accidents (equating to a reduction of 683 accidents over a 60 year period, or a reduction of 0.3% compared to the Reference Case).

7.3.6 The current design for the Silvertown Tunnel and the proposed junctions linking it to the road network on either side of the River Thames have been subject to a full Stage 1 Road Safety Audit. As part of this process a number of safety issues were identified and recommendations made for the purpose of maximising the road safety of the proposals. A further Road Safety Audit would be completed as the design of the Scheme is further developed.

[3] Unless reference is being made to another report or a study that uses the term *accident* this HIA uses the term *collision*.

7.3.7 The Distributional Impact Assessment conducted an analysis of casualty rates for a study area encompassing both proposed Tunnel portals. Table 7-2 shows the casualty rates within the impact area and across Great Britain as a whole for 2012, 2013 and 2014 combined and broken down into mode of transport and age of casualty. This is based on STATS19 casualty data. [4] During this period 502 accidents were recorded in the impact area, with a total of 633 casualties across all levels of severity.

Table 7-2 Casualty rates, 2012-2014 average

	Casualties	
Casualty type	**Impact area**	**Great Britain**
Pedestrians	10%	13%
Cyclists	6%	10%
Motorcyclists (rider or passenger)	20%	10%
Children aged 0-15	6%	9%
Young people aged 16-25	23%	*23%
Older people aged 70+	1%	*6%

* 2014 data for Road Casualties Great Britain is not currently available at this level of detail so this figure has been calculated based on 2012-2013 average

7.3.8 Pedestrians, cyclists, motorbike and scooter users are vulnerable highway users. The direct impact of the Scheme on the safety pedestrians and cyclists is considered low as the Blackwall Tunnel is not used by these groups; nor would they have access to the Silvertown Tunnel. Any increase in road collisions is therefore expected to be vehicle to vehicle. **Table 7-2** shows that there has been a high proportion of casualties for motorbike users. The sensitivity of this population is thus ‘high’.

7.3.9 The speed limit in the areas with the potential for an increase in road collisions is 30mph (48kph) and 40mph (64kph) on the A1020 Lower Lea Crossing. Severity of injury for all road users increases with the speed at

[4] Accidents reported to the police are recorded on a STATS19 form. These provide detailed statistics about the circumstances of personal injury road accidents. Boundary collisions have not been verified.

which the collision occurs (36). Limiting the speed of traffic on the A102 to 20mph (32kph) was suggested in the HIA/EqIA workshop where it was also noted that this could conflict with the A102's status as a trunk road. The COBA-LT analysis finds that the average speed on the road network in the host boroughs is expected to reduce between 2021 and 2041. [5] This would contribute to reducing the risk of serious injury. It should be noted that this is an average and thus vehicles would travel at higher speeds if so permitted; and it should also be noted that this was modelled across all of the three host boroughs and is thus not specific to the roads around the tunnels.

7.3.10 With the focus of collisions being predominantly on users of private motorised transport, and taking the findings of the COBA-LT analysis into account, the magnitude of the impact on road safety is 'low'. If the focus were expanded to include all users of the transport network the magnitude of the impact would increase.

7.3.11 Based on the sensitivity of the population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA identifies the potential for collisions to have a **Minor/Negligible** significance of effect for users of private motorised transport. This equates to the marginal positive score given by the COBA-LT analysis. .

7.3.12 This preliminary HIA conclusion is based on a precautionary approach.

Active travel: pedestrians and cyclists: Summary

7.3.13 Walking and cycling for transport purposes are key opportunities for physical activity, which is important for good health and wellbeing.

7.3.14 Although the proposed charging scheme at the Silvertown and Blackwall Tunnels could provide an incentive to use public transport, there is limited

[5] The average speed of traffic on the road network was modelled for a Reference Case and an Assessed Case for each of the AM and PM peaks and for the inter-peak (IP) hour (10:00-16:00). The traffic was found to move fastest during the IP slot and in this slot there will be a reduction from 35.9kph to 33.9kph. Modelling was conducted for years 2021, 2031 and 2041.

cross-river pedestrian and cyclist infrastructure to provide an efficient low cost alternative to the user charge.

7.3.15 There is currently considerable severance in the pedestrian and cycling networks in the vicinity of the proposed Silvertown Tunnel portals both north and south of the river. This is examined in the TA and the findings are summarised on pages 62-65 above. Although the Scheme would have no direct impact on cross river pedestrian and cyclist routes (the tunnel being an unsuitable environment for these modes of travel), the Scheme does aim to improve the pedestrian and cycle realm for lateral movement along both banks including to existing crossings for pedestrians and cyclists.

7.3.16 Existing lateral routes include the Cycle Superhighway 3 (on the north bank) and the Thames Path (on the south bank). Existing crossing options for pedestrians and dismounted cyclists include: the EAL; the Woolwich Ferry; the foot tunnels at Greenwich to the west and Woolwich to the east; DLR; and underground Jubilee Line (the latter two have restrictions relating to non-folded cycles).

7.3.17 With regard to pedestrian cross river movement, the main Scheme enhancement is linked to the potential to provide improved bus services. As discussed in the 'public transport' section of this chapter, the Scheme's enhancement of cross river bus services has an important active travel component (facilitating multi-modal travel, particularly walking).

7.3.18 With regard to improvements to pedestrian links in the areas around the tunnel portals, the main enhancements are to the footway/cycleway bridge at Boord Street. Other links and passive improvements are summarised in the Preliminary TA.

7.3.19 With regard to cross river cycle enhancement, the Scheme has no direct impact, although indirectly improved lateral movement along both banks should improve access to existing crossing options.

7.3.20 With regard to cycle network links around the tunnel portals, cyclists would benefit on the south bank from a new cycleway adjacent to the reconnected Tunnel Avenue and the improved footway/cycleway bridge at Boord Street. On the north bank, new cycleway provision would be provided adjacent to the carriageway at the modified Tidal Basin Roundabout with signal controlled Toucan crossing facilities proposed.

7.3.21 Given the forecast increase in the residential population in the neighbourhood of the tunnel portals, the impact of the Scheme on future travel choices for this population is important. The viability of transport choices are influenced by their 'availability', 'affordability' and 'efficiency (e.g. journey time)'. As one option is made more viable, so more people are likely to adopt that mode in preference to others. The improvements to the road network offered by the Scheme increases the 'availability' and 'efficiency' of crossing by motorised vehicle. This has the potential to promote car use over active travel options. To some extent the road network increase in 'availability' and 'efficiency' is balanced by the decrease in 'affordability' of car use due to the charging Scheme. Notably this should increase the viability of using bus services and the EAL as part of multi-modal active travel. The 'efficiency (journey time)' of these alternatives to car use would be an important factor in mode of travel decisions. Some consultees express concerns that the EAL is slow and/or inconvenient for cyclists (see 'effects on all travellers' chapter (Table 11.3)). The frequency of new and enhanced bus services is therefore likely to be a dominant factor in the attraction of cross river alternatives to private car use for future residents.

7.3.22 With regard to future resident use of existing direct pedestrian and cycle access for across the river (e.g. Greenwich and Woolwich foot tunnels), there is potential for some adverse impact from the operation of the Scheme on active travel decision making. To mitigate any such impact it would be important that the future residential developments in the vicinity of the the tunnel portals make strong links to existing pedestrian and cycle river-crossing facilities and incentivise active travel wherever possible. These links should be part of a shared long-term vision for area including the Scheme.

7.3.23 The current population in the local area is predominantly in the lower socio-economic groups. The local population can thus be considered vulnerable to adverse health, and other social effects of development. The semi-industrial character of the area is expected to change and to become residential. The HIA does not have information about the residents who would inhabit the new developments so, a precautionary approach suggests that the new population must also be considered vulnerable. Negative changes to the local environment tend to amplify existing health inequalities for low income groups. Older and less mobile groups, especially those without car access are likely to find the impact of the Scheme on their travel movements greater than those who are young and

more physically mobile. The HIA therefore classifies the sensitivity of the affected population as ‘high’.

7.3.24 The Scheme would include positive enhancements to the pedestrian and cyclist realm either side of each tunnel portal/the river. TfL would work with local boroughs to develop a shared long-term vision for active travel. It is vital that the modal choice for residents who would settle in the new developments should not be predetermined to vehicle use by the Scheme. The choice of travel should be an active mode.

7.3.25 It would be important to ensure that the design of the public realm and of future developments either side of the tunnel portals enables people to make short trips by foot or by bike. The built environment should be permeable for cyclists and pedestrians. In residential areas the presumption should be that, for local trips, the shortest journey can be made on foot (37). The intention is to make the environment attractive for people to use on foot or by bicycle. This would also mean ensuring that there are reasons for people to make these small journeys e.g. shops, post offices, schools etc. Much of this is not within the powers of TfL but TfL would take all reasonable steps to ensure that the boroughs would make the built environment surrounding the tunnel portals pedestrian and bicycle friendly. TfL would develop a shared long-term vision for active travel in the area with the boroughs to ensuring permeability for pedestrians and cyclists in future development surrounding the tunnel portals.

7.3.26 The magnitude of any change in active travel is considered ‘low’ as in isolation the Scheme currently has little impact on pedestrian and cyclist routes compared to improvements that facilitate road transport. It is noted that how the shared long-term vision for active travel in the area is developed would be important, particularly in promoting existing cross river active travel choices to future residents.

7.3.27 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA identifies the potential for a **negligible** significance of effect.

7.3.28 The Mayor’s Transport Strategy (MTS) (38) sets out a clear commitment to sustainable transport and a continued increase in public transport, walking and cycling mode share (Policy 11). In line with the MTS TfL and other organisations would provide additional active travel enhancements in the areas beyond the portals of the Scheme, and potentially other active travel crossings to the River Thames in the future. Schemes under

consideration include a Sustrans pedestrian and cycle bridge linking Canary wharf and Rotherhithe, and possible bridges at Gallions Reach and Belvedere to the east.

7.3.29 The HIA recommends that TfL, in developing the Scheme, works with the boroughs and those involved in planning the expected future residential developments (e.g. Knight Dragon) to develop the shared long-term vision. The vision should demonstrate how the Scheme can positively facilitate active travel through public transport links either side of the tunnel (notably the siting of bus stops and routes); as well as improved walkways and cycleways along the river and to surrounding current (and future) residential areas in both Greenwich and Silvertown.

Public transport

7.3.30 This section focuses on health impacts related to changes to bus services. Health impacts associated with other public transport services are expected to be negligible. The Scheme would improve resilience and road network performance around the Blackwall Tunnel for local bus services. This would improve both existing services, including the route 108 (the only cross river service in the area) and would create opportunities for new cross-river bus services to improve public transport links across east and south east London. PEIR Volume 1, Chapter 4 – Scheme Description states:

> *'The Silvertown Tunnel Scheme would create opportunities for new cross-river bus services to improve public transport links across south-east and east London, notably the growing employment areas in the Royal Docks and Canary Wharf. The Silvertown Tunnel is designed to accommodate double-deck buses, thus providing operational flexibility in the bus routes that could be extended across the Thames, as well as greater capacity.*
>
> *It is currently proposed that one lane in each direction would be reserved by buses and HGVs through the tunnel bores which would further enhance reliability and reduce bus journey times. This configuration has the potential, over time, to deliver in excess of 60 buses per hour in each direction*
>
> *However, since the Silvertown Tunnel has an assumed opening date of 2022/3, any plans for the bus network at this time can only be indicative and for the purpose of assessing operational*

feasibility. Services would be finalised around two years before opening, but TfL has identified two potential new services and enhancements to four existing services (predominantly though cross-river extensions).'

7.3.31 TfL are mindful of the new developments and the need to provide affordable journey options for people on lower incomes. The population reliant on bus services would include those on low incomes. For older residents, who may be mobility impaired, detailed design aspects are important, for example: access and egress onto public transport; the quality of the pedestrian route; and crossing times at signalled crossings. Population sensitivity in relation to operational public transport changes is considered 'medium'.

7.3.32 The Scheme has the potential to improve public transport bus services, particularly cross river accessibility, for those with low incomes. There may also be benefits for physical activity through increased multi-modal travel (e.g. walking to and from bus stops). The magnitude of the likely impact is therefore considered 'medium'.

7.3.33 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA identifies the potential for a **Moderate positive** significance of effect. This score should not preclude the opportunity for further enhancement measures, particularly demonstrating how the Scheme can maximise links between bus services using the tunnel and active travel. For example safe, accessible bus stops at both portals that have high quality pedestrian links and signposting to surrounding current (and future) residential areas.

Car and other vehicle road users

7.3.34 Based on the current results the preliminary TA notes that the Silvertown Tunnel would have a positive impact on road users through improved resilience due to fewer incidents disrupting traffic flows, as well as improved mitigation and new diversionary routes in the event of an incident causing congestion. Journey times through the Blackwall Tunnel in peak periods and peak directions would be reduced by around 20 minutes, leading to improved connectivity for residents and businesses in east and southeast London.

7.3.35 The TA also states that the provision of reliable journey times for freight on the strategic road network is one of the objectives of the Silvertown Tunnel. However, appropriate mitigation is required to ensure that any increase in goods vehicle traffic does not adversely impact upon local residential streets.

7.3.36 As with construction impacts the HIA notes that whilst promotion of more active or multi-modal forms of travel is generally desirable, for some people with limited mobility car use may be appropriate and should be facilitated. For this population reduced journey times could have positive impacts, particularly where this increases opportunities to access health improving service or markets (e.g. affordable healthy food or physical activity opportunities). For local businesses private vehicle transport by suppliers and clients may also be the only viable mode of transport, access improvements may therefore directly and indirectly benefit local economic activity. Taking these potential impacts into consideration the HIA classifies the sensitivity of the affected population as 'low'.[6]

7.3.37 The TA concludes that congestion in and approaching the Blackwall Tunnel is virtually eliminated by the Scheme. The Scheme (including the role of the charging policy in avoiding induced traffic) is likely to produce real and persistent benefits for motorised road user accessibility. The magnitude of the impact is therefore considered to be 'medium'.

7.3.38 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA identifies the significance of effect to be **Minor Positive**. This score should not preclude the opportunity for further enhancement measures, particularly enabling the Scheme to maximise accessibility for those people reliant on car travel due to low incomes or access deprivation:

[6] The population is considered less sensitive to operational impacts as people will be able to change; construction impacts are more abrupt and which are more likely to force a change in current activity or behaviour.

Summary

7.3.39 **Table 7-3** below summarises the operational health impacts of the Scheme for health and wellbeing.

Limitations and uncertainty

7.3.40 The preliminary HIA analysis is based on limited information. Further modelling of motorised traffic and transport behaviour and impacts is being undertaken and would inform the revised HIA analysis at the DCO stage. Further data regarding walking and cycling has been requested. At the preliminary HIA analysis stage it is noted that road safety modelling for the construction phase is not available.

Table 7-3 Road safety, accessibility and active travel: summary of operational health impacts

Receptor	Road safety	Pedestrians and cyclists	Public transport	Car and other vehicle road users
Pathway	Increased number and severity of road traffic collisions	Active travel routes	Greater accessibility for those with low incomes	Greater accessibility for those reliant on road travel
Source	Increased average traffic speed at Blackwall Tunnel	Some enhancement of routes around portals, but very limited cross river improvement	Improved current and future bus services	Improved cross river road access
Sensitivity	Medium	High	Medium	Low
Magnitude	Low	Low	Medium	Medium
Significance	Minor/negligible	Negligible	Moderate positive	Minor positive
Further Mitigation	Improved road safety around the approaches to the Blackwall tunnel	A long-term vision for active travel in the area, including links with future residential developments and existing active travel river crossing options	Bus stops at portals with active travel links to current (and future) residential areas.	Support for those on low incomes.

8. CHANGES TO LOCAL AIR QUALITY (INCLUDING DUST EMISSIONS)

8.1 Introduction

8.1.1 This section of the HIA considers changes to local air quality (including dust emissions). This issue links with Volume 1 of the Preliminary Environmental Information Report (PEIR), Chapter 6 -Air Quality, which focuses on the operational assessment of NO_2, PM_{10} and $PM_{2.5}$. The PEIR air quality chapter notes that construction impacts, in relation to construction traffic movements and dust would be reported in the ES.

8.1.2 The HIA preliminary analysis is based on professional judgement considering the interim operational air quality modelling that is available. Further HIA air quality analysis will be included in the DCO application full HIA.

8.1.3 The following Source-Pathway-Receptor model summarises the relation between air quality and health.

- **Source**: vehicle and plant machinery emissions, (including dust of both non-respirable and respirable size). Production may include combustion, wear and disturbance of exposed substrates into aerosols.
- **Pathway**: pollutant gases and dust particulates may travel through the atmosphere. Those that are respirable (can be inhaled deep into the lungs) may be absorbed by the body and have toxicological effects. Particles of non-respirable size may precipitate causing nuisance.
- **Receptor**: Local populations living, working, learning or playing within the area of effect of the change in air quality. Also owners (or users) of property affected by high levels of dust deposition.

8.1.4 The air quality assessment is split into the construction phase and operational phase.

- **Construction**: As no supporting air quality modelling is currently available the HIA only provides limited consideration as this stage.
- **Operation**: The Scheme would create an additional river crossing for traffic and it is expected to reduce the traffic using the Blackwall Tunnel. Emissions to air are expected to change in the vicinity of the new tunnel. Sources may include traffic as well as ventilation plant.

8.1.5 The HIA considers how the projects emissions profile compares to the World Health Organization (WHO) air quality guide (39) thresholds, which are in some cases more stringent than the statutory UK Air Quality Objective limits. The HIA discussion of WHO values is appropriate because air quality is a key determinant of health.[7]

8.1.6 The HIA is clear that whilst it is desirable to achieve WHO levels where possible, it should be acknowledged that in many cases this is not possible. The reason being that in built-up areas the baseline is likely to be approaching, or be in excess of, these values. Even with the use of BAT WHO levels may therefore not be achievable at the present time. For this reason the HIA considers WHO levels to be important future targets, rather than current requirements.

8.1.7 The HIA recommends that the air quality monitoring strategy for the Scheme includes data collection metrics for relevant chemicals, particle sizes and periods, such that regulators, EHOs and local public health teams can compare emission levels to WHO guide values as well as UK Air Quality Objective limit values.

8.2 Construction: preliminary analysis

8.2.1 The HIA notes the important impacts of nitrogen dioxide (NO_2) and fine particulate matter (PM_{10} and $PM_{2.5}$) on health outcomes. During the construction phase of the Scheme the disturbance of materials and wastes and the use of vehicles and plant would contribute to reduced air quality.

8.2.2 Within the immediate area around the northern Silvertown Tunnel portal (west of the A1011 and south of the A1020) there are few sensitive receptors. Similarly immediately around the southern Silvertown Tunnel portal (north of John Harrison Way) there are also few sensitive receptors. One exception is Ravensbourne College which as around 2,400 students

[7] E.g. The World Health Assembly has passed a resolution calling for reduction of air pollution – see http://bit.ly/1HO246j.

engaged in pre-degree, undergraduate and postgraduate courses[8]. Although residential development is expected in these areas, currently the immediate areas around both Silvertown Tunnel portals are predominantly in light industrial usage. Exposure is therefore predominantly to a less vulnerable population (i.e. predominantly to people working on the Scheme or in neighbouring light industrial settings). Those traveling through the area of air quality impacts are considered to have very limited exposure.

8.2.3 Beyond the immediate vicinity of the tunnel portals on both banks of the Thames the sensitivity of the potentially affected population increases. On the north bank of the Thames there are residential areas to the north east near Bowman Avenue, to the east (the Hoola development) and south east near Hanover Avenue. There is also a school (Faraday School) to the north west. On the south bank of the Thames there are residential areas to the south of John Harrison Way Greenwich, including the Peninsula NHS General Practice and Millennium Village School. Although air quality modelling has yet to be completed for construction impacts, for these more distant areas it would be expected that dispersal would greatly reduce the potential for health impacts.

8.2.4 Relevant to the sensitivity of all receptors are the baseline air quality conditions in relation to UK Air Quality Objectives and WHO guide values. The PEIR Chapter 6 -Air Quality baseline data indicates that:

- There were widespread exceedances of the UK Air Quality Objective annual mean NO_2 limit value (40µg/m³) across the study area in 2014, and that concentrations were above 50µg/m³ at multiple sites, which suggests that the hourly NO_2 objective could be exceeded at these sites. The data in PEIR Chapter 6 -Air Quality Table 6-9 indicates WHO guide values would also be exceeded for both annual average and hourly objectives.

[8] Ravensbourne Collage has around 2,400 students engaged in pre-degree, undergraduate and postgraduate courses. Being predominantly an adult population there is considered less vulnerability than for younger age groups who are more sensitive to air quality impacts due to their developmental stage.

- Concentrations of PM_{10} were generally below annual mean objectives between 2012 and 2014, however the 24 hour UK Air Quality Objectives was exceeded by multiple sites. However the data in PEIR Chapter 6 -Air Quality Table 6-10 indicates the WHO guide value would be exceeded for both annual average and hourly objectives.
- Concentrations of $PM_{2.5}$ were below the UK Air Quality Objective annual mean between 2012 and 2014 for all site locations. However the data in PEIR Chapter 6 -Air Quality Table 6-11 suggests the WHO guide value would be exceeded.

8.2.5 The elevated baseline levels of both nitrogen dioxide and fine particulate matter suggest the potential for adverse effects from further contributions to these concentrations, particularly for vulnerable groups. The progression of baseline air quality levels towards, or into excess of, WHO guideline (non-statutory) values for air pollutants should be of concern.

8.2.6 The HIA considers at this stage that the sensitivity of those exposed to construction air quality impacts is likely to be limited but that due to current uncertainties a precautionary scoring of ‘medium’ is appropriate.

8.2.7 It is noted that as much of the construction activities would be below ground level and the portal construction elevations are relatively low, the potential for wide dispersal of air pollutants is reduced. This reduces the area of impacts, but may increase the severity of impacts within this smaller area.

8.2.8 The use of river transport is considered important. As with the Road Safety, Accessibility and Active Transport section of this report, the preliminary HIA analysis assumes that river transport would be used for the bulk of excavated materials. This assumption greatly reduces the HGV air pollutant exposure levels to vulnerable populations along the road haul route. River corridor transport has the benefit of fewer proximal sensitive receptors and lower baseline levels of air pollutants (being in a relatively more open and less traffic dense context than road routes).

8.2.9 At this preliminary analysis stage the air quality modelling for the Scheme has not been sufficiently advanced for the HIA to undertake a comparison between predicted construction air quality impacts and WHO guide values. Such an analysis would be undertaken for the main DCO application HIA report. The following conclusion is therefore based on the expected outcomes based on professional judgement.

8.2.10 Based on the assumption that the construction emissions would be predominantly from standard plant and vehicle sources and that standard good practice mitigation would be adopted, the magnitude of the air quality impact from construction activities at this stage is expected to be 'low'. This assumes that the tunnel boring machinery would not have a major contribution to emissions and that the use of river barges would greatly reduce construction road transport.

8.2.11 As supporting air quality modelling is not available at this stage it is considered inappropriate to reach a definitive decision on significance. A definitive judgement would be made in the full HIA accompanying the DCO application when the air quality modelling has been undertaken.

8.2.12 Although significance cannot be determined at this stage the impact would be temporary as it is relates to the construction period and the following mitigation and enhancement measures are expected to apply:

- data collection metrics for relevant chemicals, particle sizes and periods, such that regulators, EHOs and local public health teams can compare the Scheme's construction emission levels to WHO guide values as well as UK Air Quality Objective limit values;
- a mechanism for responding to community concerns about dust and other air pollution from the Scheme; and
- link the Scheme's air quality monitoring to a public alert system and promote this service to the population of the air quality study area. For example the 'airTEXT'[9] service uses the ADMS-Urban air pollution model, which has inputs from approximately 30,000 pollution sources across London, to provide a public forecasting and alert system. Subscribing to the service is free and provides automated air pollution alerts and health bulletins which are particularly relevant to people vulnerable to air pollution.

[9] http://www.airtext.info/

Summary

8.2.13 **Table 8-1** summarises the construction impacts for health and wellbeing.

Table 8-1 Local air quality: summary of construction health impacts

Receptor	Population within the air quality study area
Pathway	Airborne transmission of pollutants, with both respiratory and nuisance impacts
Source	Emissions from: vehicles and plant; or disturbance of materials or waste
Sensitivity	Medium
Magnitude	Low (likely in most cases to be a slight deterioration in air quality, a few receptors may experience greater impacts)
Significance	N/A see above
Further Mitigation	Committed mechanism for monitoring air emissions from the Scheme in a way that allows comparison to WHO threshold values (not a commitment to achieve these values); and a committed mechanism for responding to community concerns on air quality impacts

8.3 Operation: preliminary analysis

8.3.1 This section focuses on the air quality impacts as a result of road transport distribution changes. Changes in air quality for motorists as a result of the Silvertown Tunnel atmosphere (compared to using the Blackwall tunnel) would be considered at the DCO application stage once further air quality modelling is available. Similarly changes in air quality for residential receptors as a result of tunnel ventilation are considered at that later stage. See the PEIR air quality chapter for further detail on these issues.

8.3.2 Due to the use of the charging Scheme, the operation of the Silvertown Tunnel is not expected to result in an increase in road traffic in this part of London. As a result the Scheme would redistribute current levels of road transport air pollution. Changes in air quality are partly as a result of improved traffic flows (i.e. less stationary traffic) and partly due to the diversion of road traffic through the Silvertown Tunnel. The main changes are expected to be associated with less traffic, and therefore improved air quality, at the Blackwall tunnel approaches; and more traffic, and therefore reduced air quality, at the Silvertown Tunnel approaches. The charging Scheme may also act to deter a proportion of road transport away from both the Blackwall and Silvertown Tunnels to other river crossings. The impacts on air quality levels at or approaching river crossings other than the Blackwall and Silvertown Tunnels are not

considered in detail in this HIA analysis as a charging level has been used in the PEIR modelling of transport impacts which suggests that there would not be impacts beyond the immediate vicinity of the Silvertown and Blackwall Tunnels. Improvements to bus routes due to the Scheme may also increase public transport use, reducing private car related emissions.

8.3.3 There are existing residential areas close to the approaches to the Blackwall tunnel on the northern bank of the Thames. There are fewer existing receptors close to the southern approach to the Blackwall tunnel, however in both locations future residential developments are planned. A similar receptor context applies to the northern and southern approaches to the Silvertown tunnel, although with existing residential areas at a greater distance from the tunnel portals. PEIR Chapter 6 -Air Quality Figure 6.5J summarises for this area the existing and future receptors likely to experience the greatest changes in air pollution. Due to future developments he proximity of residents to the Scheme is expected to be greater than is shown by current maps and area population statistics. This new residential population can be expected to include potentially vulnerable groups such as children, the elderly and those with existing respiratory conditions. As with construction impacts the baseline conditions show nitrogen dioxide concentration of concern to both UK Air Quality Objectives and WHO guide values; as well as levels of fine particulate matter that would be of concern from the perspective of WHO guide values, but not UK Air Quality Objectives. Given there is a degree of uncertainty about the demographic profile of this future population that would be in close proximity to changes in air pollution levels at both tunnels, on a precautionary basis, the sensitivity of this population is expected to be ‘medium’.

8.3.4 At this preliminary analysis stage the air quality modelling for the operation of the Scheme has not been sufficiently advanced for the HIA to undertake a detailed comparison with WHO guide values. Such an analysis would be undertaken for the main DCO application HIA report. The following conclusion is therefore based on the expected outcomes based on professional judgement.

8.3.5 The implementation of the Scheme is predicted to result in both improvements and deterioration in air quality at worst case receptors. In general there are more receptors where concentrations of NO_2, PM_{10} and $PM_{2.5}$ are predicted to decrease than receptors where concentrations are predicted to increase. The PEIR air quality chapter notes that a definitive judgement was not made in terms of the overall significance of the

Scheme in the operational phase as all receptors will need to be modelled that exceed UK Air Quality Objectives in line with the current guidance.

8.3.6 A definitive judgement on significance would be made when the air quality modelling has been updated.

8.3.7 Based on professional judgement the changes in air quality as a result of distribution of road transport, particularly due to displacement of vehicles from the Blackwall tunnel to the Silvertown Tunnel, is likely to result in a slight improvement in air quality around the approaches to the Blackwall tunnel and a slight decline in air quality around the approaches to the Silvertown Tunnel.

8.3.8 The PEIR assesses the overall magnitude of change in air quality impact from the operation of the Scheme as 'low'. However, a net positive impact is expected: the number of modelled receptors where concentrations of NO_2, PM10 and PM2.5 are predicted to decrease is higher than the number of modelled receptors where concentrations are predicted to increase. Further assessment will be undertaken in relation to the levels of exposure that people are predicted to experience during construction and operation.

8.3.9 The larger changes in air quality tend to be improvements and these improvements are generally where the baseline air quality is at its worst. Where air quality levels are reduced, these changes are generally in areas with existing low baseline levels of NO_2. In almost all cases these areas remain below the WHO guide values for NO_2.

8.3.10 The available modelling indicates that for a few receptors greater impacts may be experienced. The design of the future developments, particularly the location of opening windows and intake air vents is considered important in minimising the potential for adverse impacts. For example the largest deterioration in air quality is predicted at the ground floors of the Hoola development (FD9) next to the Silvertown roundabout (linking Silvertown Way, Tidal Basin Road and Lower Lea crossing) where there is a predicted increase of 4.9 $\mu g/m^3$ annual mean NO_2 with the implementation of the Scheme. The development is located near to the northern portals of the proposed Silvertown Tunnel. The Hoola development is currently the nearest receptor to the northern portal of the tunnel and the associated roundabout infrastructure and is therefore subject to the largest change in traffic.

8.3.11 As with the PEIR air quality chapter it is considered inappropriate based on the limited current modelling to reach a definitive decision on significance at this stage. A definitive judgement would be made in the full HIA accompanying the DCO application when the air quality modelling has been updated.

8.3.12 Mitigation should include a committed mechanism for monitoring air emissions from the Scheme in a way that allows comparison to WHO threshold values (not a commitment to achieve these values). This information should be made available to inform the design and siting of future developments.

Summary

8.3.13 Table 8-2 summarises the operational impacts for health and wellbeing.

Table 8-2 Local air quality: summary of operational health impacts

Receptor	Population in the area around the approaches to the Blackwall tunnel	Population in the area around the approaches to the Silvertown Tunnel
Pathway	Airborne transmission of pollutants	Airborne transmission of pollutants
Source	Emissions from vehicles using the approaches to the Blackwall tunnel	Emissions from vehicles using the approaches to the Silvertown Tunnel
Sensitivity	Medium	Medium
Magnitude	Low (likely in most cases to be a slight improvement in air quality, a few receptors may experience greater impacts)	Low (likely in most cases to be a slight deterioration in air quality, a few receptors may experience greater impacts)
Significance	N/A see above	N/A see above
Further Mitigation	Committed mechanism for monitoring air emissions from the Scheme in a way that allows comparison to WHO threshold values (not a commitment to achieve these values). This information should be made available to inform the design and siting of future developments.	Committed mechanism for monitoring air emissions from the Scheme in a way that allows comparison to WHO threshold values (not a commitment to achieve these values). This information should be made available to inform the design and siting of future developments.

Limitations and uncertainty

8.3.14 The preliminary HIA analysis has been based on professional judgement given limited information. Further modelling of air quality impacts is being carried out and this chapter would be updated when this is received.

9. CHANGES IN NOISE

9.1 Introduction

9.1.1 This section of the HIA considers changes to noise (including vibration). This issue links with the Preliminary Environmental Information Report (PEIR) chapter on noise and vibration.

9.1.2 This preliminary analysis is based on professional judgement considering the interim noise and vibration modelling that has been undertaken at this stage. Further noise and vibration modelling and analysis would be available for the DCO application full HIA.

9.1.3 The following Source-Pathway-Receptor model summarises the relation between noise / vibration and health.

- **Source**: Noise or vibration generated from construction and operational activities may cause a disturbance;
- **Pathway**: Noise disturbance propagates as a sound pressure wave through the air, to surrounding receptors. Noise may propagate for considerable distances across bodies of water with low dissipation. Vibration disturbance propagates as a pressure wave, predominantly structure-borne or through the ground, to surrounding receptors. Vibration may exacerbate noise impacts; and
- **Receptor**: Local populations living, working, learning or playing within the area of effect of the change in construction and operational noise or vibration. People who spend extended periods (residential or work) close to the source are likely to experience greater disturbance levels. Night time residential exposures to elevated noise levels are generally associated with greater health effects than the equivalent daytime levels.

9.1.4 The noise assessment is split into the construction phase and operational phase.

- **Construction**: Consideration of noise and vibration effects arising from construction plant, piling and vehicles (including vessels); and
- **Operation**: The Scheme would create an additional river crossing for traffic and it is expected to reduce the traffic using the Blackwall Tunnel. Noise and vibration are expected to increase in the vicinity of the new tunnel. Sources may include traffic as well as ventilation plant.

9.2 Preliminary analysis

9.2.1 The full HIA would consider how the projects emissions profile compares to the World Health Organization (WHO) noise guide thresholds (40,41), which are in some cases more stringent than limits set by the Environment Agency Horizontal Guidance (42,43), or British Standards (44-46).

9.2.2 The HIA is clear that whilst it is desirable to achieve the WHO levels this is not possible in many cases. In built-up areas the baseline is likely to be approaching, or be in excess of, these values. Even with the use of BAT WHO levels may therefore not be achievable. For this reason the HIA considers WHO levels to be important future targets, rather than current requirements.

9.2.3 The PEIR noise and vibration chapter defines the terms Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL) with reference to the WHO guide values. These terms are a useful adjustment to the PEIR's primary use of the BS 5228-1 ABC noise methodology which analyses changes relative to baseline levels rather than absolute values. The ABC method allows for changes that exceed WHO levels to be considered negligible where those WHO thresholds are already greatly exceeded by background levels. This is a pragmatic approach for, as noted above, WHO levels in this context must be viewed as aspirational. However contextualising any exceedance is also useful. The use of the terms LOAEL and SOAEL are therefore welcome. More detailed analysis in relation to LOAEL and SOAEL would be provided in the full HIA for the DCO application.

Construction: noise

9.2.4 Excessive or persistent noise exposure can have a detrimental effect on health. Noise disturbance is particularly detrimental if it interferes with sleep. Intrusive traffic noise can make streets less conducive for social interactions. Noise can also effect learning for both children and adults. The use of plant and vehicles during the Scheme's construction phase would increase noise levels around both tunnel approaches and around construction staging areas.

9.2.5 Within the immediate area around the northern Silvertown Tunnel portal (west of the A1011 and south of the A1020) there are few sensitive receptors. Similarly immediately around the southern Silvertown Tunnel portal (north of John Harrison Way) there are also few sensitive receptors.

One exception is Ravensbourne College which as around 2,400 students engaged in pre-degree, undergraduate and postgraduate courses. PEIR noise and vibration chapter 14.4 summarises, for the areas around the tunnel portals, sensitive non-residential receptors. The immediate areas around both Silvertown tunnel portals can be characterised as being in predominantly light industrial usage. Exposure is therefore predominantly to a less vulnerable population (i.e. predominantly to people working on the Scheme or in neighbouring light industrial settings). Those traveling through the area of air quality impacts are considered to have very limited exposure.

9.2.6 Beyond the immediate vicinity of the tunnel portals on both banks of the Thames the sensitivity of the potentially affected population increases. The noise and vibration modelling undertaken at this stage shows that at this greater distance noise impacts are reduced. However for a few receptors there may be concerns. Such receptors include:

- On the north bank of the Thames: dwellings to the north east near Bowman Avenue; Faraday School to the north west; the Hoola development (currently under construction) immediately east; and dwellings to the south east near Hanover Avenue.
- On the south bank of the Thames: Ravensbourne Collage to the north; and to the south of John Harrison Way Greenwich Peninsula NHS General Practice, Millennium Village School and residential areas.

9.2.7 The HIA considers at this stage that the sensitivity of those exposed to construction noise impacts is likely to be limited but that due to current uncertainties a precautionary scoring of ‘medium’ is appropriate.

9.2.8 PEIR noise and vibration chapter Appendix 14.A Plates 1-21 provide a visual representation of daytime noise contours through the construction period. These show that the greatest noise impacts are restricted to areas with very few sensitive receptors. The PEIR noise assessment examine potential impacts and concludes that no sensitive receptors would experience increases in daytime noise levels that would be considered significant in terms of BS 5228 construction noise guidance criteria (see PEIR noise and vibration chapter Table 14-19). At this stage the PEIR noise and vibration assessment has not modelled night-time construction impacts. Such modelling would be undertaken once data is available and results of that analysis would be discussed in the full HIA for the DCO application.

9.2.9 The HIA notes that a large (although relatively modest number, due to largely non-residential surrounding land uses) of sensitive receptors may experience levels above the general daytime WHO recommended noise level of 55 dB LAeq as a result of the Scheme. This number is estimated to be approximately:

- On the north bank of the Thames: 150 dwellings in the north east near Bowman Avenue; approximately 360 dwellings of the Hoola development (due to be completed in 2016); and approximately a further 150 dwellings in the south east near Hanover Avenue (largely comprising the flats of Western Beach Apartments).
- On the south bank of the Thames: 50 dwellings and Millennium Village School on John Harrison Way.

9.2.10 However these exceedances must be considered in the context of existing high background noise levels as indicated by PEIR noise and vibration chapter Table 14-17 for daytime noise and Table 14-18 for nigh time noise. In this context the perceived changes due to the Scheme are expected to be far less than in a context of low background noise levels.

9.2.11 For 11 receptors, as noted in PEIR noise and vibration chapter Table 14-19, noise levels would be considerably above WHO recommended levels with the greatest impact at the Hoola development experiencing 67.6 dBLAeq.

9.2.12 The use of river transport is considered important. As with the Road Safety, Accessibility and Active Transport section of this report, the preliminary HIA analysis assumes that river transport would be used for the bulk of excavated materials. This assumption greatly reduces the HGV noise exposure levels to vulnerable populations along the road haul route. River corridor transport has the benefit of fewer proximal sensitive receptors and lower baseline noise levels (being in a relatively more open and less traffic dense context than road routes).

9.2.13 At this preliminary analysis stage the noise and vibration modelling for the Scheme has not been sufficiently advanced for the HIA to undertake a detailed comparison with WHO guide values. Such an analysis would be undertaken for the main DCO application HIA report. The following conclusion is therefore based on the expected outcomes based on professional judgement.

9.2.14 Based on the assumption that the construction noise would be predominantly from standard plant and vehicle sources and that standard good practice mitigation would be adopted, the magnitude of the noise impact from construction activities is considered ‘medium’. This assumes that the tunnel boring machinery would not have major contribution to noise levels or a distinctive character that would clearly distinguish it from background noise. It also assumes that the use of river barges would greatly reduce construction road transport, and therefore vehicle noise impacts.

9.2.15 It is noted that at this stage construction night-time noise impact modelling is not sufficiently advanced to feed into the preliminary HIA assessment. It is assumed that noise from any night time working activities would not result in the exceedance of WHO night time noise guidelines of 40 dB Lnight outside (40).

9.2.16 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA expects construction noise to be associated with a **Moderate Adverse** significance of effect.

9.2.17 This impact is temporary as it is relates to the construction period. This score should prompt the consideration of further mitigation and enhancement measures, particularly around how the Scheme can include:

- data collection metrics for relevant intervals and periods, such that regulators, EHOs and local public health teams can compare noise levels to WHO guide values as well as Environment Agency Horizontal Guidance and British Standards limit values; and
- a mechanism for responding to community concerns about construction noise from the Scheme.

Construction: vibration

9.2.18 Vibrations transmitted from construction activities to residential receptors can cause anxiety as well as annoyance, and can disturb sleep, work or leisure activities. The construction of the Scheme includes the use of techniques including piling, excavation and material loading/unloading that could cause vibration impacts. Such impact are likely to have short transmission distances, limiting the number of receptors potentially affected.

9.2.19 Within the area described by the PEIR vibration assessment there are few sensitive receptors. This area is predominantly light industrial. Vibration is therefore unlikely to affect sensitive medical equipment or be a source of annoyance impacting sleep disturbance or learning.

9.2.20 Exposure is therefore predominantly to a less vulnerable population (i.e. predominantly to people working on the Scheme or in neighbouring light industrial settings). Those traveling through the area of vibration impacts are considered to have very limited exposure. The HIA therefore classifies the sensitivity of those exposed to construction vibration impacts as 'low'.

9.2.21 The potential for vibration impacts to propagate is in part dependant on the local geology. The site of the Scheme is broadly characterised as including layers of alluvial clay and London clay (47). Clay deposits have relatively high propensity for vibration propagation.

9.2.22 The preliminary analysis by the PEIR noise and vibration chapter indicates that very few construction activities would result in perceptible vibration impacts and where impacts do occur these are likely to be slight and temporary. On this basis the magnitude of the vibration impact from construction activities are expected to be 'low'.

9.2.23 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA expects construction vibration to be associated with a **Negligible** significance of effect.

9.2.24 Such a 'negligible' impact score equates to the impact being considered 'not-significant' in HIA terms for the Scheme. However this score should not preclude the inclusion of robust mitigation, including plant selection and operating practices, to minimise the potential for vibration impacts. The Scheme should also include monitoring specifically for low frequency 'hum' impacts in the range of 10Hz to 200Hz. Such 'hum' impacts can cause persistent annoyance but may not be measurable using A-weighted levels. Tunnel excavation is a potential source of such low frequency vibration.

Summary

9.2.25 The HIA recommends that the noise monitoring strategy for the Scheme includes data collection metrics for relevant intervals and periods, such that regulators, EHOs and local public health teams can compare noise

levels to WHO guide values as well as Environment Agency Horizontal Guidance and British Standards limit values.

9.2.26 **Table 9-1** summarises the construction impacts for health and wellbeing.

Table 9-1 Noise: summary of construction health impacts

Receptor	Population within the noise study area	Population and medical equipment within the vibration study area
Pathway	Airborne transmission of noise	Ground and structure borne transmission of vibration
Source	Noise from: vehicles and plant; or movement of materials or waste	Vibration from plant; or loading/unloading activities
Sensitivity	Medium	Low
Magnitude	Medium	Low
Significance	Moderate adverse (temporary)	Negligible
Further Mitigation	Committed mechanism for monitoring noise from the Scheme in a way that allows comparison to WHO threshold values; and a committed mechanism for responding to community concerns on noise impacts	Committed plant selection and operating practices to minimise the potential for vibration impacts; and monitoring for low frequency 'hum' impacts in the range of 10Hz to 200Hz.

9.3 Operation: preliminary analysis

Noise

9.3.1 Due to the use of the charging Scheme, the operation of the Silvertown Tunnel is not expected to result in an increase in road traffic in this part of London. As a result the Scheme would redistribute current levels of road transport noise. The main changes are expected to be associated with less traffic, and therefore reduced noise, at the Blackwall tunnel approaches; and more traffic, and therefore increased noise, at the Silvertown Tunnel approaches. The charging Scheme may also act to deter a proportion of road transport away from both the Blackwall and Silvertown Tunnels to other river crossings. The impacts on noise levels at or approaching river crossings other than the Blackwall and Silvertown

Tunnels are not considered in detail in this HIA analysis as a charging level has been used in the PEIR modelling of transport impacts which suggests that there would not be impacts beyond the immediate vicinity of the Silvertown and Blackwall Tunnels. Improvements to bus routes due to the Scheme may also increase public transport use, reducing private car related noise emissions.

9.3.2 Although not part of the Scheme, the operation of the Silvertown tunnel is expected to be accompanied by an increase in residential development in the areas surrounding both the Silver Town and the Blackwall Tunnel portals. The future proximity of residents during operation of the Scheme can therefore be expected to be greater than is shown by current maps and area population statistics. The potaotintial cumulative impact of the Scheme with neighbouring developments is discussed in Chapter 17 of the PEIR – cumulative Effects. As with air quality impact, this new residential population can be expected to include groups potentially vulnerable to noise impacts such as children, the elderly, those with chronic illnesses, or shift workers. Given there is a degree of uncertainty about the demographic profile of this future population, on a precautionary basis, sensitivity of this population at this stage is expected to be ‘medium’.

9.3.3 The PEIR noise and vibration chapter modelling indicates that there would generally be negligible, or no-change, in road traffic noise at the majority of receptors in the day time. For a few receptors impacts may be greater. For example a moderate adverse impacts is predicted to occur at the east tower of the Hoola development due to an increase in percentage of HGVs. These changes are in the context of high background daytime noise levels as described by the PEIR noise and vibration chapter Table 14-17. These baseline results suggest that WHO recommended day time noise criteria of 50/55 LAeq, 16hr (41) are generally already exceeded.

9.3.4 Night-time noise modelling by the PEIR noise and vibration chapter indicates that, assuming all roads in the design year have low noise surfacing, noise levels are expected to decrease for 8,582 dwellings. This is an important positive outcome for the Scheme. However for 502 dwellings a long term increase in night-time noise is expected. Whilst this change is not expected to exceed 3dB(A), this increase should be seen in the context of high baseline night-time noise levels (see PEIR noise and vibration chapter Table 14-18) that suggest that WHO recommended night-time noise criteria of 40 dB Lnight outside (40) are already exceeded.

9.3.5 The progression of baseline night-time noise levels towards, or into excess of, WHO guideline (non-statutory) values should be of concern.

9.3.6 With regard to potential ventilation noise impacts both day time and night-time noise impacts are expected to be below both background levels and WHO guideline values.

9.3.7 Based on professional judgement, the changes in noise levels as a result of the Scheme, particularly due to displacement of vehicles from the Blackwall Tunnel to the Silvertown Tunnel, is likely to result in a slight improvement in noise levels around the approaches to the Blackwall tunnel and a slight reduction in noise levels around the approaches to the Silvertown Tunnel. PEIR noise and vibration chapter Figure 14.8 indicates that the beneficial impacts are likely to be widespread, whist the adverse impacts are likely to be very localised. The magnitude of the noise impacts from operation of the Scheme is generally expected to be 'low'.

9.3.8 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA expects operational noise from the Scheme would generally be associated with the potential for a **Minor Adverse** significance of effect at the Silvertown Tunnel approaches and a **Minor Positive** health impact at the Blackwall Tunnel approaches. For a few receptors impacts be greater.

9.3.9 These scores should prompt the consideration of further mitigation and enhancement measures, particularly around how the Scheme can include:

- data collection metrics for relevant intervals and periods, such that regulators, EHOs and local public health teams can compare noise levels to WHO guide values as well as Environment Agency Horizontal Guidance and British Standards limit values. This information should be made available to inform the design and siting of future residential and other sensitive uses (e.g. schools or care homes) around the Silvertown Tunnel approaches; and
- a mechanism for responding to community concerns about operational noise from the Scheme.

Vibration

9.3.10 The PEIR vibration assessment indicates that the operation of the Scheme is not expected to be associated with vibration impacts. The population sensitivity to any impacts is considered 'low', as short propagation distances suggest limited potential to reach sensitive

receptors (although low frequency vibration may travel further than high frequency vibration). The magnitude of any vibration impacts are also considered 'low' as impacts would generally be associated with the exacerbation of noise disturbance, which is a minor impact.

9.3.11 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA expects operational vibration to be associated with a **negligible** significance of effect. Such a 'negligible' significance of effect equates to the impact being considered 'not-significant' in HIA terms for the Scheme. However this score should not preclude the tunnel design process giving due consideration to minimising the potential for low frequency vibration impacts associated with vehicle flows through the operational tunnel.

9.3.12 As well as designing out low frequency vibration impacts, it is also recommended that the Scheme include operational monitoring specifically for low frequency 'hum' impacts in the range of 10Hz to 200Hz. Such 'hum' impacts can cause persistent annoyance but may not be measurable using A-weighted levels. A mechanism for acknowledging and responding to community concerns on vibration impacts should therefore also be put in place.

Summary

9.3.13 The HIA recommends that the noise monitoring strategy for the Scheme includes data collection metrics for relevant intervals and periods, such that regulators, EHOs and local public health teams can compare noise levels to WHO guide values as well as Environment Agency Horizontal Guidance and British Standards limit values.

9.3.14 **Table 9-2** summarises the operational impacts for health and wellbeing.

Table 9-2 Noise: summary of operational health impacts

Receptor	Population in the area around the approaches to the Blackwall tunnel	Population in the area around the approaches to the Silvertown Tunnel	Population within the vibration study area
Pathway	Airborne transmission of noise	Airborne transmission of noise	Ground and structure borne transmission of vibration

Source	Noise from vehicles and plant	Noise from vehicles and plant	Vibration from vehicles
Sensitivity	Medium	Medium	Low
Magnitude	Low	Low	Low
Significance	Minor positive	Minor adverse (a few receptors may experience greater impacts)	Negligible
Further Mitigation	Committed mechanism for monitoring noise levels from the Scheme in a way that allows comparison to WHO threshold values; and a committed mechanism for responding to community concerns on noise impacts	Committed mechanism for monitoring noise levels from the Scheme in a way that allows comparison to WHO threshold values; and a committed mechanism for responding to community concerns on noise impacts	Design features and monitoring to address low frequency 'hum' impacts in the range of 10Hz to 200Hz; and a committed mechanism for responding to community concerns on vibration impacts

Limitations and uncertainty

9.3.15 The preliminary HIA analysis has been based on limited information. Further modelling of noise and vibration impacts is being undertaken and would inform the revised HIA analysis at the DCO stage.

10. CHANGE IN ACCESS TO WORK AND TRAINING

10.1 Introduction

10.1.1 This section of the HIA considers changes, if any, to opportunities for employment and training that would be likely to be caused by the construction and operation of the Scheme and their health impacts. This issue links with Volume 1, Chapter 7 - Community and Private Assets of the Preliminary Environmental Information Report (PEIR) and the Preliminary Economic Assessment Report.

10.1.2 The following Source-Pathway-Receptor model summarises the relation between employment and changes in health.

- **Source:** New employment opportunities generated directly by construction and operational activities. Or indirect changes in access to employment or training opportunities due to improved access to geographic areas or markets;
- **Pathway**: Employment has direct and indirect benefits for health particularly via mental health and socio-economic status; and
- **Receptor**: People of working age in the local employment market. Dependents of those who gain from employment.

10.1.3 The employment and training assessment is split into the construction phase and operational phase.

- **Construction**: Consideration of the construction workforce Scheme/commitment on employment; and
- **Operation**: The Scheme is seen as important to minimising the ‘barrier effect’ of the River Thames and to increasing access to markets for local firms, the size of retail and leisure catchments etc.

10.2 Construction: preliminary HIA analysis

Summary of PEIR assessment

10.2.1 PEIR Chapter 11- Effects on all Travellers states that during construction, the principal socio-economic effects would be in relation to job creation and associated expenditure.

10.2.2 The estimated peak number of personnel working on the Scheme would be approximately 1,000 people, with works phased over a total period of four to five years. As far as possible, construction staff would be employed from the local and surrounding area. Specialist subcontractors (for example relating to tunnelling or piling) would be required for the Scheme and where possible, local subcontractors and workers would be employed.

10.2.3 Beside the direct employment effects of construction, indirect and induced employment is also anticipated to occur. Indirect employment results from expenditure on supplies and services necessary for the construction of the Scheme. Induced employment results from the spending of incomes earned by those directly employed on the construction of the Scheme and workers employed by suppliers/subcontractors.

10.2.4 The total number of direct, indirect and induced employment created by the Scheme is likely to be in the region of 1,500 jobs. Taking into account displacement and leakage factors, this is likely to equate to in the region of 700 additional jobs within the London area.

10.2.5 The Construction Statement recognises that, due to the specialised nature of the Scheme, the local labour force would inevitably be supplemented by a non-local workforce. This workforce would require accommodation within the local area. The preliminary TA notes the potential for a moderate beneficial impact on local accommodation providers during the construction period.

Assessment

10.2.6 Employment is an important determinant of health and wellbeing. The preliminary TA states that as far as possible, construction staff would be employed from the local and surrounding area. The population profile suggests that due to relatively high deprivation in the surrounding boroughs the local population would benefit from good quality job opportunities. The HIA therefore classifies the sensitivity of the population as ‘high’.

10.2.7 The jobs associated with the Scheme (estimated to be 1,500) would bring benefits to the workforce and their dependants, as well as associated economic benefits to local communities e.g. providing accommodation to the non-local workforce. However as the majority of the construction employment opportunities available to the local population are likely to be

lower paid, non-specialist roles, the magnitude of the impact is considered 'medium'.

10.2.8 Based on the sensitivity of the affected population, the magnitude of the potential impact and the proposed mitigation works with the Scheme, the HIA identifies the potential for a **Moderate Positive** significance of effect by reason of opportunities for employment that would otherwise not materialise. This impact is temporary as it is relates only to the construction period. This score should not preclude the opportunity for further enhancement measures, particularly around how the Scheme can increase skills and training for local employees to allow access to higher paid managerial or specialist roles.

10.2.9 It is recommended that the Scheme includes a formal apprenticeship and training scheme to support the construction workforce to progress to more senior and specialist roles. This is in line with TfL's skills and employment strategy (48).

Summary

10.2.10 **Table 10-1** summarises the construction impacts for health and wellbeing.

Table 10-1 Access to work and training: summary of construction health impacts

Receptor	Local workforce and their dependants
Pathway	Increased employment and reduced unemployment
Source	Direct, indirect and induced employment
Sensitivity	High
Magnitude	Medium
Significance	Moderate positive (temporary)
Further Mitigation	Committed apprenticeship and training Scheme

10.3 Operation: preliminary HIA analysis

Summary of PEIR assessment

10.3.1 Chapter 11 - Effects on all Travellers states that the permanent impacts resulting from the Scheme relate primarily to improvements to journey times and reliability, with related benefits to accessibility, access to jobs and regeneration.

10.3.2 A Preliminary Regeneration and Development Impact Report has been prepared for the Scheme (Ref 7-35), the purpose of which is to

demonstrate how the Scheme would impact on the economy to the benefit of residents of the local regeneration areas.

10.3.3 In considering the general relationship between transport and development, the Preliminary Regeneration and Development Impact Report concludes that 'journey times and reliability impose real costs on businesses and the economy and reducing these would introduce efficiencies and help drive location decisions' and that although it is acknowledged that wider economic factors are also involved, there 'is very clear evidence that there is a strong and positive relationship between new investment in transport and the growth of a local economy and development'.

10.3.4 Resourcing of capital interventions over the life of the tunnel not only maintain a good state of repair but also allow for continuous improvement of both operational performance and reducing safety risks. Staffing requirements for other tunnels, for example the A13 tunnels, are in the region of around twenty staff for general operation and maintenance purposes.

10.3.5 The Preliminary Regeneration and Development Impact Report notes that highways access is vital for economic growth and development. Furthermore, highways are essential for all parts of the economy and a very important element for some sectors in particular, such as the logistics and service industries. Journey times and reliability impose real costs on businesses and the economy and reducing these would introduce efficiencies and help drive location decisions. The following consultation points are noted by the regeneration report:

10.3.6 Businesses and potential developers in East London are concerned about current cross-river highway access and in particular the congestion and unreliability of the Blackwall Tunnel.

10.3.7 Local residents in neighbouring boroughs recognise the current lack of crossing facility, congestion, poor reliability, and lack of public transport facility in area.

10.3.8 The Preliminary Regeneration and Development Impact Report finds that generally accessibility is improved by the Scheme, particularly for journey time. However the charge reduces the scale of this benefit and for smaller commercial vehicles (e.g. light goods vehicles) there is a dis-benefit. The greatest improvements relate to residents and employers in regeneration areas around the proposed Silvertown Tunnel in terms of improved bus

access to jobs and employees. The retail sector is unlikely to see improvements to business catchments under current charging assumptions, although cross-river bus access would be improved.

10.3.9 The Preliminary Economic Assessment Report notes a number of ways in which reduced transport costs from transport investment indirectly affect economic activity over a wide area. These include:

- bringing firms closer together and closer to their workforce with a resultant increase in labour productivity, product input, access to labour markets and knowledge and technology interaction and enhancement;
- allowing output and output profitability to increase;
- increasing the number of people who would be willing to work at a given wage rate, increasing the labour supply increases and thus GDP; and
- affecting the overall costs and benefits to an individual from working in different locations and the benefits to business of operating and employing people in different locations. This can potentially result in jobs moving between locations with differential productivity levels.

Assessment

10.3.10 The operational employment impacts of the Scheme would have a general population impact rather than having intended (or unintended) impacts on specific vulnerable groups. Any specific benefit for women and low income populations is likely to be affected by the user charging regime to be operated at both the Silvertown and Blackwall tunnels. These effects are considered below (see page 113 below). The sensitivity of the population to employment impacts of the Scheme is therefore considered ‘low’.

10.3.11 The direct employment generated by the operational Scheme is likely to be negligible. However there is potential for the Scheme to provide long-term improved access to employment opportunities for a large population. The benefits are for both improved cross-river commuting and a general reduction in road congestion benefitting road travel generally. Based on the Scheme having a positive, but indirect, impact on the general employment market the magnitude of any health impact generated by the employment impact of the Scheme is considered to be ‘medium’.

10.3.12 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation with the Scheme, the HIA identifies the potential for a 'moderate' positive health impact.

Summary

10.3.13 Table 10-2 summarises the operational health impacts for health and wellbeing.

Table 10-2 Access to work and training: summary of operational health impacts

Receptor	Working age population of London
Pathway	Increased access to employment opportunities
Source	Indirect employment
Sensitivity	Low
Magnitude	Medium
Significance	Moderate positive
Further Mitigation	None

Limitations and uncertainty

10.3.14 The preliminary HIA analysis has been based on limited information. Results of wider impacts analysis are not available.

11. CHANGE IN SOCIAL COHESION AND LIFETIME NEIGHBOURHOODS

11.1 Introduction

11.1.1 This section of the HIA considers changes in access to social cohesion and lifetime neighbourhoods (including neighbourhood amenity).

11.1.2 The following Source-Pathway-Receptor model summarises the relation between social cohesion, lifetime neighbourhoods and health.

- **Source**: Impacts on residential and commercial markets and access to cross river amenities due to improved accessibility and the introduction of a charging scheme;
- **Pathway**: A change in affordability of travel and living, including shopping, employment or service opportunities available. Change in community identity due to resultant migration into or out of the area; and
- **Receptor**: Current residents in areas in the locality of the Scheme.

11.1.3 The social cohesion and lifetime neighbourhoods assessment only considers the operational phase.

- **Operation**: Consideration of changes to the local community arising from planning applications coming forward, in part, in response to the Scheme for residential development and mixed-use developments in the LB Tower Hamlets, LB Newham, and RB Greenwich in the locality of the Silvertown Tunnel Scheme.

11.2 Operation: preliminary HIA analysis

Summary of PEIR assessment

11.2.1 The Preliminary Social Impacts Appraisal (Ref 7-36) prepared in line with the Department for Transport (DfT) TAG Guidance (unit A4.1) considers the social impact of the Scheme on local residents, and includes severance as one of its key areas. The assessment considers the extent to which the Scheme impedes local residents' access to community facilities and services and is mainly concerned with the effects on non-road users. The level of potential severance was assessed by means of consideration of forecast changes in motorised vehicle flow, speed and percentage HGV content. Areas identified as having significant changes in

motorised traffic flow as a result of the Scheme include Greenwich Peninsula West, Silvertown and the Aberfeldy / Leamouth area. For each of these areas, the assessment concluded that there was no change in the level of severance experienced by communities as a result of the Scheme. Residents within the Silvertown area may experience a slight improvement to the current situation with improved crossing facilities provided at the Tidal Basin Roundabout.

11.2.2 The Preliminary Outline Business Case (OBC) notes that low-income groups tend to have lower levels of car ownership and can therefore be disproportionately affected by public transport availability. This group are expected to receive a positive impact since new cross-river bus links would reduce the need to use the more expensive Underground or Emirates Air Line services. The improvements to bus routes and additional cross-river bus links would be of particular benefit to older or mobility impaired persons who may find interchange at North Greenwich difficult. New cross-river bus links may lead to wider travel horizons for residents of some nearby regeneration areas, providing low-cost travel options to access employment and education opportunities on the opposite side of the River Thames.

11.2.3 However for low-income groups who are car drivers the proposed Scheme would have a negative impact due to the road user charges planned at the Silvertown and Blackwall Tunnels. The introduction of these charges would have a direct and tangible impact on the affordability of travel by car for some users.

11.2.4 The Scheme would result in a net decrease in car user costs of £1.2m and a net increase in user charges of £10.5m for car users from the study area (in 2031), resulting in a net cost increase of £9.3m. The costs impact mainly on high and medium income car users and to a lesser extent on low income car users.

11.2.5 The enhanced bus package would result in savings for some transport users who would be able to use buses to take journeys they would otherwise have taken using more expensive modes such as car, train or the tube (Distributional Impact Assessment, section 10.6). This benefit would impact mainly on low income public transport users and to a lesser extent on medium and high income users.

11.2.6 It is noted that car users and public transport users are not mutually exclusive groups and that many people would use a mix of these forms of transport.

11.2.7 Overall the Distributional Impact Assessment concludes that while there would be improvements to the reliability of public transportation there would also be negative impacts on lower income car users due to the charging Scheme, resulting in the conclusion that the proposed Scheme is likely to have a neutral net effect on accessibility impacts.

11.2.8 The HIA notes that there are two issues that would, in some circumstances, be in conflict with one another, namely: accessibility and charging.

Accessibility

11.2.9 The Scheme is generally positive in increasing accessibility across the river. The benefits apply mainly to users of motorised vehicles in the local area both domestic and small businesses. There would also be improvements to public transport which is potentially of benefit to the whole population. Improvements in accessibility would contribute to social cohesion and these would contribute to the creation of lifetime neighbourhoods.

Charging

11.2.10 TfL proposes to charge for the use of the Silvertown and Blackwall Tunnels for two principal reasons:

- To manage the demand for both crossings and keep traffic levels within acceptable limits; and
- To help raise money to pay for the construction and operation of the new tunnel.

11.2.11 The proposed charges are shown in **Table 11-1**.

11.2.12 The charge is intended to inhibit induced demand and it has a number of other benefits. It can mitigate some of the environmental effects of the new tunnel (including social effects, for example), help to manage the road network and support growth. These benefits are contingent on the way that the charge is defined and set and for this reason it is proposed that TfL would be able vary its approach to charging in its operation of the Scheme. This is discussed below.

11.2.13 TfL has examined the potential for not imposing user charging for use of the Scheme, but this is shown not to achieve the Scheme objectives that are set out in the TA.

Table 11-1 Assessed charge per trip in 2014/15 prices

User type	**Account holder registered for auto pay**		**Non account holder**
Charge rates*	Off peak charge	Peak charge	Headline charge
Time	Weekdays **outside of peak** period and all times on weekend	Weekday **peak periods** between; 0600-1000 going Northbound and 1600-1900 going Southbound	At all times
Motorcycle, moped, motortricycle	c.£1.00	c.£2.00	c.£3.00
Car and small van	c.£1.00	c.£3.00	c.£4.00
Large van	c.£1.65	c.£5.00	c.£6.00
HGVs **	c.£4.00	c.£7.50	c.£8.50
Bus and Coach and minibus	Free (100% discount)	Free (100% discount)	Free (100% discount)

* Charging hours are 0600-1000

** Assessed charges per trip are stated in today's prices, the assumption is that these would increase for general inflation between now and tunnel opening. After the tunnel opens, the charge would increase for general inflation on a periodic basis.

11.2.14 The charging scheme is central to managing demand for and thus controlling motorised traffic flows through, the tunnel crossings (Blackwall and Silvertown). In the absence of a control mechanism to manage demand any improvements in capacity and resilience that might be generated by the Scheme would be likely to be negated by induced traffic coming onto the network. This trend was noted by SACTRA in 1994 (49) and is evidenced in a number of transport infrastructure projects (50,51). The SACTRA report is cited by stakeholders in their response to the Silvertown HIA and EqIA scoping reports.

11.2.15 The charging scheme would be operated by TfL to control traffic volumes passing through the crossing such that the Scheme does not result in an increase in motorised traffic volumes. It is acknowledged that charging for the use of the Scheme would have benefits for people living and working in proximity to the Scheme and for people using it. It is noted elsewhere in the Preliminary TA that charging would help to encourage modal shift to public transport as well as enabling better bus reliability due to the reduced congestion and creating opportunities for more cross-river bus services. It would also have a role in improving air quality as emissions would be reduced through less vehicles idling in congestion. The exact charge would be determined close to the tunnel opening date. The level would be set by TfL so as to achieve appropriate management of traffic flows through the crossing whilst having regard to the need to avoid likely significant adverse environmental effects and to raise revenue to help pay for the construction and operation of the Scheme.

11.2.16 The populations of RB Greenwich, LB Tower Hamlets and LB Newham are all predicted to rise by 2036 and the demand for river crossings is expected to increase. The use and character of the land in the neighbourhood surrounding the tunnel portals would change from light industrial to residential, leading to changes in the density of the residential population living close to the tunnel portals.[10]

11.2.17 TfL are concerned to ensure that any charging scheme would be fair and flexible (38) and that it would not be a regressive control mechanism *i.e.* one that takes a proportionally greater amount from those on lower incomes.

11.2.18 The Distributional Impact Appraisal (DIA) user benefits assessment considers the impact on cost, time and reliability of travel as a result of the charging scheme. The DIA makes strong links between people on low

[10] The Base Case.includes developments that are programmed to be completed and partially (if built out in phases) or fully operational during construction of the Scheme. This is proposed on the basis that these developments will be in place when Scheme construction is taking place and therefore it is appropriate to assume their presence in the base case.

incomes and frequent use of bus services. Those on low incomes are therefore expected to benefit from improved bus services (and therefore would not be subject to the charging scheme); whilst those on higher incomes are expected to benefit from reduced private car journey congestion (with the charge scheme having little impact on affordability). The DIA concludes that there would be a net benefit both for those on low incomes and for those on medium and high incomes.

11.2.19 The HIA considers how the charging scheme may affect those on low incomes, including those dependent on car travel. This group may include those with mobility constraints due to age, ill-health or disability. Lifetime neighbourhoods are designed to be inclusive regardless of age or disability. Use of the tunnels would be free of charge for the Disabled vehicle tax class and with a 100% discount for blue badge holders.

Assessment

11.2.20 This considers the effects of changes to accessibility and charging on social cohesion and lifetime neighbourhoods. As noted above there would be beneficial social effects arising from improving access across the river and from other improvements. These would be noticed in different ways by different groups e.g. drivers, small businesses and people who do not own a car. The potentially regressive nature of the effects from charging, and the consequential potential to increase social inequalities, are the focus of this section.

11.2.21 The Scheme brings improvements in future access across the river to facilities and amenities (education, leisure, social networks, food choice, etc.). However for some people, particularly those on low income who are dependent on car travel, the Scheme would have an impact on the affordability of accessing current cross-river facilities and amenities due to the introduction of the charging scheme at the Blackwall Tunnel. People on low incomes reliant on cross river amenities, particularly their place of work or education, would be particularly vulnerable in this regard. The affordability of accessing new cross-river facilities and amenities and their living in an increasingly desirable area may also disproportionately affect current and future residents on low incomes. The sensitivity of the current and future populations to changes in social cohesion and lifetime neighbourhoods is considered to be ‘high’.

11.2.22 The Scheme would take place in an area in which large social change is expected. The predicted residential development coupled with the convenience of the tunnel access for those able to regularly afford it is

likely to increase the desirability of the areas around the tunnel portals. The magnitude of impact is therefore likely to be 'medium'. However, TfL and the boroughs are considering ways in which demand for the Scheme can be managed without widening, or entrenching, health, and other social, inequalities. The following bullets note two important factors that would contribute to minimising any impact.

- The transport model assumes a significantly improved level of bus service across a number of illustrative route corridors. New cross-river public transport links such as Crossrail would also help to mitigate adverse effects by providing alternative public transport options.
- A community fund would be available to the host boroughs who would be able to decide on its exact function and distribution. The community fund is an opportunity to deliver transport, environmental and social enhancements to local communities. The size of this fund and the way in which this fund is distributed would contribute to the social and the economic effects of the Scheme. The quotation below provides results concerning the social effects of road pricing that were found in Stockholm, Sweden:

  "Research from previous studies addressing road pricing may be of some help although a toll for a single section of one road would have different effects than an area based road pricing scheme. There appears to be very limited peer reviewed evidence on the social effects of toll roads including effects on equity.

  Nonetheless, in Stockholm, for example, it has been noted that if revenues from a road pricing trial were used for improving public transport, this would benefit women and low-income groups the most. If revenues were used for tax cuts, the net benefits would be about equal for men and women on the average, but with benefits particularly for high-income groups. The authors of the study noted that "Given that it is likely that the revenues would be used to some extent to improve the public transport system, we conclude that the proposed congestion-charging scheme for Stockholm is progressive rather than regressive" (52).

  When the programme commenced in Stockholm researchers were able to report that initial car drivers crossing the toll cordon had a 15 percentage-points higher rate of switching to public transit as compared with those not crossing the cordon. There

was some evidence of peak spreading, in particular toward a later departure time, as a result of the charging scheme, but most people chose a departure time within 15 minutes both before and during the trial. In the welfare analysis, the researchers found no clear pattern of increasing burden by either increasing income or decreasing income, and the increase in the Gini Coefficient was insignificant. They also found no significant difference in either the mode-switching behaviour or the average welfare effect for women versus for men (53).”

11.2.23 Further details on the Community Fund are set out within the Preliminary Case for the Scheme. The HIA recommends that the boroughs use the community fund in ways which offset any social imbalance caused by the charging scheme. The value of the fund would be discussed with the host boroughs and detailed proposals included in the DCO application. The community fund would be secured through a DCO requirement (similar to a planning condition) or a development consent obligation (similar to a planning obligation).

11.2.24 Although traffic demand for the crossing is to be managed by the user charge, the effects of charging on low income groups would also be mediated by the availability of improved affordable public transport. In Stockholm revenues from charging were used to improve public transport. This was considered beneficial to women and low-income groups and the charging was seen as progressive. The proposed Scheme would enable an improvement in bus services and thus has the potential to be progressive.

11.2.25 The community fund offers a flexible resource which is expected to benefit local communities, a counterpoint to any change in affordability, particularly for the most vulnerable. The details of this community fund have not yet been fully agreed but further details are set out within the Preliminary Case for the Scheme.

11.2.26 For cross river travel the community fund would be particularly important in addressing any adverse impact for those on low incomes who are dependent on car use for important journeys (e.g. people with mobility constraints who work across the river). It should be noted that the tunnel would be free of charge for blue badge holders and those in the disabled vehicle taxation class. Use of the community fund is expected to be greater during the years immediately following implementation of the charge. Over time people would adapt to the Scheme. TfL would consider

monitoring and evaluation to ensure that social effects continue to be fair when the Scheme is in operation.

11.2.27 Work is ongoing to determine the mechanism by which the community fund would operate, however TfL are committed to achieving outcomes that avoid an adverse impact on social cohesion and lifetime neighbourhoods.

11.2.28 This assessment assumes that the community fund would provide sufficient resources in a well-managed, targeted and sustainable manner (to be determined through future work with the boroughs) that would fully offset any social imbalance caused by the charging scheme. Based on equitable management of demand for the Scheme through the implementation of the mitigation described above, the magnitude of impact is considered to be 'low'.

11.2.29 Based on the sensitivity of the affected population, the magnitude of the potential impact and existing mitigation proposed with the Scheme (notably the use of the community fund), the HIA identifies the potential for a 'negligible' health impact arising from any adverse effect of the Scheme on social cohesion and lifetime neighbourhoods.

Summary

11.2.30 Table 11-2 summarises the operational impacts of the Scheme for health and wellbeing arising from its likely effects on social-cohesion and lifetime neighbourhoods.

Table 11-2 Social cohesion and lifetime neighbourhoods: summary of operational health impacts

Receptor	Those on low incomes
Pathway	Displacement due to reduced affordability
Source	Charging scheme and living costs
Sensitivity	High
Magnitude	Medium
Significance	Negligible
Further Mitigation	Work is ongoing to determine the mechanism by which the community fund would operate, however TfL are committed to achieving outcomes that avoid an adverse impact on social cohesion and lifetime neighbourhoods. The value of the fund would be discussed with the host boroughs and detailed proposals included in the DCO application. The community fund would be secured through a DCO requirement (similar to a planning condition) or a development consent obligation (similar to a planning obligation).

Limitations and uncertainty

11.2.31 The preliminary HIA analysis has been based on limited information. Further modelling of traffic and transport behaviour and impacts is being undertaken and would inform the revised HIA analysis at the DCO stage.

12. HEALTH ACTION PLAN

12.1.1 The Health Action Plan (HAP) is intended to convert the HIA's recommendations into a protocol for implementing the recommendations and monitoring relevant health outcomes. The Health Action Plan aims to further reduce potential negative health impacts of the Scheme and enhance its potential health benefits.

12.1.2 The HAP would be competed as part of updating and finalising the preliminary HIA for the DCO application stage in 2016.

12.1.3 The Health Action Plan (HAP) would form part of the Overarching Management Plans for the Scheme. The HAP would establish the proposed actions needed to mitigate identified impacts and promote health opportunities in the Scheme. The HAP would assign actions, timeframes, resources, responsibilities and collaborating organizations to the mitigation and enhancement measures identified in this assessment. The HAP would include a monitoring system designed to track implementation progress and selected outcomes. The monitoring system would include appropriate key performance indicators and an early-warning system for any problems occurring at the community level. Evaluation and verification protocols would also be included to determine when successful implementation has been accomplished. The HAP would be reviewed by key stakeholders prior to construction activities commencing. Key features of the HAP include:

- Allocation of responsibility;
- Timeframes for implementation;
- Resource requirements;
- Collaborating organizations;
- Monitoring system;
- Key performance indicators;
- Evaluation and Verification protocols; and
- Stakeholder consultation.

12.1.4 It should be noted that the Health Action Plan itself should also be the subject of ongoing monitoring to ensure that it continues to be relevant to the Scheme

and the affected population. Responsibility for monitoring the Health Action Plan lies with TfL and the boroughs.

13. APPENDICES

Appendix A POLICY CONTEXT

A.1.1 This appendix notes the wider policy context in which the HIA has been developed. It considers the policy context for the process of HIA before looking in turn at each of the topics considered within the HIA.

Health Impact Assessment

A.2.1 European Union

- Health for Growth: EU health programme (2014-20) (54)
- EU Health Strategy "Together for Health" (55)
- EU 7th Environment Action Programme to 2020 (56)
- Solidarity in Health: Reducing Health Inequalities in the EU (57)
- EU Occupational Safety and Health (OSH) Strategic Framework 2014-2020 (58)
- European Environment and Health Strategy (59)
- European Pact for Mental Health and Well-Being (60)

A.2.2 World Health Organization

- Parma Declaration on Environment and Health (61)
- Ashgabat Declaration on the Prevention and Control of Non-communicable Diseases (62)
- Health 2020. A European policy framework and strategy for the 21st century (63)
- Children's health and environment. Developing action plans (64)
- The effectiveness of health impact assessment (65)
- Gaining health. The European Strategy for the Prevention and Control of Non-communicable Diseases (66)
- The precautionary principle: protecting public health, the environment and the future of our children (67)
- Mental health: facing the challenges, building solutions (68)

- Policies and practices for mental health in Europe. Meeting the challenges (69)

A.2.3 United Kingdom

- Helping people live well for longer (70)

A.2.4 London

- The Mayor's Transport Strategy (38)
- Better Health for London: Next Steps (71)
- Mayor of London's response to the London Health Commission (72)
- London Mental Health: The invisible costs of mental ill health (73)
- London 2012 equalities review (74)
- Access to primary health care (75)
- Access to GP Care (76)

Road safety, accessibility and active travel

A.3.1 European Union

- EU Commission White Paper, A strategy on nutrition, overweight, and obesity-related health issues (77)
- EU Action Plan on Childhood Obesity 2014-2020 (78)

A.3.2 World Health Organization

- Amsterdam Declaration: Making THE Link: Transport choices for our health, environment and prosperity (79)
- Preventing road traffic injury: a public health perspective for Europe (80)
- Transport, environment and health (81)
- Youth and road safety in Europe. Policy briefing (82)
- Steps to health. A European framework to promote physical activity for health (83)

- The challenge of obesity in the WHO European Region and the strategies for response (84)
- Collaboration between the health and transport sectors in promoting physical activity (85)
- Obesity and inequities. Guidance for addressing inequities in overweight and obesity (86)
- Physical activity promotion in socially disadvantaged groups: principles for action (87,88)
- Young and physically active: a blueprint for making physical activity appealing to youth (89)

A.3.3 United Kingdom

- Everybody active, every day: a framework to embed physical activity into daily life (90)

A.3.4 London

- Improving the Health of Londoners: Health Action Plan, TfL (91) (the physical activity impacts of all Schemes should be evaluated).

Air quality

A.4.1 European Union

- Directive 2008/50/EC on ambient air quality and cleaner air for Europe. May 2008 (92)
- Clean Air Policy Package. December 2013 (93)

A.4.2 World Health Organization

- Air quality guidelines for Europe (39)
- Health effects of black carbon (94)
- Health effects of transport-related air pollution (95)

A.4.3 United Kingdom

- The air quality strategy for England, Scotland, Wales and Northern Ireland (96)

Noise

A.5.1 European Union

- The Environmental Noise Directive (2002/49/EC) (97)

A.5.2 World Health Organization

- Night noise guidelines for Europe (40);
- Burden of disease from environmental noise. Quantification of healthy life years lost in Europe (98);
- WHO guidelines for community noise (41).

A.5.3 United Kingdom

- Environment Agency. Horizontal guidance: environmental permitting. H3 Noise assessment and control (43).

Work and training

A.6.1 European Union

- Agenda for new skills and jobs (99)
- Youth on the Move (100)
- Education and Training 2020 (101)
- New Skills for New Jobs (102)
- EU programme for Education, Training, Youth, and Sport for 2014-2020 (103)

A.6.2 United Kingdom

- Improving health and work: changing lives (104)

Healthcare services and other social infrastructure

A.7.1 European Union

- Effective, accessible and resilient health systems (105)

Social cohesion and lifetime neighbourhoods

A.8.1 World Health Organization

- Social determinants of health. The solid facts (106)
- Reducing health inequities through action on the social determinants of health (107)

Appendix B EVIDENCE BASE

Summary of evidence base: road safety and accessibility

B.1.1 Air quality, dust and noise impacts of transport are addressed separately in their respective HIA topic chapters. It is noted that air quality, including fine particulate matter, is a particularly important impact of most vehicle transport.

B.1.2 The primary function of transport is the movement of people and goods between places, enabling access to employment, economic, and social opportunities as well as to essential services. Transport needs would depend on many local contextual factors e.g. existing public transport, as well as individual factors, e.g. mobility. But transport which is affordable and accessible may be viewed as an important determinant of health by facilitating access to key socio-economic opportunities (32).

B.1.3 Inadequate transport provision may add to social exclusion among already vulnerable groups, i.e. those who are unemployed, elderly, sick, on low incomes, and women, presenting a barrier to jobs, health services, education, shops and other services (32).

B.1.4 Lack of access to a car may contribute to transport related social exclusion. In the UK, car ownership is strongly associated with income, yet the association between car ownership and improved health is independent of income and social class. This may be explained by the improved access that a car provides (32).

B.1.5 Physical injury and death are the most direct health impacts of motorised transport. More indirect impacts include changes to: physical activity and obesity; mental health; air quality and cardiorespiratory health; social exclusion and inequalities; and environmental impacts related to fuel emissions and climate change. Injuries and deaths caused by motor-vehicles are indisputable and already closely monitored with many effective interventions in place to minimise this harm. The strength of evidence about other indirect health related impacts varies according to the pathways concerned, from strong quantifiable evidence of air pollution effects, to much weaker evidence on the health effects of transport noise and community severance (32).

B.1.6 Community severance occurs where road traffic (speed or volume) inhibits access to goods, services, or people. Traffic speed and volume reduces: physical activity; social contacts; children's play; and access to

goods and services. No studies have investigated mental or physical health outcomes in relation to community severance, it is therefore considered likely, but unproven, that community severance by roads and traffic adversely affects health and well-being (108).

B.1.7 Transportation barriers are important for healthcare access, particularly for those with lower incomes. Transportation barriers lead to rescheduled or missed appointments, delayed care, and missed or delayed medication use. These consequences may lead to poorer management of chronic illness and thus poorer health outcomes (109).

B.1.8 The most commonly affected body regions in traffic accident victims are upper/lower limbs, followed by the head/neck region. In terms of severity, the head/neck region is highlighted in studies related to severity and mortality. Most studies state that between 58% and 60% of people involved in traffic accidents have trauma severity considered to be moderate to light, and around 35% to 40% have serious or life-threatening trauma. Studies highlight pedestrians as the groups with the most frequent fatalities (110).

B.1.9 A considerable minority11 of individuals involved in a road traffic crash develop post-traumatic stress disorder (PTSD). PTSD can have serious and long-lasting consequences for quality of life, absenteeism from work and is associated with higher levels of pain and disability. These negative impacts have consequences to both the individual and society. Consistent predictors of PTSD include: rumination about the trauma; perceived threat to life; a lack of social support; higher Acute Stress Disorder symptom severity; persistent physical problems; previous emotional problems; previous anxiety disorder; and involvement in litigation/compensation (111).

B.1.10 Occupants of smaller, lighter passenger cars are more likely to be killed or injured in collisions with larger, heavier sport utility vehicles and light trucks than in collisions with other cars. The presence of both very large

[11] Prevalence rates of PTSD following a RTC vary considerably across studies, ranging from 6% to 45%.

and much smaller vehicles on roadways, makes crashes involving these vehicles—and resulting deaths and injuries—inevitable (112).

B.1.11 Few studies have been undertaken on the impacts of heavy goods vehicles (HGV). A relatively small study found that compared to collisions with other types of vehicles, cyclists who collided with an HGV were more severely injured and had a higher mortality rate (113).

Interventions

B.1.12 As the built environment is directly related to the risk of pedestrian injury, changing the built environment is a sound, but often underutilized approach to transport related injury control. Even modest interventions to the built roadway environment may result in meaningful reductions in the risk of pedestrian injury, particularly for children. Interventions include use of: overpasses; road closures; signage changes; and traffic calming (114).

B.1.13 Similarly built environment features that either slow traffic down (traffic calming) or separate children from traffic (playgrounds) were associated with both increased walking and less pedestrian injury. Factors that are associated with more walking, but with less road safety include: higher pedestrian volume; population and road density; schools; urban location; land use mix; proximity to services/facilities; and crosswalks. Many of these built environment correlates may not be inherently dangerous, but rather are markers for increased exposure to traffic (115).

B.1.14 Street lighting may prevent road traffic crashes, injuries and fatalities. Street lighting is a relative low-cost intervention that improves a driver's visual capabilities and ability to detect roadway hazards (116).

B.1.15 Speed cameras and related automated enforcement devices are worthwhile interventions for reducing road traffic injuries and deaths in both rural and urban settings (117).

B.1.16 There is insufficient evidence to determine whether organisational travel plans are effective for improving health or changing travel mode. There is potential for such travel plans to change modes of travel to work, school and tertiary education, with positive environmental, social and physical health outcomes. Therefore organisational travel plans should be considered as complex health promotion interventions, with considerable potential to influence community health outcomes depending on the environmental context in which they are introduced (118).

B.1.17 Road safety campaigns have an overall accident-reducing effect of 9%. Those campaigns delivered with personal communication in a way that is proximal in space and time to the behaviour targeted by the campaign (i.e. at the roadside and/or as part of enforcement strategies) are associated with greater accident reductions (119).

B.1.18 Active transport to work or school is significantly associated with improved cardiovascular health and lower body weight. The strength of the evidence varies from weak (mental health and cancer), moderate (body weight), to strong (cardiovascular health) (120).

Physical activity

B.1.19 Land use mix, connectivity and population density and overall neighbourhood design are important determinants of physical activity. The built environment is more likely to be associated with transportation walking compared with other types of physical activity including recreational walking (121).

B.1.20 Active transport to work (122) or school (123) is significantly associated with improved cardiovascular health and lower body weight. However, the strength of the evidence varies from weak (mental health and cancer), moderate (body weight), to strong (cardiovascular health) (122).

B.1.21 Environmental factors identified as being positively associated with cycling included presence of dedicated cycle routes or paths, separation of cycling from other traffic, high population density, short trip distance, proximity of a cycle path or green space and for children projects promoting 'safe routes to school'. Negative environmental factors were perceived and objective traffic danger, long trip distance, steep inclines and distance from cycle paths (124).

B.1.22 Active travel, particularly walking and cycling, is recommended because of the health benefits associated with increased physical activity. Use of public transport generally involves some walking to bus stops or train stations. A range of 8-33 additional minutes of walking is attributable to public transport use. A greater uptake of public transport by inactive adults is likely to lead to significant increases in the adult population considered sufficiently active (125).

B.1.23 A gradient exists between increasing BMI and direct healthcare costs and indirect costs due to reduced productivity and early premature mortality (126). Prolonged sedentary time is independently associated with deleterious health outcomes regardless of physical activity (127).

B.1.24 Compared with metabolically healthy normal-weight individuals, obese persons are at increased risk for adverse long-term outcomes even in the absence of metabolic abnormalities, suggesting that there is no healthy pattern of increased weight (128). Being overweight (BMI ≥25 to <30 kg/m(2)) or obese (BMI ≥30 kg/m(2)) is associated with a significantly increased risk of coronary heart disease and stroke, compared with normal weight (BMI ≥20 to <25 kg/m(2)) (129).

B.1.25 The evidence shows an inverse dose-response association between levels of recreational physical activity and risk of hypertension (high blood pressure) (130). Physical activity seems to enhance cardiovascular fitness during the course of the lifecycle, improve blood pressure, and is associated with decreased prevalence of hypertension and coronary heart disease. It may also delay or prevent age-related increases in arterial stiffness. Aerobic exercise seems to better benefit blood pressure and vascular function (131).

B.1.26 Being overweight or obese is also associated with an increased risk of cancer (132). Prolonged TV viewing and time spent in other sedentary pursuits is associated with increased risks of certain types of cancer (133). Avoiding adult weight gain itself may confer protection against certain types of cancers (134). Both pre-diagnosis and post-diagnosis physical activity are associated with reduced breast cancer-specific mortality and all-cause mortality (135). There is evidence to support an inverse relation of physical activity, in particular exercise frequency, to gastroesophageal cancer risk (136). Leisure time physical activity is associated with reduced risk of developing lung cancer among smokers (137). Lifestyle interventions focusing on increasing physical activity decrease the risk of gastric cancer, in addition to a myriad of other health benefits (138). Among patients with certain cancers appropriate exercise may be beneficial in ameliorating a range of treatment-induced adverse effects (139).

B.1.27 Body weight gain is also a quantifiable predictor of type 2 diabetes mellitus (140).

B.1.28 The evidence for interventions promoting physical activity aimed at general adult populations (as opposed to targeted individual programmes) are inconclusive (141). A recent review collates the attributes of interventions that are likely to be more successful in increasing physical activity (142). Mitigation strategies can be informed by these principles.

B.1.29 Safety considerations are one of the most prominent influences of older adults' decisions about mobility. Street connectivity, pedestrian access and transit, and retail and services are also important. These factors are amenable to change and can help promote mobility for older adults (143).

B.1.30 Weight loss may be associated with modest improvements in physical, but not necessarily mental, health (144). Physical activity reduced depressive symptoms and increases quality of life in people with mental illness (145). However stress may impair efforts to be physically active (146). From a population health perspective, promoting physical activity may serve as a valuable mental health promotion strategy in reducing the risk of developing depression (147).

B.1.31 Multilevel interventions that make alternatives to driving private motor vehicles more convenient, such as walking and cycling, are needed to promote healthy weight in the adult population (148).

B.1.32 Studies that are shown to be effective in lower socioeconomic position participants primarily included community-based strategies or policies aimed at structural changes to the environment. Interventions targeting individual-level behaviour change may be less successful in lower socioeconomic position populations. It is essential that efforts to prevent obesity do not leave behind the most disadvantaged members of society (149).

B.1.33 Sport may be associated with improved psychosocial health in addition to improvements attributable to participation in physical activity. Specifically, club-based or team-based sport seems to be associated with improved health outcomes compared to individual activities, due to the social nature of the participation. Notwithstanding this, individuals who prefer to participate in sport by themselves can still derive mental health benefits which can enhance the development of true-self-awareness and personal growth which is essential for social health (150).

Occupational

B.1.34 Modifiable behavioural and vehicle-related risk factors are likely to contribute to work-related traffic injury. There is a lack of quality epidemiological evidence on risk factors for work-related road traffic crashes, and the few robust studies cover diverse risk factors in diverse populations. Sleepiness and fatigue-related risk factors featured most often, suggesting that these factors are major causes of work-related traffic injury (151).

B.1.35 Workplace physical activity and yoga programmes are associated with a significant reduction in depressive symptoms and anxiety, respectively. Their impact on stress relief is less conclusive (152).

Sensitivities

B.1.36 Disadvantaged groups are least likely to own a car, compounding disadvantage in a car-dominated society. Yet, ironically, the same groups experience a disproportionate amount of the harmful effects of cars. Children from the poorest households are between four and five times more likely to be killed in a road traffic accident than their counterparts from the most affluent households (32).

B.1.37 Children are a particularly vulnerable group for road casualties (153).

B.1.38 Motor vehicle crashes are a predominant cause of reported trauma during pregnancy, indicating the vulnerability of pregnant women (154).

B.1.39 While road traffic crashes are known to have a significant impact in terms of deaths and hospitalisations, the burden of psychological impacts on injured school-aged children and adolescents is estimated to be up to 46% in the first 4 months following crash involvement and up to 25% 4-12 months following the crash. Young people should therefore be considered vulnerable both in terms of physical and mental health outcomes from traffic related accidents (155).

B.1.40 Cyclists are a vulnerable group for road traffic injuries. Specifically older cyclists are more likely to sustain injury after being hit by a car, in particular head injury, and are more likely to die as a result (156).

B.1.41 However on average, the estimated health benefits of cycling are substantially larger than the risks relative to car driving for individuals shifting their mode of transport. Furthermore for society as a whole, the benefits are even larger because there is a reduction in air pollution emissions and eventually fewer traffic accidents. Policies stimulating cycling are likely to have net beneficial effects on public health, especially if accompanied by suitable transport planning and safety measures (157).

B.1.42 The vulnerability of older adults increases with reduced mobility. The provision of safe travel options (public and private) that allow easy access to services and amenities is a vital factor in maintaining mobility amongst older road users (158). Difficulties using public transport can limit older people's participation in society, thereby impacting negatively on their health. Bus design, service provision and performance, information, and

the attitudes of staff and the community, impact on older people's ability to catch buses (159).

B.1.43 Acute physical exercise enhances executive functioning in preadolescent children, adolescents and young adults (160).

B.1.44 People with a mental illness are much more likely to experience poor physical health when compared to the general population. Greater attention should be paid to the physical health of people with mental health disorders so that preventable illness does not result in higher levels of morbidity and mortality for this disadvantaged population (161).

B.1.45 Low socioeconomic position is associated with less physical activity during leisure-time compared to those with high socioeconomic position (162).

Advisory thresholds

B.1.46 For air quality and noise impacts see those respective evidence review sections. For transport related accidents there are no lower thresholds for acceptable levels of serious harm or fatality. No threshold for severance impacts was identified from the literature.

Summary air quality evidence base

Road tunnels

B.1.47 Commuters and workers within road tunnels are exposed to tunnel atmospheres which include volatile and semi-volatile organic compounds, along with numerous metals and oxides of sulphur, nitrogen, and carbon. Broadly the literature suggests that the concentration of most toxicants detected in communities exposed to tunnel emissions are below those concentrations that are generally considered to pose either a significant acute or chronic health hazard (163).

B.1.48 Emissions may cause short-term health effects for tunnel users in busy traffic, and may also cause health effects in residential neighbourhoods around tunnels. Adverse health effects can arise as a result of short-term exposure to traffic pollutants. One possible effect includes aggravation of asthma, either immediately or over subsequent hours. Accrued effects from repeated tunnel use might include small increases in lifetime risk of cancer, and potential for increased bronchitic events or respiratory infection. Typically used tunnel management procedures are unlikely to adequately protect users from these risks. People who live near to tunnels

or their stacks may be at risk if the presence of the tunnel alters the ongoing quality of the neighbourhood ambient air. Risks to cardiorespiratory health might arise if people are exposed to contaminated air from tunnel emissions. Important indicators for this risk are levels of NO2 and particulates. Of particular concern is an association between impaired lung development in children and emissions from traffic. Particulates from tunnels and volatile compounds including benzene may produce an increased lifetime risk for cancer. Every tunnel is different, and its effect on health has to be judged accordingly. The concentrations of air pollutants that occur within road tunnels, and the consequent emissions from stacks and portals into the external atmosphere, are highly variable. They depend on factors that determine vehicle emissions (traffic volume, speed, fleet composition, road gradient, and fuel quality and tunnel length) and the rate of dilution (governed by the tunnel's ventilation system, and by traffic volume and speed). Health-based exposure limits are used to set limits for in-tunnel pollution. In most tunnels, there is a feedback system so that high concentrations of pollutants trigger either an increase in ventilation or traffic management measures aimed at reducing total vehicle emissions inside the tunnel. Globally, the most widely adopted in-tunnel exposure limit is that for carbon monoxide (CO), based on the World Health Organization (WHO) guidelines (WHO 2000). Carbon monoxide is the only traffic-dominated air pollutant for which WHO guidelines exist for exposure durations relevant for tunnel transit (typically ~2 minutes; rarely more than 30 minutes). A visibility limit is also applied in most tunnels for safety purposes. The most serious risks and the greatest technical management challenges occur in congested conditions. Traffic management plans should be adopted to minimise or eliminate congestion within the tunnel. However, this approach needs to be balanced against the potential for greater health risks if traffic diversion leads to severe congestion or inappropriate use of surface roads in residential areas. The most effective long-term measure for reducing health risks associated with road tunnels is to adopt vehicles fitted with technologies and/or fuels that reduce emissions (164).

General Air Quality Health effects (other than dust, which is considered separately)

B.1.49 The following sections discuss some of the ways in which air quality can impact upon health. The main airborne contaminants are discussed, however the list should not be taken as exhaustive.

B.1.50 Most prevalent air pollutants are fine particles (PM), carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and ozone (O_3). Fine

particles (e.g. $PM_{2.5}$) are generated mechanically or by combustion processes such as traffic or heating. Secondary formation of fine particles from gaseous pollutants (e.g. NOx, VOCs), is also relevant. CO is the result of incomplete combustion of fuel. A major source is vehicular exhaust. Traffic is a very relevant source for PM and NO_2; the latter is generated during high temperature combustion. SO_2 is produced by volcanoes and biomass fuels which contains sulphur compounds. Tropospheric O_3 is secondary formed from NOx and VOCs in the presence of sunlight (165).

B.1.51 Air pollution interventions can be successful at improving air quality and are associated with health benefits, mainly by reduced cardiovascular and/or respiratory mortality and/or morbidity (166).

B.1.52 Chronic exposure to outdoor air pollution (particulate matter (PM_{10}), nitrogen dioxide and sulphur dioxide) is associated with modestly reduced lung function (forced expiratory volume) in adults. The effects were most marked in men, older adults and ex-smokers (167).

B.1.53 Increased risks for hypertensive pregnancy disorders are associated with exposure to particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide during pregnancy. Exposure to $PM_{2.5}$ and nitrogen dioxide are also associated with significantly increased risk for preeclampsia (168).

B.1.54 There is sufficient evidence that outdoor air pollution increases asthma severity in children and limited evidence for an association with new-onset of childhood asthma, lung infections and middle ear infections. The evidence for an association of ambient air pollution and sudden infant death syndrome (SIDS) is limited (165).

B.1.55 There is an association between asthma prevalence with exposure to traffic in those living very close to heavily trafficked roads carrying a lot of trucks. However the effect on public health is unlikely to be large as air pollutants are likely to make only a small contribution, compared with other factors, in the development of asthma, and in only a small proportion of the population (169).

B.1.56 Short-term exposure to high levels of air pollution may trigger myocardial infarction (heart attack). With the exception of ozone, all the main air pollutants (carbon monoxide, nitrogen dioxide, sulphur dioxide, and particulate matter) are significantly associated with a near-term increase in myocardial infarction risk (170).

B.1.57 Also Gauderman (171)

B.1.58 **Particulate matter**: Particulate matter (PM) is a complex mixture of organic and inorganic substances. Particles found in ambient air range in size from a few nanometres (nm) to several hundred micrometres (µm) in diameter. PM_{10} refers to particulate matter that is generally less than 10 millionths of a metre (10 µm) in diameter. $PM_{2.5}$ refers to particles less than 2.5 µm in diameter. Although it is believed that much of the health impact of particulate matter is due to fine particulates ($PM_{2.5}$), coarse particulates ($PM_{2.5\text{-}10}$) cannot be considered as harmless, hence guidelines and targets for both $PM_{2.5}$ and PM_{10}.

B.1.59 The Committee on the Medical Effects of Air Pollutants (COMEAP) (172) report that the acute effects of particle exposure include increases in hospital admissions and premature death of the elderly and sick due to diseases of the respiratory and cardiovascular systems. The evidence is that both $PM_{2.5}$ and PM_{10} cause additional hospital admissions and deaths on high pollution days. There are also less severe effects of short-term particle exposure during pollution episodes, such as worsening of asthma symptoms and even a general feeling of being unwell leading to a lower level of activity (termed reduced activity days). Long-term exposure to particles causes increased levels of fatal cardiovascular and respiratory diseases, including lung cancer, which reveal themselves as increased rates of death in cities with higher concentrations of airborne particles. Intervention studies have shown marked health improvements as a result of pollution abatement (173). In quantitative terms a pollution reduction of 1 µg/m^3 of $PM_{2.5}$ would lead to on average 20 days increased life expectancy from birth per person (the extent to which individuals are affected is likely to be highly variable) (174).

B.1.60 Ambient airborne particulate matter (PM) is an important environmental pollutant for many different cardiopulmonary diseases and lung cancer. Epidemiological studies show a strong exposure-response relationship between PM for short-term effects (premature mortality, hospital admissions) and long-term or cumulative health effects (morbidity, lung cancer, cardiovascular and cardiopulmonary diseases, etc). The size of the airborne particles and their surface area determine the potential to elicit inflammatory injury, oxidative damage, and other biological effects. These effects are stronger for fine and ultrafine particles because they can penetrate deeper into the airways of the respiratory tract and can reach the alveoli in which 50% are retained in the lung parenchyma. Composition of the PM varies greatly and depends on many factors. The

major components of PM are transition metals, ions (sulfate, nitrate), organic compound (PAHs), quinoid stable radicals of carbonaceous material, minerals, reactive gases, and materials of biologic origin. Toxicological research has shown that PM have several mechanisms of adverse cellular effects, such as cytotoxicity through oxidative stress mechanisms, oxygen-free radical-generating activity, DNA oxidative damage, mutagenicity, and stimulation of proinflammatory factors. Vehicular exhaust particles are found to be most responsible for small-sized airborne PM air pollution in urban areas (175).

B.1.61 There is suggestive evidence that high concentration levels of short-term (but not long-term) coarse particle ($PM_{10-2.5}$) exposure increases hospital admissions and mortality. Relationships are generally stronger for respiratory endpoints, though associations with cardiovascular endpoints cannot be excluded (176).

B.1.62 The evidence is still emerging for the health effects of black carbon (BC) (a component of $PM_{2.5}$). However the research to date shows that BC and correlated co-emissions (e.g. VOCs and PAHs) appear causally related with all-cause, cardiovascular, and lung cancer mortality, and perhaps with adverse birth outcomes and central nervous system effects. BC is generally composed of an elemental carbon nucleus with a coating of mixed organic and inorganics compounds. BC can therefore act as a carrier of other pollutants, in addition to being reactive within the lung fluid (177).

B.1.63 Tyre wear and brake wear particles are present in air, water, soils/sediments and biota. Although only a small fraction of the abraded rubber is airborne, the smallest particles, which probably comprise the largest proportion, can be transported over relatively large distances. The health aspects associated with the inhalation of these particles are largely unknown; however exposure of human lung epithelial cells to organic extracts of tire particles causes an increase in cell mortality and DNA damage, as well as significant modification of cell morphology (178).

B.1.64 **Sulphur dioxide**: There is increasing evidence that SO_2 exposure is an important cause of cardiovascular death and hospital admissions. While the evidence for influencing COPD admissions remains less strong, there is increasing mechanistic evidence to suggest that SO_2 continues to be an important source of respiratory exposure in both the short and long term (172).

B.1.65 **Ozone**: Ozone (O_3) accumulates as a secondary air pollutant following atmospheric photochemical reactions involving oxides of nitrogen (NO_X) and volatile organic chemicals (VOCs). Ozone is a respiratory irritant and a powerful oxidant that reacts to cause epithelial cell damage and inflammation. There is some evidence that the broncho-constrictor effects of inhaled O_3 decrease with age, suggesting that children and young adults may be more sensitive. There is increasing epidemiological evidence that short term exposure to O_3 has important adverse effects on asthmatics, with evidence for increased demands on the National Health Service. Epidemiological studies have also identified O_3 as a pollutant that enhances cardiovascular disease probably through its pro-inflammatory effects on the lung (172).

B.1.66 **Nitrogen dioxide**: There are several oxides of nitrogen (NO_X) in the ambient atmosphere but the principal compound in terms of direct health effects is nitrogen dioxide (NO_2). The main man-made source of NO_X emissions is fossil fuel combustion. Exposure to elevated concentrations of NO_2 has been linked with a range of respiratory symptoms including broncho-constriction, increased bronchial reactivity, airway inflammation, and decreases in immune defence leading to increased susceptibility to respiratory infection. Controlled exposure studies assessing the health effects of short-term exposures to NO_2 show health effects at lower levels more consistently in asthmatics than non-asthmatics. There is no evidence for a NO_2 lower threshold in epidemiological studies and the exposure-response effect of repeated, daily, peak exposures to NO_2 is unknown. NO_2 has been associated with adverse health effects even when the annual average NO_2 concentration complied with the WHO annual guideline value of 40 µg m–3. However, since NO_2 is an important constituent of combustion-generated air pollution, and is highly correlated with other primary and secondary combustion products, it is still unclear to what extent the health effects observed in epidemiological studies are attributable to NO_2 itself or to other correlated pollutants (172).

B.1.67 **Carbon monoxide**: Carbon monoxide (CO) as a toxic gas which competes very successfully with oxygen for binding sites on haemoglobin, reduces the amount of oxygen transported in the blood, and reduces the efficiency of off-loading of oxygen at the tissues. Evidence of health effects is associated with exposure to CO at concentrations significantly higher than those found outdoors in the UK. Outdoor concentrations of CO in the UK are now low and expected to continue to fall in urban areas of the UK (172).

Sensitivities

B.1.68 Variation in individuals sensitivities' to the common air pollutants means that adverse effects can be expected to occur in some individuals even at low concentrations and that, as concentrations rise, effects would increase (172).

B.1.69 Age is the most consistent effect modifier of the association between short-term exposure to particulate matter and death and hospitalization, with older persons experiencing higher risks. In addition to physiological changes that accompany age, older persons are likely have different indoor/outdoor activity patterns, occupational exposures, and social networks (179).

B.1.70 However there is uncertainty for the sensitivity of older people to air pollution. Elderly people may be more susceptible to air pollution; or as levels of many air pollutants (e.g. sulphur dioxide and particulate matter) have fallen dramatically over the last 50 years in the UK, the results may be due to higher air pollution exposure in the past (167).

B.1.71 Those with lower socio-economic status (SES) face higher particulate matter–associated risks, however current evidence does not yet justify a definitive conclusion that socioeconomic characteristics modify the effects of air pollution on mortality (179).

B.1.72 There is a significant association between hospital emergency visits for wheezing and gastroenteric disorders in children 0–2 years of age and air pollution levels (180).

B.1.73 Children differ from adults in many aspects which are relevant when assessing health risks from chemicals. This concerns critical development windows, exposure circumstances, metabolism, and the disease spectrum. In children, birth deformities, neurodevelopment, reproductive outcomes and respiratory system are mainly affected by chemical exposures (165).

B.1.74 There is an association between air pollution and daily chronic obstructive pulmonary disease (COPD) related emergency department visits for individuals aged 40 years and older. Air pollution should therefore be considered a risk factor in COPD exacerbation (181).

B.1.75 Both gaseous pollutants and PM are weakly associated with a higher risk of diabetes-related mortality and morbidity; the association with gaseous pollutants, particularly NO_2 and O_3, was strongest (182).

Advisory thresholds

B.1.76 For air quality, any exceedance of the thresholds set out by the World Health Organization (183) could be considered a significant negative impact. Such standards are in some cases more stringent than those for AQMAs set out in the UK Air Quality Standards Regulations 2010 (184) (see Table 13-1). Notably for Particulate Matter there is as yet no identifiable threshold below which $PM_{2.5}$ would not pose a risk to health (185).

B.1.77 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (96) sets out air quality objectives and policy options to further improve air quality in the UK. Notwithstanding that there are lower aspirational targets set by the WHO (183) the appropriate air quality requirements are the statutory values set out in the Air Quality Standards Regulations 2010 (184).

Table 13-1 Comparison of UK Air Quality Objectives and WHO Guide Values

Pollutant	UK Air Quality Objective	WHO Guide Value
Particles (PM_{10})	50 µg/m3 24 hour mean	50 µg/ m3 24 hour mean
	40 µg/ m3 annual mean	20 µg/ m3 annual mean
Particles ($PM_{2.5}$)	25 µg/ m3 annual mean	10 µg/ m3 annual mean
	No equivalent	25 µg/m3 24 hour mean
Nitrogen dioxide	200 µg/ m3 1 hour mean	200 µg/ m3 1 hour mean
	40 µg/ m3 annual mean	40 µg/ m3 annual mean
Ozone	100 µg/ m3 8 hour mean	100 µg/ m3 8 hour mean
Sulphur dioxide	125 µg/ m3 24 hour mean	20 µg/ m3 24 hour mean
	No equivalent	500 µg/ m3 10 minute mean

B.1.78 Long-term exposure to fine particulate air pollution ($PM_{2.5}$) is associated with natural-cause mortality, even within concentration ranges well below the present European annual mean limit value (186).

B.1.79 The REVIHAAP report by the World Health Organization (185) into the health effects of air pollution may result in lowering of EU statutory thresholds and WHO recommended levels for air pollutants. The REVIHAAP report highlights that the WHO has set a short-term (24-hour) $PM_{2.5}$ limit value, however this needs to be reflected in EU and national emissions standards. The report also notes the need for the EU to re-evaluate (lower) its other PM limit values. The REVIHAAP report states with regard to PM that current scientific evidence implies that guidelines and standards cannot be proposed that would lead to complete protection against the adverse effects on health of PM, as the complete elimination of anthropogenic PM is not feasible. Rather, the standard setting process needs to achieve the lowest concentrations possible in the context of local constraints, abilities and public health priorities.

Statutory thresholds

B.1.80 The UK Air Quality Strategy sets out air quality objectives and policy options to improve air quality in the UK (96). The strategy sets down standards and objectives for air quality pollutants and allows Local Authorities to review air quality in their area against these.

Summary dust emissions evidence base

B.1.81 IAQM guidance on construction dust impacts notes that the most common impacts are dust soiling and increased ambient PM10 concentrations due to dust arising from activities on the site. Dust soiling would arise from the deposition of PM in all size fractions, but would be associated mostly with particulate matter greater than 10 µm. The ambient PM relevant to health outcomes would be that measured as PM10, although most of this would be in the PM2.5-10 fraction, rather than the PM2.5 fraction. Research undertaken in the US suggests that 85% to 90% by weight of the fugitive dust emissions of PM10 from construction sites are PM2.5-10 and 10% to 15% are in the PM2.5 fraction (187).

Health effects

B.1.82 Dust covers a spectrum of particulates of different sizes, compositions and origins. Generally the discussion of dust focuses on impacts other than fine particulates (e.g. $PM_{2.5}$) which are covered under air quality impacts. The health impacts from the larger particulates of dust depend

on the toxicity of the particles, their size and the level of exposure experienced. Impacts range from reductions in well-being from property being covered in layers of precipitated dust, to respiratory conditions from inhalation. The former are not well documented in the scientific literature.

B.1.83 The term ‘nuisance’ dust should not be used in relation to low-toxicity dusts (e.g. those containing low crystalline silica content) as it erroneously implies that there are no health problems that might arise from exposure. Exposure to low-toxicity dusts, can cause chronic obstructive pulmonary disease or other respiratory diseases (188).

B.1.84 The evidence base on community (non-occupational) dust health impacts is incomplete. However the association between high dust exposures and health impacts is established by occupational setting studies. There is cross-over between air quality particulate matter (e.g. PM_{10}) impacts and more general dust impacts, reference should therefore also be made to the air quality evidence base above. It should be noted that dust originates both naturally (e.g. sea salt), as a result of ground disturbance (e.g. spoil heaps) and from man-made activates (e.g. tyre ware).

B.1.85 Wind can erode and disperse fine-grained material from an impoundment of stored or waste substrate that stands above the level of its surroundings. Such dust dispersion can be a serious nuisance as well as a health hazard to inhabitants and animals in nearby settlements. It can also degrade crops, making them less marketable, and pollute soil, surface water and ground water. Wind can seasonally erode waste impoundments in all types of climate, but the erosion intensifies and persists for more of each year as regional aridity increases. As clouds of dust are often observed billowing across the top surfaces of waste impoundments in dry windy weather, there is a common misconception that dust arises from erosion of the top surface of an impoundment, resulting in much effort and money being misspent on top treatments when in fact the sloped sides of the impoundments are the source of blown dust. The upper windward slopes, and particularly the areas just below windward crests, are most susceptible to wind erosion (189).

B.1.86 In addition to dust originating locally, atmospheric aerosols (gaseous dispersion of either fine liquid droplets or fine solid particles) are emitted by other natural and anthropogenic sources. The main natural sources of atmospheric aerosols influencing air quality across Europe are African dust, sea spray and wildfires. Contributions from natural sources to mean annual PM_{10} levels in 2008 and 2009 were 5 $\mu g/m^3$ in the UK (190)

B.1.87 Dust from the African and Asian deserts can affect air quality in Europe, with prolonged exposure of individuals living at considerable distances from the source of particulates (191).

B.1.88 The main global source of atmospheric mineral dust is the Sahara desert, which produces about half of the annual mineral dust. Sahara dust transport can lead to PM levels that substantially exceed the established limit values in Europe. Whilst the association of fine particles ($PM_{2.5}$) with total or cause-specific daily mortality is not significant during Saharan dust intrusions into Europe; the health impacts of coarser fractions (PM_{10} and $PM_{2.5\text{-}10}$) is inconclusive (192).

B.1.89 Desert dust cloud toxicity may be influenced by manmade materials that are aerosolised during cloud formation or transport (e.g. adsorption of pesticides, herbicides, and industrial emissions, etc.). Microorganisms may also be mobilized into the atmosphere along with desert soils. Some of these are pathogens that are capable of surviving long-range transport on a global scale (191).

B.1.90 Whilst stringent policies succeed in reducing road transport particulate matter (PM) exhaust emissions, they do not address "non-exhaust" emissions from brake wear, tyre wear, road wear, and suspension in air of road dust. Non-exhaust emissions and in particular suspension in air of road dust are major contributors to exceedances at street locations of the PM_{10} air quality standards in various European cities. Furthermore, wear-related PM emissions that contain high concentrations of metals may cause significant health risks for the population, especially those living near intensely trafficked locations (193).

B.1.91 Exhaust and non-exhaust traffic-related sources are estimated to contribute almost equally to traffic-related PM_{10} emissions. However, whilst constituents of airborne brake wear particles have been recognized as dangerous or potentially dangerous for the human health, there are no comprehensive studies linking brake wear particles with adverse effects on human health (194).

B.1.92 Dust particles can adsorb and concentrate odorants, causing a potential inter-relation between dust and odour nuisance. In addition, organic particles can decay and generate odorous compounds. Odorants can exist in much higher concentrations in the dust particles than in equivalent volumes of air. Thus, inhalation of odorous dust and deposition of the dust particles in the mucus overlying the olfactory mucosa are likely responsible for some odour-related complaints. Dust particles may be

responsible for a considerable proportion of odorant emissions from buildings and odour perceptions by downwind neighbours. Odour control may therefore require a reduction in dust emission from buildings (195). Volatile organic compounds (VOCs), which can be harmful to health, preferentially bind to smaller-sized dust particles (196).

Occupational

B.1.93 Dusty occupational environments are of potential concern, such as handling of dusty materials, machining, cutting, drilling, milling and rock pounding. A lot of the dust is harmless as it is too large to be respirable except when present in high concentrations when it can cause some discomfort. However, it still has the potential to inflict injury on the sensitive cornea, and the mucosal lining of the eyelids. At such levels it is termed 'nuisance dust'. However some forms of dusts are distinctly harmful, giving rise to impairment of lung function and pneumoconiosis (dust-induced changes in the lung). This includes coal dust (miners lung) and agricultural grain (farmer's lung) (197).

B.1.94 There is a high prevalence of skin symptoms and skin hypersensitivity in construction workers compared to the general population. One of the main occupational determinants is nuisance due to dust exposure (198).

B.1.95 Occupational exposure to respirable quartz dust is associated with airway obstruction consistent with chronic obstructive pulmonary disease (COPD) (199).

B.1.96 In addition to inhalation and deposition dust impacts, under certain conditions dust becomes explosive. The conditions require: combustible dust; an ignition source; an oxidant (usually oxygen in the air); mixing; and confinement (200). Resulting fires may be both a health hazard in their own right, but also the contaminants released from the fire, and potentially firefighting equipment.

Sensitivities

B.1.97 As for particulate matter sensitivity in air quality section.

Advisory thresholds

B.1.98 In Britain, the 'de facto' occupational airborne exposure limits for nuisance dusts are 10 mg/m^3 for inhalable dust and 4 mg/m^3 for respirable dust. Since these limits were set over 30 years ago exposures in industry have decreased and although in the past, many occupational dust exposures

may have exceeded these limits, today this is less likely. However, there is good evidence from epidemiology and toxicology studies that current dust exposures may still present a risk to workers and that for some of those who are affected, there are devastating health consequences. Recommendations from the Institute of Occupational Medicine, health and safety professionals should consider 1 mg/m^3 of respirable dusts as a more appropriate guideline than the value of 4 mg/m^3 currently used (188).

B.1.99 The amount of dust that might cause complaint or nuisance in a particular circumstance is very difficult to determine and there are no statutory limits such as those applicable to suspended particulates or gaseous pollutants. The literature is unclear on the origin of studies that have been used by industry and environmental assessments as a basis for determining the likelihood of dust deposition nuisance. The Quality of Urban Air Review Group (201) is perhaps the most authoritative source. The report notes that reference is frequently made to an annual deposition rate of 200 mg/m^2/day, although the basis of this figure has never been adequately traced. This value is said to represent the threshold for serious nuisance. The report references Bate and Coppin (202) who note the unreliability of the 200 mg/m^2/day criterion and that the literature contains a range of criteria from 133 to 350 mg/m^2/day. Given this uncertainty, Bate and Coppin suggest it may be more appropriate to set a criterion for nuisance of two to three times the existing background deposition rate. The Quality of Urban Air Review Group report notes the limitation of this approach is that there is no reliable published database of existing deposition rates to act as a baseline (202). Bate and Coppin also state that as the nature of dust plays an important role in determining its nuisance impact, for example for coal dust a deposition rate of 80 mg/m^2/day (rather than 200 mg/m^2/day) is likely to give rise to complaints.

B.1.100 The uncertainty in the literature underpinning the thresholds commonly applied to determine dust nuisance suggests the need for caution. In addition to quantified deposition measures, consideration of: background dust levels; the nature of the dust (e.g. colour or staining properties); and the duration of effect (daily and weekly as well as annual deposition rates) may all be important.

B.1.101 Peak event analysis is one approach that could be used during extreme particulate events that may contribute to local complaints regarding intermittently dusty conditions. These outlier events may not appear through conventional analytical approaches. In comparison with

conventional descriptive approaches, peak event analysis provided a more analytical and data-driven means to identify suspended particulate events with meaningful and perceptible effects on local residents (203).

Statutory thresholds

B.1.102 The Control of Substances Hazardous to Health Regulations 2002 (COSHH) (204) creates obligations on employers for control of hazardous substances in the workplace, including the effects of dust. The duty extends as far as is reasonably practicable, to any other person, whether at work or not, who may be affected by the work carried out by the employer.

B.1.103 The Health and Safety Executive state that dust can become a substance hazardous to health under COSHH when it is present at concentrations in the air equal to or greater than: 10 mg/m^3 (as a time-weighted average over an eight-hour period) of inhalable dust; or 4 mg/m^3 (as a time-weighted average over an eight-hour period) of respirable dust (205).

B.1.104 Summary noise evidence base

B.1.105 Health effects of noise (vibration is considered separately)

B.1.106 The evidence base that noise has the potential to impact on health outcomes is strong, with many good quality studies both in community as well as occupational settings. The evidence base highlights that subjective influences can be as important to adverse reactions as the actual noise levels themselves. However for the majority of people there are health based noise thresholds set by the WHO below which impacts are not expected.

B.1.107 Noise is pervasive in everyday life and can cause both auditory and non-auditory health effects. Noise-induced hearing loss remains highly prevalent in occupational settings, and is increasingly caused by social noise exposure. Evidence of the non-auditory effects of environmental noise exposure on public health is growing. Observational and experimental studies have shown that noise exposure leads to annoyance, disturbs sleep and causes daytime sleepiness, increases the occurrence of hypertension and cardiovascular disease, and impairs cognitive performance in schoolchildren. Non-auditory health effects of environmental noise are manifold, serious and, because of the widespread exposure, very prevalent. These factors stress the need to regulate and reduce environmental noise exposure (ideally at the source) and to enforce exposure limits to mitigate negative health consequences of chronic exposure to environmental noise. Efforts to reduce noise exposure would eventually be rewarded by lower amounts of annoyance, improved learning environments for children, improved sleep and lower prevalence of cardiovascular disease. The review notes the importance of sleep disturbance in affecting health outcomes and summarises WHO findings for general health effects at different levels of night-time noise (206). These are reproduced in Table 13-2.

B.1.108 Noise-induced sleep disturbance constitutes an important mechanism on the pathway from chronic noise exposure to the development of adverse health effects. Noise mitigation strategies to improve public health include noise reduction at the source, active noise control (e.g. noise optimized take-off and approach procedures for aircraft), optimized traffic operations (including traffic curfews), better infrastructural planning, better sound insulation in situations where other options are not feasible, and adequate limit values (207).

B.1.109 Noise stress exerts a clear negative effect on attention, working memory and episodic recall. Furthermore personality characteristics, in particular neuroticism, and sleep disturbance influence the impact of noise stressors on performance in interaction with task complexity (208).

Table 13-2 WHO definitions of health effects of different average night noise levels

Below 30 dB LAeq,night,outside	Although individual sensitivities and circumstances may differ, it appears that up to this level no substantial biological effects are observed. LA,eq,night,outside of 30 dB is equivalent to the no observed effect level (NOEL) for night noise.
30–40 dB LAeq,night,outside	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbance, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example children, the chronically ill, and elderly people) are more susceptible. However, even in the worst cases the effects seem modest. LA,eq,night,outside of 40 dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.
40–55 dB LAeq,night,outside	Adverse health effects are observed among the exposed population. Many people have to adapt their lives to cope with the noise at night. Vulnerable groups are more severely affected.
Above 55 dB LAeq,night,outside	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

From Basner et al (206).

B.1.110 Noise is an influential source of stress. Effects of noise on performance depend on the type of noise, nature of the task, and personal characteristics. Intermittent noise of relatively short duration is most disruptive, particularly where it interferes with speech or cognitive tasks because there is limited capacity for the individual to compensate. In contrast, for conditions of continuous noise of longer duration, individuals can develop more effective coping strategies (209).

B.1.111 Although the use of physical barriers is an established effective mitigation strategy for noise impacts, the presence of vegetation can generally reduce the negative perception of noise. Whilst the evidence is weaker for

vegetation being an effective noise attenuating physical barrier, the use of vegetation as part of a noise barrier could be considered (210).

B.1.112 A limitation of physical noise abatement measures is that in addition to sound characteristics, other more subjective influences affect noise perception. For example, although annoyance is one of the main impacts associated with environmental noise, non-acoustical factors play an important role in annoyance ratings. Technical interventions reducing noise levels may therefore not have impacts on annoyance proportionate to their impacts on sound levels. The most important modifiers of annoyance ratings are: attitude towards the noise source; trust in the authorities involved; direction of change of noise level; and information available about the change (211).

Transport specific studies

B.1.113 Transport is a well-established source of environmental noise. Road traffic noise is a significant risk factor for cardiovascular diseases. Chronic long-term exposure to transportation noise is associated with the prevalence and incidence of cardiovascular diseases, including hypertension, ischemic heart diseases and stroke. Meta-analysis has found an 8% increase in risk per increase of the weighted day-night noise level L DN of 10 dB (A) within the range of approximately 52-77 dB (A) (5 dB-category midpoints) (212).

B.1.114 The evidence is stronger for an association between the noise annoyance and arterial hypertension than for the risk of ischemic heart disease (213).

Sensitivities

B.1.115 At risk groups most often mentioned in the literature are: children; the elderly; the chronically ill; and people with a hearing impairment. Other categories include: those of sensitive persons; shift workers; people with mental illness (e.g. schizophrenia or autism); people suffering from tinnitus; and foetuses and neonates. The mechanism for vulnerability has not been clearly described and relevant research has seldom focused on the health effects of noise in these groups in an integrated manner. Effects of noise on schoolchildren are the best documented. The available evidence shows that children are less vulnerable for annoyance than adults, but more vulnerable for cognitive effects of noise. They are not per se more vulnerable as a group, but more at risk because of less-developed coping strategies, and they are in a sensitive developmental period. This is indicative of a life phase effect rather than an age effect.

Children seem to be less vulnerable for awakenings due to noise but more vulnerable for physiological effects during sleep and related motility. There is some evidence that annoyance from both road and air traffic noise predicts asthma prevalence in children (both self-reported and diagnosed). Evidence does not indicate that the elderly are more vulnerable to noise in terms of annoyance and sleep disturbance. Age-specific comparisons rather show an inverted U-shaped relation and indicate that both young and older people are less at risk as far as annoyance and disturbance are concerned. But, possibly, the elderly are more vulnerable regarding cardiovascular effects, and this may be a combined effect of air pollution and noise (214).

B.1.116 Based on the relatively low quality evidence, chronic occupational noise exposure of expectant mothers did not seem to be associated with birth weight of their newborns, congenital anomalies, preterm birth and fetal growth. Results on threatened abortions, preterm labour and on aircraft noise exposure and birth weight remain inconclusive. There is some evidence for an association between detrimental effects and chronic noise exposure regarding increased stress hormone levels in urine and saliva and increased systolic blood pressure in early and late childhood (215).

Occupational

B.1.117 There is a statistically significant increase of systolic and diastolic blood pressure in workers experiencing a high level of noise exposure compared to low or intermediate exposure. Heart rate, hypertension and electrocardiogram (ECG) anomalies are also statistically higher in high exposure participants compared to low exposure participants (216).

B.1.118 Stricter enforcement of legislation and better implementation of hearing loss prevention programs (HLPP) can reduce noise levels in workplaces (217).

Advisory thresholds

B.1.119 Table 13-3 sets out evidence based noise thresholds for health impacts compiled by the European Environment Agency (218). The World Health Organization state that a threshold of 40 dB Lnight outside should be the target of the night noise guideline to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly (40). The Community Guidelines from the World Health Organization (41) recommends 50/55 LAeq, 16hr as health based threshold, which is in line with earlier recommendations and guidance from ISO and national and

international environment agencies (218). The WHO Community Guidelines are currently being updated (219).

Table 13-3 Evidence based effects of noise on health and wellbeing

Effect	Dimension	Acoustic indicator12	Threshold[13]	Time domain
Annoyance disturbance	Psychosocial, quality of life	Lden[14]	42	Chronic
Self-reported sleep disturbance	Quality of life, somatic health	Lnight[15]	42	Chronic
Learning, memory	Performance	Leq	50	Acute, chronic
Reported health	Wellbeing clinical health	Lden	50	Chronic
Hypertension	Physiology somatic health	Lden	50	Chronic
Ischaemic heart diseases	Clinical health	Lden	60	Chronic

WHO Guidelines for Community Noise

B.1.120 The World Health Organisation (WHO) state that, in dwellings, the critical effects of noise are on sleep, annoyance and speech interference. To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level in outdoor living areas should not exceed 55 dB LAeq for a steady, continuous noise. To protect the majority

[12] Lden and Lnight are defined as outside exposure levels.
[13] Level above which effects start to occur or start to rise above background.
[14] Lden is the day-evening-night equivalent level. This is the A-weighted, Leq noise level, measured over the 24 hour period, with a 10 dB penalty added to the levels between 2300 and 0700 hours and a 5 dB penalty added to the levels between 1900 and 2300 hours to reflect people's extra sensitivity to noise during the night and the evening.
[15] Lnight is the night equivalent level Leq. This is the A-weighted, Sound Level, measured overnight 2300 - 0700 hours.

of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB LAeq.

B.1.121 To avoid sleep disturbance, indoor guideline values for bedrooms are 30 dB LAeq for continuous noise and 45 dB LAmax for single sound events. These indoor noise levels correspond to sound pressure levels at the outside façades of the living spaces of 45 dB LAeq and 60 dB LAmax. These values have been obtained by WHO assuming that the noise reduction from outside to inside with the window partly open is 15 dB.

Table 13-4 WHO Guidelines on Community Noise 1999, guideline values for community noise in specific environments.

Specific environment	Critical health effect(s)	Leq [dBA]	Time base [hours]	Lmax, fast [dBA]
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech comprehension and moderate annoyance, daytime and evening	35	16	45
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School class rooms and pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoors	Sleep disturbance	30	sleeping-time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time	30	8	40
	Sleep disturbance, daytime and evenings	30	16	-
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		

Specific environment	Critical health effect(s)	Leq [dBA]	Time base [hours]	Lmax, fast [dBA]
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music through headphones/earphones	Hearing impairment (free-field value)	85 #4	1	110
Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	-	-	140 #2
	Hearing impairment (children)	-	-	120 #2
Outdoors in parkland and conservation areas	Disruption of tranquillity	#3		

#1: as low as possible
#2: peak sound pressure (not Lmax, fast), measured 100 mm from the ear
#3: existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low

WHO Night Noise Guidelines for Europe

B.1.122 The 2009 WHO publication 'Night Noise Guidelines for Europe' reviews the scientific evidence on the health effects of night-time noise exposure, and presents derived health-based guideline values (40). The guidelines present a night noise guideline (NNG) of 40 dB Lnight (outside) and an interim target of 55 dB(A) aimed at situations where the 40 dB(A) target is not achievable for various reasons. It should be noted that these guidelines are applicable to WHO European Region member States. Furthermore, the guideline value is expressed as a yearly average, and hence occasional exceedances should not necessarily be interpreted as likely to result in harmful effects.

B.1.123 Lnight, outside is the night-time noise indicator (Lnight) of Directive 2002/49/EC of 25 June 2002: the A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night periods of a year; in which: the night is eight hours (usually 23.00 – 07.00 local time), a year is a relevant year as regards the emission of sound and an average year as regards the meteorological circumstances, the

incident sound is considered, the assessment point is the same as for Lden. See Official Journal of the European Communities, 18.7.2002, for more details.

British Standards Guidance

B.1.124 The following summary of relevant BS guidance is provided as these are a key reference point for the assessment of noise impacts.

BS 4142: 2014

B.1.125 The British Standard 'BS 4142: 2014, Methods for rating and assessing industrial and commercial sound' (44) provides guidance on assessment of industrial and commercial noise, comparing the ‘rating level’ of the new noise source with the existing ‘background level’.

B.1.126 The sound from the industrial/commercial source is rated by taking into account the sound level of the source, known as the specific sound level, and its characteristics, such as tonal, impulsive or intermittency of the source, and applying an appropriate correction to give the rating level of the sound source. To gain an initial estimate of the potential impacts of the sound source, it is compared to the background noise level, and the level by which the rating level exceeds the background noise level indicates the following potential impacts:

Table 13-5 BS 4142: 2014 industrial and commercial sound

Difference	Assessment
Around 10 dB or more	Likely to be an indication of a significant adverse impact, depending on the context
Around 5 dB	Likely to be an indication of an adverse impact, depending on the context
0 dB or less	An indication of the specific sound source having a low impact, depending on the context

B.1.127 The standard states that “where an initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following:

- The absolute level of the sound
- The character and level of the residual sound compared to the character and level of the specific sound

- The sensitivity of the receptor”

BS 8233: 2014

B.1.128 The British Standard 'BS 8233: 2014, Guidance on Sound insulation and noise reduction for buildings' (45) provides additional guidance based on the recommendations of the World Health Organisation. BS 8233: 2014 is primarily intended to guide the design of new or refurbished buildings undergoing a change of use rather than to assess the effect of changes in the external noise climate. BS 8233: 2014 deals with control of noise from outside the building, noise from plant and services within it, and room acoustics for non-critical situations, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building. The criteria desirable levels of steady state, “anonymous” noise within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below:

Table 13-6 BS 8233: 2014 guidance based on WHO recommendations

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB LAeq, 16 hour	-
Dining	Dining room/area	40 dB LAeq, 16 hour	-
Sleeping (daytime resting)	Bedroom	35 dB LAeq, 16 hour	30 dB LAeq, 8 hour

B.1.129 BS 8233: 2014 notes, however that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

B.1.130 The standard also recommends that for traditional external amenity areas, such as gardens, it is desirable that external noise levels do not exceed 50 dB LAeq, T, and that 55 dB LAeq, T would be acceptable in noisier environments. However, it is recognised that these values may not be achievable in all areas where development is desirable and in such locations, development should be designed to achieve the lowest practicable levels.

B.1.131 General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce

external noise and space planning and sound insulation for the control of internal noise levels.

BS 5228:2009+A1:2014

B.1.132 The 'British Standard BS 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites, noise (46), provides methods of estimating construction noise. The Standard also includes several example methods for determining the thresholds at which 'significant effects' may occur at residential dwellings. BS Annex E provides guidance for assessing significant noise impacts for construction and demolition activities. A variety of methods are provided. The ABC method is one that is commonly used and determines significance relative to existing background noise levels.

B.1.133 Table 13-7 shows the example ABC threshold of significant effect test for dwellings. The table can be used as follows: for the appropriate period (night, evening/weekends or day), the ambient noise level is determined and rounded to the nearest 5 dB. This is then compared with the total noise level, including construction. If the total noise level exceeds the appropriate category value, then a significant effect is deemed to occur.

Table 13-7 BS 5228 ABC Noise Significance Test

Assessment Category and Threshold Value Period (LAeq)	**Threshold Value, in decibels (dB)**		
	Category A (a)	**Category B (b)**	**Category C (c)**
Night-time (2300 – 0700)	45	50	55
Evenings and Weekends (d)	55	60	65
Daytime (0700 – 1900) and Saturdays (0700 – 1300)	65	70	75
NOTE 1: A significant effect has been deemed to occur if the total LAeq noise level, including construction, exceeds the threshold level for the Category appropriate to the ambient noise level			
NOTE 2: If the ambient noise level exceeds the threshold values given in the table (i.e. if the ambient noise level is higher than the above values), then a significant effect is deemed to occur if the total LAeq noise level for the period increases by more than 3 dB due to construction activity			
NOTE 3: Applied to residential receptors only.			

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

B.1.134 It should be noted that the thresholds in BS 5228-1:2009+A1:2014 are examples and therefore there is scope for them to be adapted if deemed necessary under local circumstances.

B.1.135 It is recommended that where the ABC method is used, the second method of BS 5228 Annex E ('5dB change method') is also used within a 'sensitivity assessment' to verify the prediction of potentially significant effects identified using the ABC method.

B.1.136 The approach presented by BS guidance is recognised and can be useful, but caution should be exercised. Where there are existing high background noise levels the methodology is likely to find there is no significant impact despite exceeding WHO recommended noise thresholds.

Statutory thresholds

B.1.137 The Environment Agency has a Pollution Prevention and Control Guidance series, which includes noise:

B.1.138 Horizontal Guidance for Noise Part 1 - Regulation and Permitting (42); and

B.1.139 Horizontal Guidance for Noise Part 2 - Noise Assessment and Control (43).

B.1.140 Statutory nuisance is defined in the Environmental Protection Act 1990 (220-223) as various uses or impacts that are "prejudicial to health or a nuisance".

B.1.141 Prejudicial to health has been taken to mean injurious, or likely to cause injury, to health; with a direct or indirect underlying threat to health not just a risk of personal injury or accident.

B.1.142 Nuisance is generally considered to be some form of damage to, or unreasonable and substantial interference with a person's use or enjoyment of property.

B.1.143 This includes noise emitted from from premises or caused by a vehicle, machinery or equipment in a street.

B.1.144 It is noted that there are various defences to nuisance claims, including 'Best Practicable Means' and 'Statutory Authority'. However these are defences and not exemptions. The grant of statutory authority, for example a planning permission or environmental permit, does not necessarily permit a nuisance to take place, (*Coventry v Lawrence 2014*) (224).

Summary vibration evidence base

B.1.145 There is not a strong evidence base that vibration impacts outside of occupational scenarios (such as working with vibrating machinery) are an important determinant of health. However although vibration effects generally do not propagate far, there is emerging evidence that under certain conditions vibration can increase disturbance particularly from sources that produce both noise and vibration.

B.1.146 British Standard BS 5228-2:2009+A1:2014 (225) states that vibrations transmitted from site activities to a neighbourhood can cause anxiety as well as annoyance, and can disturb sleep, work or leisure activities. Vibrations can also cause structure-borne noise which can be an additional irritant to occupants of buildings e.g. loose fittings are prone to rattle (structural damage is rare). In any neighbourhood, some individuals would be more sensitive to vibration than others.

B.1.147 A large study of railway traffic found strong impacts of annoyance from ground-borne vibrations, especially in areas where the ground consists of clay. The study found noise annoyance was higher in groups exposed to strong vibrations, and vibration annoyance was higher in groups with high sound levels. The study concluded that noise annoyance increases in the presence of simultaneously occurring vibrations. Vibrations may facilitate the perception of noise and make it difficult to ignore and habituate to, which may lead to an increased risk of perceiving the noise as more annoying than in situations with no simultaneous vibrations. Three useful quantitative findings can be derived from this study. Although these findings relate to railway impacts it may be reasonable to generalise them other sources of vibration (226).

B.1.148 The data showed vibration annoyance increased with higher vibration velocities from 5% at 0.1 mm/s to 80% at 0.5 mm/s, with a steep increase in vibration annoyance around 0.4 mm/s.

B.1.149 The measured vibration velocity declined by approximately 47% for each doubling of distance.

B.1.150 The study concludes that to compensate for the additional disturbance impact of vibration a 5 - 7 dB lower noise level is needed in areas with strong or frequent ground-borne vibrations.

B.1.151 A small study concluded that nocturnal vibration has a negative impact on sleep and that the impact increases with greater vibration amplitude. The finding links vibration (independently of noise) to sleep disturbance, which is known to have short- and long-term health consequences (227).

B.1.152 A further small study concluded that vibration exposure led to a significant change of heart rate. Cardiac responses were higher in the high-vibration condition than in the low-vibration condition. The study notes that the long term exposure of people to such vibrations may affect cardiovascular function (228).

B.1.153 Low frequency noise, the frequency range from about 10Hz to 200Hz, is a special environmental noise problem, particularly to sensitive people in their homes. Four main subjective factors are involved in responses to low frequency noise: auditory perception; pressure on the eardrum; perception through vibration of the chest; and more general feeling of vibration. ‘Hum', is the name given to a low frequency noise which is causing persistent complaints, but often cannot be traced to a single, or any, source. The effects of a Hum may include pressure or pain in the ear or head, body vibration or pain, loss of concentration, nausea and sleep disturbance. Regulatory authorities must accept that annoyance by low frequency noise presents a real problem which is not addressed by commonly used assessment methods. In particular, the A-weighted level is very inadequate. Special difficulties arise when, despite persistent annoyance, there is no "measurable" noise or, as might occur in urban areas, the noise levels at low frequencies are in the 40 - 50dB range (229).

B.1.154 A mechanism to support causal relationships between vibration impacts and human perception is from evidence that the mechanoreceptive hair-cells of the human inner ear have a remarkable sensitivity to displacement, whether excited by sound or substrate-borne vibration. In

addition to the cochlea's roles in perception of frequencies associated with speech, the human vestibular system (usually associated with balance) is also extremely sensitive to low-frequency and infrasound vibrations. Investigations indicate that the seismic sensitivity of the human vestibular system exceeds that of the cochlea for low-frequencies (230).

Occupational (vibration)

B.1.155 The greatest adverse health impacts associated with direct exposure to vibration are reported for occupational settings. However such occupational exposure levels are very unlikely to be experienced by community members.

B.1.156 British Standard BS 5228-2:2009+A1:2014 (225) states that exposure to prolonged and regular work with high-vibration hand held tools can be a serious hazard to health. Workers using such equipment can suffer various forms of adverse effects, collectively known as hand–arm vibration syndrome. The best known effect is vibration white finger (VWF) which is a prescribed industrial disease. Exposure to high levels of whole body vibration (WBV), e.g. for drivers of certain mobile plant in rough terrain conditions, can also be a serious hazard to health.

Advisory thresholds (vibration)

B.1.157 British Standard BS 5228-2:2009+A1:2014 (225) states that human beings are known to be very sensitive to vibration, the threshold of perception being typically in the Peak Particle Vibration (PPV) range of 0.14 mm/s to 0.3 mm/s. Vibrations above these values can disturb, startle, cause annoyance or interfere with work activities. At higher levels they can be described as unpleasant or even painful. In residential accommodation, vibrations can promote anxiety lest some structural mishap might occur.

B.1.158 BS 5228-2:2009+A1:2014 Annex B provides guidance on the likely reaction of people to various levels of vibration measured in terms of the PPV, see Table 13-8.

Table 13-8 BS guidance on human response to vibration levels

Peak Particle Vibration Level	Impact
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies

	associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments would cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

B.1.159 The results of vibration sensitivity from BS 5228-2:2009+A1:2014 (225) and Gidlöf-Gunnarsson et al (226) suggest that a vibration threshold of no more than 0.3 mm/s PPV should generally be the target to avoid adverse health impacts.

Statutory thresholds (vibration)

B.1.160 Environmental Protection Act 1990 defines noise as including vibration (220-223).

B.1.161 As vibration is included within the definition of noise for statutory nuisance, see regulation of noise impacts above.

Summary access to work and training evidence base

B.1.162 Employment is beneficial for health, particularly for depression and general mental health (231).

B.1.163 The nine most pronounced factors considered as important for a healthy workplace are, in descending order: collaboration/teamwork; growth and development of the individual; recognition; employee involvement; positive, accessible and fair leader; autonomy and empowerment; appropriate staffing; skilled communication; and safe physical work (232).

B.1.164 **Job related stress**: Working long hours is associated with depressive state, anxiety, sleep condition, and coronary heart disease (233). Unfavourable work characteristics, such as low job control and too high or too low job demands, may have a spill over effect on leisure-time resulting in less physical activity (234). Job strain is associated with hypertension (high blood pressure) (235,236) and may be associated with an increased risk of ischemic stroke (heart attack) (237). The evidence supports that

psychosocial job stresses are related to disrupted immune responses but further research is needed to demonstrate cause-effect relationships (238).

B.1.165 The modest association between perceived job insecurity and incident coronary heart disease is partly attributable to poorer socioeconomic circumstances and less favourable risk factor profiles among people with job insecurity (239). Lower levels of job insecurity are associated with having lower amounts of role ambiguity and role conflict, greater amounts of organizational communication, less organizational change, younger employees, and white-collar and permanent work (240).

B.1.166 **Unemployment**: The long-term unemployed carry a markedly higher burden of disease, particularly mental illness, than employed persons and those who are unemployed only for a short time. The burden of disease increases with the duration of unemployment. The vicious circle of unemployment and disease can be broken only by the combined effects of generally available health care, special health-promoting measures among the unemployed, and social interventions (241).

B.1.167 When patients are diagnosed with a disease, they develop an organized pattern of beliefs about their health condition. These beliefs are called illness perceptions and they determine patients' future behaviour concerning managing the disease. A review of illness perceptions and work participation in patients with somatic diseases and complaints found non-working patients perceived more serious consequences, expected their illness to last a longer time, and reported more symptoms and more emotional responses as a result of their illness. Working patients had a stronger belief in the controllability of their condition and a better understanding of their disease (242).

B.1.168 There are ongoing questions about whether unemployment has causal effects on suicide as this relationship may be confounded by past experiences of mental illness. Plausible interpretations of likely pathways between unemployment and suicide are complex and difficult to validate given the poor delineation of associations over time and analytic rationale for confounder adjustment evident in the revised literature (243). However findings suggest that long-term unemployment is associated with greater incidence of suicide. Results suggest that risk is greatest in the first five years, and persists at a lower but elevated level up to 16 years after unemployment (244).

B.1.169 Risky alcohol consumption (associated with hazardous, binge, and heavy drinking) is more prevalent among the unemployed. They are also more likely to be smokers, to use illicit and prescription drugs, and to have alcohol and drug disorders (abuse, dependence). Problematic substance use increases the likelihood of unemployment and decreases the chance of finding and holding down a job. Unemployment is a significant risk factor for substance use and the subsequent development of substance use disorders. However, the current research provides only limited information about which individuals are more likely to be affected. Unemployment increases the risk of relapse after alcohol and drug addiction treatment (245).

B.1.170 Beneficial health effects of returning to work have been documented in a variety of populations, times, and settings. Return-to-work programs may improve not only financial situations but also health. Poor health interferes with people's ability to go back to work. Some evidence suggested that earlier reemployment may be associated with better health (244).

B.1.171 **Interventions**: Workplace interventions can achieve small positive effects on major health outcomes, for example decreases in BMI, self-reported musculoskeletal symptoms, and self-reported job stress (246).

B.1.172 Improved health-related and economic outcomes were associated with employer-sponsored wellness programs. Companies with successful programs tended to include wellness as part of their corporate culture and supported employee participation in several key ways. Occupational wellness interventions including health assessments, lifestyle management, and healthy behaviours result in improved economic outcomes (health care costs, return on investment, absenteeism, productivity, workers' compensation, utilization) as well as decreased health risks. Programmes associated with favourable outcomes had several characteristics in common (247):

- the corporate culture encouraged wellness to improve employees' lives, not only to reduce costs;
- employees and leadership were strongly motivated to support the wellness programs and to improve their health in general;
- employees were motivated by a participation-friendly corporate policy and physical environment;
- successful programs adapted to the changing needs of the employees;

- community health organizations provided support, education, and treatment; and
- successful wellness programs utilized technology to facilitate health risk assessments and wellness education.

B.1.173 Well-targeted and efficiently implemented diet-related worksite health promotion interventions may improve labour productivity by 1%-2%. On larger worksites, such productivity gains are likely to more than offset the costs of implementing such interventions (248).

B.1.174 There is insufficient evidence to advise for or against the use of drug and alcohol testing of occupational drivers for preventing injuries as a sole, effective, long-term solution in the context of workplace culture, peer interaction and other local factors (249). There is also limited evidence for effective interventions to prevent injuries in the construction industry (250).

Sensitivities

B.1.175 Poor health, particularly self-perceived health, is a risk factor for exit from paid employment through disability pension, unemployment and, to a lesser extent, early retirement (251). The impact on families is often unrecognised and underestimated. The adverse impacts on families include emotional, financial, family relationships, education and work, leisure time, and social activities (252).

B.1.176 Gender inequalities exist in occupation settings. Employed women tend to have more job insecurity, lower control, worse contractual working conditions and poorer self-perceived physical and mental health than men do. Conversely, employed men tend to have a higher degree of physically demanding work, lower support, higher levels of effort-reward imbalance, higher job status, are more exposed to noise and work longer hours than women do (253).

B.1.177 Low-household income is related to poor health (254). However the true causal relationship between income and health may be small due to biases and confounding factors (255). There is some evidence to support a threshold of income inequality beyond which adverse impacts on health begin to emerge. However such findings need to be interpreted with caution (256).

Summary social cohesion evidence base

B.1.178 The literature includes a range of related terminologies linked to social cohesion. These include social capital and community cohesion.

B.1.179 Social Capital is a multi-component, dynamic concept. There are many definitions of social capital, but most recognise the importance of positive social networks. Social capital can be measured at individual, community or organisational level. There are different types of social capital (bridging, bonding and linking). Different types of social capital may be more important to different age groups, genders and cultures. There is some evidence that social capital has links to a range of health and related outcomes. Social capital has less predictive value than other socioeconomic indicators, but can act as a buffer against social disadvantage. Certain dimensions of social capital are more health-enhancing than others. Social capital can have a downside – e.g. strong community ties can result in the exclusion of outsiders and restrictions on individual freedoms (257).

B.1.180 In general, both individual social capital and area/workplace social capital had positive effects on health outcomes (258). Studies have suggested social capital can increase the odds of good health by 27% (259). There is some evidence that neighbourhood social capital is beneficial for the health and well-being of adolescents and children, especially those who reside in deprived neighbourhoods (260). There is some evidence for both a buffer effect and a dependency effect of social capital on socioeconomic inequalities in health (261). Favourable psychosocial environments go hand in hand with better health. Poor psychosocial environments may be health damaging and contribute to health inequalities (262). There is moderate evidence of protective effects for mental health of perceived emotional support, perceived instrumental support, and large, diverse social networks (263).

B.1.181 A positive ethnic or racial identity can also be protective against the effects of adversity for minority ethnic groups. There is evidence that that social networks and social supports have a moderating effect on the relationship between disadvantage and a wide range of outcomes (264).

B.1.182 Community cohesion is about helping divided communities to gel or mesh into an integrated whole to develop common goals and a shared vision (265). Involving local communities in area-based and regeneration activities helps build trust and a stronger united community ‘voice’. Local input can help improve residents’ perceptions of (and satisfaction with)

their neighbourhood. Local input can also help improve access to (and satisfaction with) community facilities and NHS services (266).

B.1.183 Neighbourhood socioeconomic status and social climate affect child health outcomes, i.e. birth weight, injuries, behavioural problems, and child maltreatment. On average, 10% of variation in health outcomes are explained by neighbourhood determinants. Interventions in underprivileged neighbourhoods can reduce health risks to children, especially in families that lack resources (267).

B.1.184 Parent-child health and well-being is inextricably linked with parental social support. The relationship between socio-economic status and child difficulties is mediated by financial hardship and parenting stress. Higher levels of parental social support are associated with lower levels of: parenting stress; ineffective parenting; and child difficulties. Parental social support is important irrespective of parenting stress levels (268).

Sensitivities

B.1.185 Social capital is an important construct for understanding the establishment of health risk behaviours in young people. The different elements of family and community social capital varied in terms of their saliency within each behavioural domain, with positive parent-child relations, parental monitoring, religiosity and school quality being particularly important in reducing risk (269).

B.1.186 Migration has contributed to the richness in diversity of cultures, ethnicities and races in developed countries. Individuals who migrate experience multiple stresses that can impact their mental wellbeing, including the loss of cultural norms, religious customs, and social support systems, adjustment to a new culture and changes in identity and concept of self. Rates of mental illness may therefore be higher in some migrant groups (270).

Advisory thresholds

B.1.187 Not applicable.

Statutory thresholds

B.1.188 Not applicable.

Appendix C Notes of HIA/EqIA workshop

Item		Comments	Action by
Introduction to the Scheme – TfL (Catherine Timson) presented an overview of the Scheme including objectives, timescales, programmes and work done to date.			
1	TfL	Q: Asked whether at this stage the findings from the workshop can still influence the Scheme/design. A: TfL replied that comments at this stage can be taken forward as there is still a statutory pre-application consultation in September from which feedback on the Scheme would be taken into account.	
2		Q: Charging regime – how much confidence does TfL have that it would prevent increases in traffic flows? A: The charge would be set at a level which balances traffic flow against user benefits and environmental impacts and would be flexible so it can be adjusted to ensure this balance is maintained. The DCO powers applied for would allow for this flexibility.	Ongoing discussion on user charging.
3		Q: Would the LPAs have an input into the charging regime? A: TfL is currently discussing the charging with all LPAs – this would lead to an appropriate mechanism in the DCO application.	Share traffic modelling results.
4		Q: Concerned the Scheme is so reliant on traffic modelling – want to see the model. A: Traffic modelling is still ongoing and would be shared when the modelling results are available.	Share traffic modelling results.

Item		Comments	Action by
5	Newham	Q: Gallion's reach is not listed as a Mayoral Scheme in the scoping report. Is Gallions Bridge included in the modelling? Silvertown Tunnel would have negative impacts for LB Newham and Newham would support the Scheme only if there is a bridge at Gallions. There needs to be a clear commitment to another crossing and the modelling for Silvertown done along with this. A: Gallion's Reach is part of the consultation on east London crossings and TfL would ensure it is referenced as part of that. However modelling for Silvertown cannot take account of a future Scheme at this stage in the process.	
6		Q: The scope talks about ferry Schemes but the biggest east London River crossing at Woolwich is missing. A: TfL would include it in the scope.	Ensure Woolwich is referenced.
HIA/EqIA – Introduction to the purpose of the workshop – Ben Cave and Alison Powell presented a summary of the scoping for each topic including definitions, spatial scope, time scales, programmes and purpose of each assessment.			
7	Newham	Q: Why is a 1km boundary picked for noise? Would London City Airport be taken into account in the noise assessment chapter of the ES? The airport is quiet at night. Also need to look at air pollution from airport. A: the baseline was explained in full and it was agreed to circulate the ES scope to all parties so that they could understand how the airport would be addressed.	TfL to circulate Noise and Air Quality methodologies.

Item		Comments	Action by
8	TfL	Why is it a 10m walk time for the spatial scope? A: this reflects the extent of community networks in the local area i.e. how people go about their life on foot (primary school, doctors, and local shop). It is not an exact science and any local knowledge on where this line should be drawn is welcome. Some suggestions were made on the boundary line.	
9	Greenwich	Q: this boundary does not include the Blackwall Tunnel, this skews the assessment. A: The assessment includes the Blackwall Tunnel and the impact of removing traffic on this route.	
10	Newham	Q: How have you forecast future receptors? Although some of the land near the northern portal has previously been allocated for industrial use, it is expected that a lot of the land south of Royal Docks would be designated for residential use (mostly mixed use developments). Newham's Local Plan review starts next year. Referenced huge GLA land sale, lots of sites could come forward. A: the ES must look at the existing and future baselines and the impact of the development on these. TfL would arrange for a discussion with Jacobs who are looking at future employment so that we can understand exactly if and how this is being addressed.	Get Jacobs to speak to Newham and Greenwich on future development.

Item		Comments	Action by
11	Tower Hamlets	Q: Southwark should be included in the wider area spatial scope because of the impact on Rotherhithe Tunnel which would not be charged and therefore could attract more traffic. A: TfL would add the borough to the sub regional map.	
12	Newham	Q: Newham has a high proportion of low income groups and would expect local jobs from this Scheme as well as apprenticeships. They have a tunnelling academy. A: Yes, TfL is learning from the lead by Crossrail 1 and their major push for local jobs for local people and this is something that the Scheme is looking to deliver.	
13	Tpwer Hamlets	Q: Would the EqIA look at the impact of tolling on discouraging tunnel journeys? A: TfL is working on the charging regime now. It would include the use of account holders. This point would be looked at as part of the EqIA assessment.	
Scoping discussion			
Housing - Scoped out			
Access to health care and social infrastructure			
14	Newham	Q: would the assessment take into account specific issues? The average age of Newham is 31 – need to look at planning an improved social fabric – walkways etc. to encourage this young population to be active. A: Yes TfL would look at this.	

Item		Comments	Action by
15	Greenwich	Q: Suggest it be **scoped in** during construction, journey patterns are important. Impact of increased construction traffic on the roads. Improvements of walk and cycling route linkages could be potential mitigation for impacts during operation. A: This would be taken into account and looked at. Q: Would construction of the Scheme affect traffic on roads around the Blackwall Tunnel A: Yes, would mostly be just looking at night time closures of the Blackwall Tunnel but there is likely to be some impact – TfL would liaise with emergency services (including ambulances) particularly during construction.	
16	TFL	Q: Health is a major TfL issue. When you redirect motorised traffic it increases traffic injuries and people are less likely to cycle on roads where the traffic increases. The health inequalities become worse. The population of children is increasing in these boroughs, this would affect them. We need to encourage walking, cycling, and improved safety. Faster moving traffic is good for roads but not for safety and pedestrians. Also, if roads freer more local trips are generated. Related to this issue the suggestion was made that, in the construction and the operation phases, the assessment should focus on ensuring that the Scheme enables travel by a range of transport modes and that people are encouraged to use active travel (public transport, walking, cycling) as well as motorised transport. This approach would be better than modelling the effects of the Scheme on all services. A: This would be taken into account as part of the assessment.	

Item		Comments	Action by
17		Q: There should be information on doctors and healthcare centres where people are walking to these? A: TfL is looking to gather this information. TfL is looking at new cycle connections as a part of the Scheme.	
18	PHE	Q: Can people walk and cycle through the tunnel? A: No there would be a much expanded bus offer. TfL is looking at how walking and cycling is addressed in the approaches to the tunnel. Q: Is it too late to include walking and cycling in the tunnel? A: TfL has carried out a number of studies into this and it has been ruled out due to the cost and safety and security implications. There are other cross river options such as the Woolwich and Greenwich foot tunnels and the Emirates Airline.	
19		Q: Did the option assessment include just charging on the Blackwall Tunnel and not building a new tunnel? A: This option has been assessed as part of the Options Assessment which is available on the Silvertown Tunnel website.	
Access to open space and nature			

Item		Comments	Action by
20	Newham	Q: Suggest this is scoped in as is an opportunity to encourage new open space (see Proposal Map on Newham's website for allocated land and designated sites for nature conservation). All along the Thames Newham have local nature sites, not this far down but this is an opportunity to encourage more activity and could be positive – it should be scoped in as better links can be provided. A: TfL would pick this up. Q; if you are increasing traffic flows on roads like the A13 you are increasing severance – you may affect access to things like the Lea Valley. A: TfL need to make sure this is considered. We would look at the all the relevant information. We would look at enhancement and improved linkages e.g. cycle networks.	Look at proposals map and links to open space.
Air Quality			
21	Newham	Q: Concerned the ES is light on PM10 and PM2.5 emissions as there are no clear thresholds for these so the assessment is only looking at where limits are breached. The effects on human health from a worsening in levels of these may not be possible to be picked up however a negative change is still negative whether above or below. Fears this would underplay the impacts. A: TfL - we would look into this with the air quality team – **action.**	Look at consideration of PM10 and PM2.5
22	Newham	Q: Traffic modelling is pointless now because things would change in the next 5 years a lot. Canning Town is a large area and changing massively. You need to model this change – these would be tall buildings of 8-10 storeys and would create the equivalent of wind tunnels for air pollution. This is the same for the wharf area and Greenwich Peninsula. Greenwich has similar concerns. Newham and Greenwich are biggest growth areas in London. A: TfL would look at what can be taken into account at this stage.	

Item		Comments	Action by
23		Q: The recent EU judgement concluded the 2030 deadline for air pollution is unacceptable, that we need an earlier date. DEFRA is looking at a new date in September. The baseline for London would change which would affect the HIA and EqIA. How are you dealing with this? A: TfL - we need to look at this. We are working with the LPAs and ULEZ team. Q: It is not just thresholds there are strong epidemiological markers here this is a key issue for these populations. Nothing in this area of London would be the same in four years due to all the land use changes. A: TfL - we need to look at how the suite of studies addresses land use change/zoning/population increase and health and at what we are assessing as receptors in 2036?	
24	Greenwich	Q: If the Woolwich ferry is non-charging that might lead to a concentration of HGVs in the centre of Woolwich that would cause problems in the residential areas near Woolwich ferry. A: TfL is assessing this and looking at impacts.	
25		Q: Did the option assessment include just charging on the Blackwall Tunnel and not building a new tunnel? A: This option has been assessed as part of the Options Assessment which is available on the Silvertown Tunnel website.	TfL to check with traffic team whether this information is available

Item		Comments	Action by
26	TfL	Q: If all future developments have car parking how would that influence traffic flows? How do we stop the new tunnel clogging up? A: This needs to be taken into account. User charging would manage demand and public transport would be crucial.	
27	Newham	They won't have car free developments as low PTAL.	
Noise			
28	Newham	Q: How would that assessment take into account the fact that City Airport (LCA) is shut on weekends/during the night, etc.? So baseline levels are different? A: TfL – would look into this.	
29	Greenwich	Q: When the traffic is free flow (fast) that leads to noise impacts, speed should be taken into account. At the moment there is a 30mph limit, a mitigation option could be to have speed limits of 20mph, which could also contribute to road safety. When the road is congested it leads to air quality issues. A: TfL – would consider this.	

Item		Comments	Action by
30	Tower Hamlets	Q: Referenced the potential for late night Rotherhithe tunnel noise impacts as more people might use this link when the other tunnels are charged. A: TfL - Would look into this.	
31	Greenwich	Q: Where the deprivation levels are low, the overall impacts are expected to be worse. Social housing is usually allocated near roads. A: TfL - we are looking at social and distributional analysis. Where the difference in behaviours is.	
32		Q: Is it planned for waste to be removed using the river? A: This is being reviewed at present, there are lots of factors including traffic levels on the river, contamination levels, road capacity and end destination for spoil. The river would always be used when it is possible.	
Road safety – to be scoped in			
33	TfL Greenwich	Q: Should I look at speed reduction to 20mph to reduce severance impacts. Q: Greenwich roads are 20mph, TfL roads aren't	
Access to work			

Item		Comments	Action by
34	Newham	Q: Local employment and apprenticeships are needed. Concerned about the impacts of different charging levels on each side of the river and the access/equalities impacts of this. User charging may lead to limiting the access to employment of people who cannot afford to pay on a daily basis. This would have a depressive effect if charged on access to jobs and training. A: TfL – the EqIA would need to assess this.	
Climate Change – scope out			
35	TfL PHE	Statement can be included that the road itself would lead to climate change as it would inevitably attract more traffic. Need to look at climate adaptation, creating more shade etc. Q: be aware of overheating of buildings- anything that stops people opening windows (road noise…)	
Other points raised			
	Greenwich	Would like to see the evidence behind the charging strategy in advance.	
	Newham	It's all driven by traffic modelling, have concerns about that as not seen any modelling.	

Appendix D List of scoping consultees

Title	Borough/Organisation	Address
Director of Public Health Newham	LB Newham	Newham Dockside 1st/3rd Floors, West Wing 1000 Dockside Road London E16 2QU
Principal Environmental Health Officer	LB Newham	Newham Dockside 1st/3rd Floors, West Wing 1000 Dockside Road London E16 2QU
Principal Transport Planner	LB Newham	Newham Dockside 1st/3rd Floors, West Wing 1000 Dockside Road London E16 2QU
Planning	LB Newham	Newham Dockside 1st/3rd Floors, West Wing 1000 Dockside Road London E16 2QU
Director of Public Health	LB Tower Hamlets	Tower Hamlets Council Town Hall Mulberry Place 5 Clove Crescent E14 2BG
Team Leader, Pollution	LB Tower Hamlets	Tower Hamlets Council Town Hall Mulberry Place 5 Clove Crescent E14 2BG

Title	Borough/Organisation	Address
Planning Officer	LB Tower Hamlets	Tower Hamlets Council Town Hall Mulberry Place 5 Clove Crescent E14 2BG
Director of Public Health Greenwich	RB Greenwich	The Woolwich Centre Wellington Street Woolwich SE18 6HQ
Pollution monitoring team manager	RB Greenwich	The Woolwich Centre Wellington Street Woolwich SE18 6HQ
Transportation Planning and Strategy Manager	RB Greenwich	The Woolwich Centre Wellington Street Woolwich SE18 6HQ
London Special Interest Group for Transport		
Project Director NHS London Healthy Urban Development Unit	Healthy Urban Development Unit	NHS London Healthy Urban Development Unit 1 Lower Marsh, London, SE1 7NT
Regional Director of Public Health for London; Deputy Regional Director of Public Health for London Health Improvement Manager	Public Health England	Public Health England London Regional Office, 151 Buckingham Palace Road, London SW1W 9SZ

Bibliography

1. World Health Organization. Preamble to the Constitution of the World Health Organization; signed on 22 July 1946 by the representatives of 61 States and entered into force on 7 April 1948. New York 1948. http://bit.ly/1cgnJ3S.

2. NHS Healthy Urban Development Unit. HUDU Rapid Health Impact Assessment (HIA) Tool. London 2013. http://bit.ly/1jBO7en.

3. WHIASU. Health Impact Assessment: a practical guide. Cardiff, Wales: Wales Health Impact Assessment Support Unit 2012. http://bit.ly/WH8g9F.

4. Cooke A, Friedli L, Coggins T, et al. Mental well-being impact assessment: a toolkit for well-being: Members of the National MWIA Collaborative (England) 2011. http://bit.ly/1k7DLTR.

5. European Parliament, Council of the European Union. Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance. In: Official Journal of the European Union, editor. L 124/1; 2014. http://bit.ly/1Oq7OCD.

6. Department for Transport. National Policy Statement for National Networks. London; 2014. http://bit.ly/1DODPP1.

7. HM Government of Great Britain & Northern Ireland. Greater London Authority Act 2007. http://bit.ly/1jghuld.

8. Greater London Authority. Health issues in planning 2007. http://bit.ly/IJxCOF.

9. Greater London Authority. Further Alterations to the London Plan. London: GLA 2015. http://bit.ly/1AlWIHh.

10. Quigley R, den Broeder L, Furu P, Bond A, Cave B, Bos R. Health Impact Assessment: International Association for Impact Assessment and World Health Organization 2006. http://bit.ly/X2iOxM.

11. World Health Organization Regional Office for Europe, European Centre for Health Policy. Health impact assessment: main concepts and suggested approach. Gothenburg consensus paper. Brussels: WHO Regional Office for Europe, ECHP 1999. http://bit.ly/XyA89L.

12. Dahlgren G, Whitehead M. Policies and strategies to promote social equity in health. Stockholm: Institute for Future Studies; 1991.

13. Barton H, Grant M. A health map for the local human habitat. *The Journal of the Royal Society for the Promotion of Health* 2006; **126**(6): 252-3.

14. Marmot M, Allen J, Goldblatt P, et al. Fair society, healthy lives 2010. http://bit.ly/1iK9VjN.

15. Department of the Environment. Integrated Pollution Prevention and Control (Northern Ireland). A Practical Guide. Belfast, Northern Ireland 2003. http://bit.ly/1EpyWig.

16. Joint Research Centre. Reference documents. 2015. http://bit.ly/1A0bjrr.

17. World Health Organization. Transport sector: preliminary findings. Initial review. Geneva, Switzerland: Public Health & Environment Department (PHE), WHO 2011. http://bit.ly/1M9Nd4V.

18. Royal Borough of Greenwich. Joint Strategic Needs Assessment 2012. http://bit.ly/1KFCZJy.

19. Royal Borough of Greenwich. Health and Wellbeing Strategy 2015-2018 2015. http://bit.ly/1ViJpqp.

20. Public Health England. Health Profiles. 2015. http://www.apho.org.uk/default.aspx?RID=49802.

21. Office for National Statistics. Subnational Population Projections, 2012-based projections 2014. http://bit.ly/1MB4pRJ.

22. London Borough of Newham. Joint Strategic Needs Assessment 2011-12. September 2012 Update 2012. http://www.newham.info/jsna

23. London Borough of Newham. Improving the health of people in Newham: Newham's Health & Wellbeing Strategy 2013.

24. Tower Hamlets Council. Joint Strategic Needs Assessment 2015. http://bit.ly/1h32DgO.

25. Tower Hamlets Council. Health and Wellbeing Strategy: Towards a Healthier Tower Hamlets 2013-2016 2013. http://bit.ly/1NXhypR.

26. Office for National Statistics. Census 2011 Population by Age, UK Districts 2014. http://bit.ly/1KOttSm.

27. Ganten D, Haines A, Souhami R. Health co-benefits of policies to tackle climate change. *Lancet* 2010; **376**(9755): 1802-4. 10.1016/S0140-6736(10)62139-3

28. Haines A, McMichael AJ, Smith KR, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: overview and implications for policy makers. *Lancet* 2009; **347**(9707): 2104-14. 10.1016/S0140-6736(09)61759-1.

29. Confalonieri U, Menne B, Akhtar R, et al. Human health. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE, eds. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, UK: Cambridge University Press; 2007: 391-431.

30. Intergovernmental Panel on Climate Change. Human health: impacts, adaptation and co-benefits. Geneva, Switzerland: IPCC, WMO and UNEP 2014. http://1.usa.gov/1fBCTa3.

31. Woodcock J, Edwards P, Tonne C, et al. Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *The Lancet* 2009; **374**(9705): 1930-43. 10.1016/S0140-6736(09)61714-1.

32. Thomson H, Jepson R, Hurley F, Douglas M. Assessing the unintended health impacts of road transport policies and interventions: translating research evidence for use in policy and practice. *BMCPublic Health* 2008; **8**: 339. 10.1186/1471-2458-8-339.

33. Saunders LE, Green JM, Petticrew MP, Steinbach R, Roberts H. What are the health benefits of active travel? A systematic review of trials and cohort studies. *PLoS One* 2013; **8**(8): e69912. 10.1371/journal.pone.0069912.

34. Transport for London. London Cycling Design Standards 2014. https://tfl.gov.uk/corporate/publications-and-reports/cycling.

35. Transport for London. The Mayor's vision for cycling in London – an Olympic legacy for all Londoners 2013. http://bit.ly/1NZub3u.

36. Richter ED, Berman T, Friedman L, Ben-David G. Speed, road injury, and public health. *Annu Rev Public Health* 2006; **27**: 125-52. 10.1146/annurev.publhealth.27.021405.102225.

37. Department for Communities & Local Government, Department for Transport. Manual for streets 2007. http://bit.ly/VPf6Vc.

38. Greater London Authority, Transport for London. The Mayor's Transport Strategy 2010. http://bit.ly/1I0vfmP.

39. World Health Organization Regional Office for Europe. Air quality guidelines for Europe. Copenhagen, Denmark 2000. http://bit.ly/1HXtli4.

40. World Health Organization Regional Office for Europe. Night noise guidelines for Europe. Copenhagen, Denmark 2009. http://bit.ly/1vY4TJ.

41. World Health Organization. Guidelines for community noise. Geneva: WHO 1999. http://bit.ly/17VGPyp.

42. Environment Agency. Horizontal Guidance for Noise Part 1 - Regulation and Permitting, Integrated Pollution Prevention and Control (IPPC) 2002. http://bit.ly/1KrEaz4.

43. Environment Agency. Horizontal Guidance for Noise Part 2 - Noise Assessment and Control. Bristol 2002. http://bit.ly/1gQ01Du.

44. BSI. Methods for rating and assessing industrial and commercial sound: British Standard Institute 2014. http://bit.ly/1FSadlr.

45. BSI. Guidance on Sound insulation and noise reduction for buildings: British Standard Institute 2014. http://bit.ly/1EeHzuT.

46. BSI. Code of practice for noise and vibration control on construction and open sites. Noise. London, England: British Standards Institution 2008. http://bit.ly/1pWgM08.

47. British Geological Survey. Website accessed 12/08/15. http://mapapps.bgs.ac.uk/geologyofbritain/home.html

48. Transport for London. TfL Skills and Emplyment Strategy: progress report and future strategy 2014. http://bit.ly/1Jy8uBB.

49. Standing Advisory Committee on Trunk Road Assessment. Trunk roads and the generation of traffic, Department of Transport, 1994. http://bit.ly/1J3JRNT.

50. Goodwin P. Induced traffic again. And again. And again. *Local Transport Today* 2006; **450**(24 August): 17.

51. Noland RB. Transport Planning and Environmental Assessment: Implications of Induced Travel Effects. *International Journal of Sustainable Transportation* 2007; **1**(1): 1-28. 10.1080/15568310601095131.

52. Eliasson JM, Lars-Göran. Equity effects of congestion pricing: Quantitative methodology and a case study for Stockholm. *Transportation Research Part A: Policy and Practice* 2006; **40**(7): 602–20. 10.1016/j.tra.2005.11.002.

53. Karlström A, Franklin JP. Behavioral adjustments and equity effects of congestion pricing: Analysis of morning commutes during the Stockholm Trial. *Transportation Research Part A: Policy and Practice* 2009; **43**(3): 283–96. 10.1016/j.tra.2008.09.008.

54. DG Health and Food Safety. Third Health Programme 2014-2020. 2014. http://ec.europa.eu/health/programme/policy/index_en.htm.

55. Commission of the European Communities. Together for health: a strategic approach for the EU 2008-2013. Brussels 2007. http://bit.ly/1mYmFMa.

56. European Parliament, Council of the European Union. Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet' Text with EEA relevance. 2013. http://bit.ly/1Wx24vF.

57. Commission of the European Communities. Communication from the Commission on Solidarity in Health: Reducing health inequalities in the EU 2009. http://bit.ly/Uas4jw.

58. DG Employment, Social Affairs & Inclusion,. EU Occupational Safety and Health (OSH) Strategic Framework 2014-2020 2014.

59. Commission of the European Communities. Communication from the Commission to the Council, the European Parliament and the European Economic and Social Committee - A European Environment and Health Strategy. Brussels; 2003. http://bit.ly/1h9g9zn.

60. Commission of the European Communities, World Health Organization Regional Office for Europe, Slovenian Presidency of the EU. European Pact for Mental Health and Well-Being 2008. http://bit.ly/1KQHJsT.

61. World Health Organization Regional Office for Europe. Parma declaration on environment and health. Parma, Italy 2010. http://bit.ly/1FHhYiA.

62. World Health Organization Regional Office for Europe. Ashgabat Declaration on the Prevention and Control of Noncommunicable Diseases in the Context of Health 2020 2013. http://bit.ly/1MZOrnb.

63. WHO Regional Office for Europe. Health 2020: a European policy framework and strategy for the 21st century: Copenhagen, Denmark 2013. http://bit.ly/1zopCoi.

64. World Health Organization Regional Office for Europe. Children's health and environment. Developing action plans 2005. http://bit.ly/1O17mN6.

65. Wismar M, Blau J, Ernst K, Figueras J. The effectiveness of Health Impact Assessment: scope and limitations of supporting decision-making in Europe: World Health Organization on behalf of the European Observatory on Health Systems and Policies, 2007. http://bit.ly/ZyKYV8.

66. World Health Organization Regional Office for Europe. Gaining health. The European Strategy for the Prevention and Control of Noncommunicable Diseases. Copenhagen 2006. http://bit.ly/1RfcCwr.

67. Martuzzi M, Tickner JA. The precautionary principle: protecting public health, the environment and the future of our children. Copenhagen: World Health Organization Regional Office for Europe,, 2004. http://bit.ly/1rS0uCV.

68. World Health Organization Regional Office for Europe. Mental health: facing the challenges, building solutions. Copenhagen, Denmark: WHO 2005. http://bit.ly/1ft2nGS.

69. World Health Organization Regional Office for Europe. Policies and practices for mental health in Europe. Meeting the challenges 2008. http://bit.ly/1L3nGvJ.

70. Department of Health. Living Well for Longer: National Support for Local Action to Reduce Premature Avoidable Mortality. London 2014. http://bit.ly/1OFuzG7.

71. Mayor of London, NHS England, Public Health England, London Councils, London CCGs. Better Health for London: Next Steps 2015. http://bit.ly/1FHpHNC.

72. Mayor of London. Mayor of London's response to the London Health Commission 2015. http://bit.ly/1L3sNw0.

73. Mayor of London. London mental health: the invisible costs of mental ill health: Greater London Authority 2014. http://bit.ly/1pHl2h7.

74. Greater London Authority. London 2012 equalities reviews. 2012. http://bit.ly/1FHqlLb.

75. Greater London Authority. Access to primary health care. 2013. http://bit.ly/1MFoCWD.

76. Greater London Authority. Access to GP Care. 2015. http://bit.ly/1iKrqY0.

77. Commission of the European Communities. White Paper on: A Strategy for Europe on Nutrition, Overweight and Obesity related health issues. 2007. http://bit.ly/1Wxa1B0.

78. European Union. EU Action Plan on Childhood Obesity 2014 - 2020. 2014. http://bit.ly/1LjwiAk.

79. World Health Organization Regional Office for Europe, United Nations Economic Commission for Europe. Amsterdam Declaration: Making THE Link: Transport choices for our health, environment and prosperity. Third High-level Meeting on Transport, Health and Environment, Amsterdam 2009. http://bit.ly/1YO0Jmm.

80. Racioppi F, Eriksson L, Tingvall C, Villaveces A. Preventing road traffic injury: a public health perspective for Europe. Copenhagen, World Health Organization Regional Office for Europe, 2004. http://bit.ly/1P53P0Z.

81. World Health Organization Regional Office for Europe. Transport, environment and health 2000. http://bit.ly/1SgruyZ.

82. Sethi D, Racioppi F, Mitis F. Youth and road safety in Europe. Policy briefing. Copenhagen, World Health Organization Regional Office for Europe, 2007. http://bit.ly/1Wxbtn5.

83. World Health Organization Regional Office for Europe. A European framework to promote physical activity for health. Copenhagen, Denmark 2007. http://bit.ly/1N01i8S.

84. World Health Organization Regional Office for Europe. The challenge of obesity in the WHO European Region and the strategies for response. Copenhagen 2007. http://bit.ly/1h9vQXh.

85. Dombois O, Kahlmeier S, Martin-Diener E, Martin B, Racioppi F, Braun-Fahrländer C. Collaboration between the health and transport sectors in promoting physical activity. Copenhagen, World Health Organization Regional Office for Europe, 2006. http://bit.ly/1OFCwuT.

86. Loring B, Robertson A. Obesity and inequities. Guidance for addressing inequities in overweight and obesity. Copenhagen: World Health Organization Regional Office for Europe,; 2014. http://bit.ly/1KRiaIj.

87. World Health Organization regional Office for Europe. Physical activity promotion in socially disadvantaged groups: principles for action. Copenhagen 2013. http://bit.ly/1PN4YZk.

88. World Health Organization regional Office for Europe. Physical activity promotion in socially disadvantaged groups: principles for action. Policy summatry. Copenhagen 2013. http://bit.ly/1OFV26h.

89. Kelly P, Matthews A, Foster C. Young and physically active: a blueprint for making physical activity appealing to youth. Copenhagen 2012. http://bit.ly/1j0vW5y.

90. Public Health England. Everybody active, every day: a framework to embed physical activity into daily life. 2014. http://bit.ly/1PjRKmd.

91. Mayor of London. Improving the Health of Londoners: Health Action Plan. London: Transport for London 2014. http://bit.ly/1I1x1l4.

92. European Parliament, European C. Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe 2008. http://bit.ly/14V0IRv.

93. DG Environment, European Commission. The Clean Air Policy package 2013. http://bit.ly/1k0GBv3.

94. World Health Organization Regional Office for Europe. Health effects of black carbon. Copenhagen 2012. http://bit.ly/1M1kBsu.

95. WHO Regional Office for Europe. Health effects of transport-related air pollution. Denmark: WHO Regional Office for Europe 2005. http://bit.ly/1pOBYT7.

96. HM Government of Great Britain & Northern Ireland. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007. http://bit.ly/1SHWUOV.

97. European Parliament, Council of the European Union. Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. *Official Journal of the European Communities* 2002; **L 189**: 12-25. http://bit.ly/1CS2TJZ.

98. World Health Organization Regional Office for Europe. Burden of disease from environmental noise. Quantification of healthy life years lost in Europe. Copenhagen, Denmark: EEA, European Communities 2011. http://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf.

99. Commission of the European Communities. Agenda for new skills and jobs. 2010. http://bit.ly/1jy0qvM.

100. DG Employment, Social Affairs & Inclusion,. Youth on the Move. 2010. http://bit.ly/1O1DekK2015).

101. European Commission. Education and Training 2020 (ET 2020). 2009. http://bit.ly/1M1lMs9.

102. DG Employment, Social Affairs & Inclusion,. New Skills for New Jobs. http://bit.ly/1JChntE2015).

103. Commission of the European Communities. Erasmus + : The new EU programme for Education, Training, Youth and Sport for 2014-2020. 2015. http://bit.ly/1RfOz0n.

104. Department for Work and Pensions. Improving health and work: changing lives. London; 2008. http://bit.ly/1KRssbt.

105. Commission of the European Communities. Communication from the Commission: On fffective, accessible and resilient health systems. 2014. http://bit.ly/1FHWGl9.

106. Wilkinson RG, Marmot M. Social determinants of health: the solid facts. Denmark: World Health Organization 2003. http://bit.ly/1iCY3iz.

107. World Health Organization. Reducing health inequities through action on the social determinants of health 2009. http://bit.ly/1MK3eS5.

108. Mindell JS, Karlsen S. Community severance and health: what do we actually know? *JUrbanHealth* 2012; **89**(2): 232-46. 10.1007/s11524-011-9637-7.

109. Syed ST, Gerber BS, Sharp LK. Traveling towards disease: transportation barriers to health care access. *J Community Health* 2013; **38**(5): 976-93. 10.1007/s10900-013-9681-1.

110. Calil AM, Sallum EA, Domingues CA, Nogueira LS. Mapping injuries in traffic accident victims: a literature review. *RevLatAmEnfermagem* 2009; **17**(1): 120-5.

111. Heron-Delaney M, Kenardy J, Charlton E, Matsuoka Y. A systematic review of predictors of posttraumatic stress disorder (PTSD) for adult road traffic crash survivors. *Injury* 2013; **44**(11): 1413-22. 10.1016/j.injury.2013.07.011.

112. Vernick JS, Tung GJ, Kromm JN. Interventions to reduce risks associated with vehicle incompatibility. *EpidemiolRev* 2012; **34**(1): 57-64. 10.1093/epirev/mxr016.

113. Manson J, Cooper S, West A, Foster E, Cole E, Tai NR. Major trauma and urban cyclists: physiological status and injury profile. *EmergMedJ* 2013; **30**(1): 32-7. 10.1136/emermed-2011-200966.

114. DiMaggio C, Li G. Roadway characteristics and pediatric pedestrian injury. *EpidemiolRev* 2012; **34**(1): 46-56. 10.1093/epirev/mxr021.

115. Rothman L, Buliung R, Macarthur C, To T, Howard A. Walking and child pedestrian injury: a systematic review of built environment correlates of safe walking. *InjPrev* 2014; **20**(1): 41-9. 10.1136/injuryprev-2012-040701.

116. Porchia BR, Baldasseroni A, Dellisanti C, Lorini C, Bonaccorsi G. Effectiveness of two interventions in preventing traffic accidents: a systematic review. *AnnIg* 2014; **26**(1): 63-75.

117. Wilson C, Willis C, Hendrikz JK, Le BR, Bellamy N. Speed cameras for the prevention of road traffic injuries and deaths. *CochraneDatabaseSystRev* 2010; (11): CD004607. 10.1002/14651858.CD004607.pub4.

118. Hosking J, Macmillan A, Connor J, Bullen C, Ameratunga S. Organisational travel plans for improving health. *CochraneDatabaseSystRev* 2010; (3): CD005575. 10.1002/14651858.CD005575.pub3.

119. Phillips RO, Ulleberg P, Vaa T. Meta-analysis of the effect of road safety campaigns on accidents. *AccidAnalPrev* 2011; **43**(3): 1204-18. 10.1016/j.aap.2011.01.002.

120. Xu H, Wen LM, Rissel C. The relationships between active transport to work or school and cardiovascular health or body weight: a systematic review. *Asia PacJ Public Health* 2013; **25**(4): 298-315. 10.1177/1010539513482965.

121. McCormack GR, Shiell A. In search of causality: a systematic review of the relationship between the built environment and physical activity among adults. *Int J Behav Nutr Phys Act* 2011; **8**: 125. 10.1186/1479-5868-8-125.

122. Xu H, Wen LM, Rissel C. The relationships between active transport to work or school and cardiovascular health or body weight: a systematic review. *Asia Pac J Public Health* 2013; **25**(4): 298-315. 10.1177/1010539513482965.

123. Larouche R, Saunders TJ, Faulkner G, Colley R, Tremblay M. Associations between active school transport and physical activity, body composition, and cardiovascular fitness: a systematic review of 68 studies. *J Phys Act Health* 2014; **11**(1): 206-27. 10.1123/jpah.2011-0345.

124. Fraser SDS, Lock K. Cycling for transport and public health: a systematic review of the effect of the environment on cycling. *The European Journal of Public Health* 2011; **21**(6): 738-43. http://eurpub.oxfordjournals.org/content/21/6/738.abstract.

125. Rissel C, Curac N, Greenaway M, Bauman A. Physical activity associated with public transport use--a review and modelling of potential benefits. *Int J Environ Res Public Health* 2012; **9**(7): 2454-78. 10.3390/ijerph9072454.

126. Dee A, Kearns K, O'Neill C, et al. The direct and indirect costs of both overweight and obesity: a systematic review. *BMC Research Notes* 2014; **7**(1): 1-9. 10.1186/1756-0500-7-242.

127. Biswas A, Oh PI, Faulkner GE, et al. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Ann Intern Med* 2015; **162**(2): 123-32. 10.7326/M14-1651.

128. Kramer CK, Zinman B, Retnakaran R. Are metabolically healthy overweight and obesity benign conditions?: A systematic review and meta-analysis. *Ann Intern Med* 2013; **159**(11): 758-69. 10.7326/0003-4819-159-11-201312030-00008.

129. Global Burden of Metabolic Risk Factors for Chronic Diseases C, Lu Y, Hajifathalian K, et al. Metabolic mediators of the effects of body-mass index, overweight, and obesity on coronary heart disease and stroke: a pooled analysis of 97 prospective cohorts with 1.8 million participants. *Lancet* 2014; **383**(9921): 970-83. 10.1016/S0140-6736(13)61836-X.

130. Huai P, Xun H, Reilly KH, Wang Y, Ma W, Xi B. Physical activity and risk of hypertension: a meta-analysis of prospective cohort studies. *Hypertension* 2013; **62**(6): 1021-6. 10.1161/HYPERTENSIONAHA.113.01965.

131. Pal S, Radavelli-Bagatini S, Ho S. Potential benefits of exercise on blood pressure and vascular function. *J Am Soc Hypertens* 2013; **7**(6): 494-506. 10.1016/j.jash.2013.07.004.

132. Zhang Y, Liu H, Yang S, Zhang J, Qian L, Chen X. Overweight, obesity and endometrial cancer risk: results from a systematic review and meta-analysis. *Int J Biol Markers* 2014; **29**(1): e21-9. 10.5301/jbm.5000047.

133. Schmid D, Leitzmann MF. Television viewing and time spent sedentary in relation to cancer risk: a meta-analysis. *J Natl Cancer Inst* 2014; **106**(7). 10.1093/jnci/dju098.

134. Keum N, Greenwood DC, Lee DH, et al. Adult weight gain and adiposity-related cancers: a dose-response meta-analysis of prospective observational studies. *J Natl Cancer Inst* 2015; **107**(3). 10.1093/jnci/dju428.

135. Zhong S, Jiang T, Ma T, et al. Association between physical activity and mortality in breast cancer: a meta-analysis of cohort studies. *Eur J Epidemiol* 2014; **29**(6): 391-404. 10.1007/s10654-014-9916-1.

136. Behrens G, Jochem C, Keimling M, Ricci C, Schmid D, Leitzmann MF. The association between physical activity and gastroesophageal cancer: systematic review and meta-analysis. *Eur J Epidemiol* 2014; **29**(3): 151-70. 10.1007/s10654-014-9895-2.

137. Buffart LM, Singh AS, van Loon EC, Vermeulen HI, Brug J, Chinapaw MJ. Physical activity and the risk of developing lung cancer among smokers: a meta-analysis. *J Sci Med Sport* 2014; **17**(1): 67-71. 10.1016/j.jsams.2013.02.015.

138. Singh S, Devanna S, Edakkanambeth Varayil J, Murad MH, Iyer PG. Physical activity is associated with reduced risk of esophageal cancer, particularly esophageal adenocarcinoma: a systematic review and meta-analysis. *BMC Gastroenterology* 2014; **14**: 101. 10.1186/1471-230X-14-101.

139. Gardner JR, Livingston PM, Fraser SF. Effects of exercise on treatment-related adverse effects for patients with prostate cancer receiving androgen-deprivation therapy: a systematic review. *J Clin Oncol* 2014; **32**(4): 335-46. 10.1200/JCO.2013.49.5523.

140. Kodama S, Horikawa C, Fujihara K, et al. Quantitative relationship between body weight gain in adulthood and incident type 2 diabetes: a meta-analysis. *Obes Rev* 2014; **15**(3): 202-14. 10.1111/obr.12129.

141. Brand T, Pischke CR, Steenbock B, et al. What works in community-based interventions promoting physical activity and healthy eating? A review of reviews. *Int J Environ Res Public Health* 2014; **11**(6): 5866-88. 10.3390/ijerph110605866.

142. Horodyska K, Luszczynska A, van den Berg M, et al. Good practice characteristics of diet and physical activity interventions and policies: an umbrella review. *BMC Public Health* 2015; **15**: 19. 10.1186/s12889-015-1354-9.

143. Yen IH, Fandel Flood J, Thompson H, Anderson LA, Wong G. How design of places promotes or inhibits mobility of older adults: realist synthesis of 20 years of research. *J Aging Health* 2014; **26**(8): 1340-72. 10.1177/0898264314527610.

144. Warkentin LM, Das D, Majumdar SR, Johnson JA, Padwal RS. The effect of weight loss on health-related quality of life: systematic review and meta-analysis of randomized trials. *Obes Rev* 2014; **15**(3): 169-82. 10.1111/obr.12113.

145. Rosenbaum S, Tiedemann A, Sherrington C, Curtis J, Ward PB. Physical activity interventions for people with mental illness: a systematic review and meta-analysis. *J Clin Psychiatry* 2014; **75**(9): 964-74. 10.4088/JCP.13r08765.

146. Stults-Kolehmainen MA, Sinha R. The effects of stress on physical activity and exercise. *Sports Med* 2014; **44**(1): 81-121. 10.1007/s40279-013-0090-5.

147. Mammen G, Faulkner G. Physical activity and the prevention of depression: a systematic review of prospective studies. *Am J Prev Med* 2013; **45**(5): 649-57. 10.1016/j.amepre.2013.08.001.

148. McCormack GR, Virk JS. Driving towards obesity: a systematized literature review on the association between motor vehicle travel time and distance and weight status in adults. *Prev Med* 2014; **66**: 49-55. 10.1016/j.ypmed.2014.06.002.

149. Beauchamp A, Backholer K, Magliano D, Peeters A. The effect of obesity prevention interventions according to socioeconomic position: a systematic review. *Obes Rev* 2014; **15**(7): 541-54. 10.1111/obr.12161.

150. Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for adults: informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act* 2013; **10**: 135. 10.1186/1479-5868-10-135.

151. Robb G, Sultana S, Ameratunga S, Jackson R. A systematic review of epidemiological studies investigating risk factors for work-related road traffic crashes and injuries. *InjPrev* 2008; **14**(1): 51-8. 10.1136/ip.2007.016766.

152. Chu AH, Koh D, Moy FM, Muller-Riemenschneider F. Do workplace physical activity interventions improve mental health outcomes? *Occup Med (Lond)* 2014; **64**(4): 235-45. 10.1093/occmed/kqu045.

153. National Institute for Health & Clinical Excellence. Preventing unintentional road injuries among the under-15s. London: National Institute for Health and Clinical Excellence 2010. http://bit.ly/1krN3dh.

154. Mendez-Figueroa H, Dahlke JD, Vrees RA, Rouse DJ. Trauma in pregnancy: an updated systematic review. *AmJObstetGynecol* 2013; **209**(1): 1-10. 10.1016/j.ajog.2013.01.021.

155. Mehta S, Ameratunga SN. Prevalence of post-traumatic stress disorder among children and adolescents who survive road traffic crashes: a systematic review of the international literature. *JPaediatrChild Health* 2012; **48**(10): 876-85. 10.1111/j.1440-1754.2011.02076.x.

156. Lustenberger T, Inaba K, Talving P, et al. Bicyclists injured by automobiles: relationship of age to injury type and severity--a national trauma databank analysis. *JTrauma* 2010; **69**(5): 1120-5. 10.1097/TA.0b013e3181d0f68b.

157. Johan de Hartog J, Boogaard H, Nijland H, Hoek G. Do the health benefits of cycling outweigh the risks? *EnvironHealth Perspect* 2010; **118**(8): 1109-16. 10.1289/ehp.0901747.

158. Oxley J, Whelan M. It cannot be all about safety: the benefits of prolonged mobility. *TrafficInjPrev* 2008; **9**(4): 367-78. 10.1080/15389580801895285.

159. Broome K, McKenna K, Fleming J, Worrall L. Bus use and older people: a literature review applying the Person-Environment-Occupation model in macro practice. *Scandinavian Journal of Occupational Therapy* 2009; **16**(1): 3-12. 10.1080/11038120802326222.

160. Verburgh L, Konigs M, Scherder EJ, Oosterlaan J. Physical exercise and executive functions in preadolescent children, adolescents and young adults: a meta-analysis. *Br J Sports Med* 2014; **48**(12): 973-9. 10.1136/bjsports-2012-091441.

161. Stanley S, Laugharne J. The impact of lifestyle factors on the physical health of people with a mental illness: a brief review. *Int J Behav Med* 2014; **21**(2): 275-81. 10.1007/s12529-013-9298-x.

162. Beenackers MA, Kamphuis CB, Giskes K, et al. Socioeconomic inequalities in occupational, leisure-time, and transport related physical activity among European adults: a systematic review. *Int J Behav Nutr Phys Act* 2012; **9**: 116. 10.1186/1479-5868-9-116.

163. Kuykendall JR, Shaw SL, Paustenbach D, Fehling K, Kacew S, Kabay V. Chemicals present in automobile traffic tunnels and the possible community health hazards: a review of the literature. *Inhal Toxicol* 2009; **21**(9): 747-92. 10.1080/08958370802524357.

164. National Health and Medical Research Council. Systematic literature review: air quality in and around traffic tunnels. Canberra: Commonwealth of Australia,, Commonwealth of Australia, 2008. http://bit.ly/1LdyrLn.

165. Röösli M. Non-cancer effects of chemical agents on children's health. *ProgBiophysMolBiol* 2011; **107**(3): 315-22. 10.1016/j.pbiomolbio.2011.08.006.

166. Henschel S, Atkinson R, Zeka A, et al. Air pollution interventions and their impact on public health. *IntJPublic Health* 2012; **57**(5): 757-68. 10.1007/s00038-012-0369-6.

167. Forbes LJ, Kapetanakis V, Rudnicka AR, et al. Chronic exposure to outdoor air pollution and lung function in adults. *Thorax* 2009; **64**(8): 657-63.

168. Pedersen M, Stayner L, Slama R, et al. Ambient air pollution and pregnancy-induced hypertensive disorders: a systematic review and meta-analysis. *Hypertension* 2014; **64**(3): 494-500. 10.1161/HYPERTENSIONAHA.114.03545.

169. Gowers AM, Cullinan P, Ayres JG, et al. Does outdoor air pollution induce new cases of asthma? Biological plausibility and evidence; a review. *Respirology* 2012; **17**(6): 887-98. 10.1111/j.1440-1843.2012.02195.x.

170. Mustafic H, Jabre P, Caussin C, et al. Main air pollutants and myocardial infarction: a systematic review and meta-analysis. *JAMA* 2012; **307**(7): 713-21. 10.1001/jama.2012.126.

171. Gauderman WJ, Vora H, McConnell R, et al. Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study. *Lancet* 2007; **369**(9561): 571-7. 10.1016/S0140-6736(07)60037-3.

172. COMEAP. Review of the UK Air Quality Index: Department of Health 2011. http://bit.ly/qFCdNH.

173. HM Government of Great Britain & Northern Ireland. Clean Air Act 1956. http://bit.ly/1MaxPFD.

174. COMEAP. The mortality effects of long-term exposure to particulate air pollution in the United Kingdom: Produced by the Health Protection Agency for the Committee on the Medical Effects of Air Pollutants 2010. http://bit.ly/qYQ6tc.

175. Valavanidis A, Fiotakis K, Vlachogianni T. Airborne particulate matter and human health: toxicological assessment and importance of size and composition of particles for oxidative damage and carcinogenic mechanisms. *JEnvironSciHealth CEnvironCarcinogEcotoxicolRev* 2008; **26**(4): 339-62. 10.1080/10590500802494538.

176. Adar SD, Filigrana PA, Clements N, Peel JL. Ambient Coarse Particulate Matter and Human Health: A Systematic Review and Meta-Analysis. *CurrEnvironHealth Rep* 2014; **1**: 258-74. 10.1007/s40572-014-0022-z.

177. Grahame TJ, Klemm R, Schlesinger RB. Public health and components of particulate matter: the changing assessment of black carbon. *JAir Waste ManagAssoc* 2014; **64**(6): 620-60.

178. Wik A, Dave G. Occurrence and effects of tire wear particles in the environment--a critical review and an initial risk assessment. *EnvironPollut* 2009; **157**(1): 1-11. 10.1016/j.envpol.2008.09.028.

179. Bell ML, Zanobetti A, Dominici F. Evidence on vulnerability and susceptibility to health risks associated with short-term exposure to particulate matter: a

systematic review and meta-analysis. *AmJEpidemiol* 2013; **178**(6): 865-76. 10.1093/aje/kwt090.

180. Orazzo F, Nespoli L, Ito K, et al. Air pollution, aeroallergens, and emergency room visits for acute respiratory diseases and gastroenteric disorders among young children in six Italian cities. *EnvironHealth Perspect* 2009; **117**(11): 1780-5. 10.1289/ehp.0900599.

181. Arbex MA, de Souza Conceicao GM, Cendon SP, et al. Urban air pollution and chronic obstructive pulmonary disease-related emergency department visits. *JEpidemiolCommunity Health* 2009; **63**(10): 777-83. 10.1136/jech.2008.078360.

182. Janghorbani M, Momeni F, Mansourian M. Systematic review and metaanalysis of air pollution exposure and risk of diabetes. *EurJEpidemiol* 2014; **29**(4): 231-42. 10.1007/s10654-014-9907-2.

183. World Health Organization Regional Office for Europe. Air quality guidelines. Global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide 2006. http://bit.ly/1GZKsRd.

184. HM Government of Great Britain & Northern Ireland. Environmental protection: the air quality standards regulations. London 2010. http://bit.ly/1mq3Ewz.

185. World Health Organization Regional Office for Europe. Review of evidence on health aspects of air pollution - REVIHAAP project: final technical report. Copenhagen, Denmark 2013. http://bit.ly/SbuOOv.

186. Beelen R, Raaschou-Nielsen O, Stafoggia M, et al. Effects of long-term exposure to air pollution on natural-cause mortality: an analysis of 22 European cohorts within the multicentre ESCAPE project. *Lancet* 2014; **383**(9919): 785-95. 10.1016/S0140-6736(13)62158-3

187. Institute of Air Quality Management. Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance 2011. http://bit.ly/1YOoJFL.

188. Cherrie JW, Brosseau LM, Hay A, Donaldson K. Low-toxicity dusts: current exposure guidelines are not sufficiently protective. *AnnOccupHyg* 2013; **57**(6): 685-91. 10.1093/annhyg/met038.

189. Blight GE. Wind erosion of waste impoundments in arid climates and mitigation of dust pollution. *Waste ManagRes* 2008; **26**(6): 523-33. 26/6/523 pii ;10.1177/0734242X07082027.

190. Viana M, Pey J, Querol X, Alastuey A, de LF, Lukewille A. Natural sources of atmospheric aerosols influencing air quality across Europe. *SciTotal Environ* 2013; **472**: 825-33. 10.1016/j.scitotenv.2013.11.140.

191. Griffin DW. Atmospheric movement of microorganisms in clouds of desert dust and implications for human health. *ClinMicrobiolRev* 2007; **20**(3): 459-77, table. 10.1128/CMR.00039-06.

192. Karanasiou A, Moreno N, Moreno T, Viana M, de LF, Querol X. Health effects from Sahara dust episodes in Europe: literature review and research gaps. *EnvironInt* 2012; **47**: 107-14. 10.1016/j.envint.2012.06.012.

193. van der Gon HA, Gerlofs-Nijland ME, Gehrig R, et al. The policy relevance of wear emissions from road transport, now and in the future--an international workshop report and consensus statement. *JAir Waste ManagAssoc* 2013; **63**(2): 136-49.

194. Grigoratos T, Martini G. Brake wear particle emissions: a review. *EnvironSciPollutResInt* 2015; **22**(4): 2491-504. 10.1007/s11356-014-3696-8.

195. Bottcher RW. An environmental nuisance: odor concentrated and transported by dust. *ChemSenses* 2001; **26**(3): 327-31.

196. Ni JQ, Robarge WP, Xiao C, Heber AJ. Volatile organic compounds at swine facilities: a critical review. *Chemosphere* 2012; **89**(7): 769-88. 10.1016/j.chemosphere.2012.04.061.

197. Tandayi M, Osim EE, Chinyanga HM. The need for a regular comprehensive health surveillance on industrial workers. *CentAfrJMed* 1999; **45**(6): 158-60.

198. Timmerman JG, Heederik D, Spee T, Smit LA. Skin symptoms in the construction industry: occurrence and determinants. *AmJIndMed* 2014; **57**(6): 660-8. 10.1002/ajim.22314.

199. Bruske I, Thiering E, Heinrich J, Huster KM, Nowak D. Respirable quartz dust exposure and airway obstruction: a systematic review and meta-analysis. *OccupEnvironMed* 2014; **71**(8): 583-9. 10.1136/oemed-2013-101796.

200. Hassan J, Khan F, Amyotte P, Ferdous R. A model to assess dust explosion occurrence probability. *JHazardMater* 2014; **268**: 140-9. 10.1016/j.jhazmat.2014.01.017.

201. Quality of Urban Air Research Group. Airborne Particulate Matter in the United Kingdom: Third Report of the Quality of Urban Air Review Group.

Birmingham: Prepared at the request of the Department of the Environment by the University of Birmingham 1996. http://bit.ly/1EQoDUQ.

202. Bate KJ, Coppin NJ. Impact of dust from mineral workings: Loughborough University 1990.

203. Orkin A, Leece P, Piggott T, Burt P, Copes R. Peak event analysis: a novel empirical method for the evaluation of elevated particulate events. *EnvironHealth* 2013; **12**: 92. 10.1186/1476-069X-12-92.

204. HM Government of Great Britain & Northern Ireland. The Control of Substances Hazardous to Health Regulations 2002. http://bit.ly/18lHsSS.

205. Health & Safety Executive. Health topics - Dust 2014. http://bit.ly/1MaAqzx.

206. Basner M, Babisch W, Davis A, et al. Auditory and non-auditory effects of noise on health. *Lancet* 2014; **383**(9925): 1325-32. 10.1016/S0140-6736(13)61613-X.

207. Munzel T, Gori T, Babisch W, Basner M. Cardiovascular effects of environmental noise exposure. *EurHeart J* 2014; **35**(13): 829-36. 10.1093/eurheartj/ehu030.

208. Wright B, Peters E, Ettinger U, Kuipers E, Kumari V. Understanding noise stress-induced cognitive impairment in healthy adults and its implications for schizophrenia. *Noise Health* 2014; **16**(70): 166-76. 10.4103/1463-1741.134917.

209. Szalma JL, Hancock PA. Noise effects on human performance: a meta-analytic synthesis. *PsycholBull* 2011; **137**(4): 682-707. 10.1037/a0023987.

210. Dzhambov AM, Dimitrova DD. Urban green spaces' effectiveness as a psychological buffer for the negative health impact of noise pollution: a systematic review. *Noise Health* 2014; **16**(70): 157-65. 10.4103/1463-1741.134916.

211. Laszlo HE, McRobie ES, Stansfeld SA, Hansell AL. Annoyance and other reaction measures to changes in noise exposure - a review. *SciTotal Environ* 2012; **435-436**: 551-62. 10.1016/j.scitotenv.2012.06.112.

212. Babisch W. Updated exposure-response relationship between road traffic noise and coronary heart diseases: a meta-analysis. *Noise and Health* 2014; **16**(68): 1-9. 10.4103/1463-1741.127847.

213. Ndrepepa A, Twardella D. Relationship between noise annoyance from road traffic noise and cardiovascular diseases: a meta-analysis. *Noise Health* 2011; **13**(52): 251-9. 10.4103/1463-1741.80163.

214. van Kamp I, Davies H. Noise and health in vulnerable groups: a review. *Noise Health* 2013; **15**(64): 153-9. 10.4103/1463-1741.112361.

215. Hohmann C, Grabenhenrich L, de KY, et al. Health effects of chronic noise exposure in pregnancy and childhood: a systematic review initiated by ENRIECO. *IntJHygEnvironHealth* 2013; **216**(3): 217-29. 10.1016/j.ijheh.2012.06.001.

216. Tomei G, Fioravanti M, Cerratti D, et al. Occupational exposure to noise and the cardiovascular system: a meta-analysis. *SciTotal Environ* 2010; **408**(4): 681-9. 10.1016/j.scitotenv.2009.10.071.

217. Verbeek JH, Kateman E, Morata TC, Dreschler WA, Mischke C. Interventions to prevent occupational noise-induced hearing loss: a Cochrane systematic review. *IntJAudiol* 2014; **53 Suppl 2**: S84-S96. 10.3109/14992027.2013.857436.

218. European Environment Agency. Good practice guide on noise exposure and potential health effects. Copenhagen, Denmark: The Expert Panel on Noise (EPoN) for the EEA 2010. http://bit.ly/1oohdkw.

219. World Health Organization Regional Office for Europe. Update of WHO guidelines for community noise for the European Region. *WHO website* 2014. http://bit.ly/1lroMow.

220. HM Government of Great Britain & Northern Ireland. Environmental Protection Act 1990. http://bit.ly/1Nkn5pH.

221. Northern Ireland Environment Agency. Northern Ireland Primary Legislation. 2015. http://bit.ly/1MaehkT.

222. The Pollution Prevention and Control Regulations (Northern Ireland). 2003. http://bit.ly/1A0kPuM.

223. Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control. 2008. http://bit.ly/1BNkQqB.

224. Coventry and others (Respondents) v Lawrence and another (Apellants) (No.2). 2014. http://bit.ly/1EiUTkl.

225. BSI. Code of practice for noise and vibration control on construction and open sites. Vibration. London, England: British Standards Institution 2009.

226. Gidlöf-Gunnarsson A, Ogren M, Jerson T, Ohrstrom E. Railway noise annoyance and the importance of number of trains, ground vibration, and building situational factors. *Noise Health* 2012; **14**(59): 190-201. 10.4103/1463-1741.99895.

227. Smith MG, Croy I, Ogren M, Persson WK. On the influence of freight trains on humans: a laboratory investigation of the impact of nocturnal low frequency vibration and noise on sleep and heart rate. *PLoSOne* 2013; **8**(2): e55829. 10.1371/journal.pone.0055829.

228. Croy I, Smith MG, Waye KP. Effects of train noise and vibration on human heart rate during sleep: an experimental study. *BMJ Open* 2013; **3**(5). 10.1136/bmjopen-2013-002655.

229. Leventhall HG. Low frequency noise and annoyance. *Noise Health* 2004; **6**(23): 59-72.

230. Todd NPM, Rosengren SM, Colebatch JG. Tuning and sensitivity of the human vestibular system to low-frequency vibration. *Neuroscience Letters* 2008; **444**(1): 36-41. http://www.sciencedirect.com/science/article/pii/S0304394008011130.

231. van der Noordt M, H IJ, Droomers M, Proper KI. Health effects of employment: a systematic review of prospective studies. *Occup Environ Med* 2014; **71**(10): 730-6. 10.1136/oemed-2013-101891.

232. Lindberg P, Vingard E. Indicators of healthy work environments--a systematic review. *Work* 2012; **41 Suppl 1**: 3032-8. 10.3233/WOR-2012-0560-3032.

233. Bannai A, Tamakoshi A. The association between long working hours and health: a systematic review of epidemiological evidence. *Scand J Work Environ Health* 2014; **40**(1): 5-18. 10.5271/sjweh.3388.

234. Fransson EI, Heikkila K, Nyberg ST, et al. Job strain as a risk factor for leisure-time physical inactivity: an individual-participant meta-analysis of up to 170,000 men and women: the IPD-Work Consortium. *Am J Epidemiol* 2012; **176**(12): 1078-89. 10.1093/aje/kws336.

235. Babu GR, Jotheeswaran AT, Mahapatra T, et al. Is hypertension associated with job strain? A meta-analysis of observational studies. *Occup Environ Med* 2014; **71**(3): 220-7. 10.1136/oemed-2013-101396.

236. Landsbergis PA, Dobson M, Koutsouras G, Schnall P. Job strain and ambulatory blood pressure: a meta-analysis and systematic review. *Am J Public Health* 2013; **103**(3): e61-71. 10.2105/AJPH.2012.301153.

237. Fransson EI, Nyberg ST, Heikkila K, et al. Job strain and the risk of stroke: an individual-participant data meta-analysis. *Stroke* 2015; **46**(2): 557-9. 10.1161/STROKEAHA.114.008019.

238. Nakata A. Psychosocial job stress and immunity: a systematic review. *Methods Mol Biol* 2012; **934**: 39-75. 10.1007/978-1-62703-071-7_3.

239. Virtanen M, Nyberg ST, Batty GD, et al. Perceived job insecurity as a risk factor for incident coronary heart disease: systematic review and meta-analysis. *BMJ* 2013; **347**: f4746. 10.1136/bmj.f4746.

240. Keim AC, Landis RS, Pierce CA, Earnest DR. Why do employees worry about their jobs? A meta-analytic review of predictors of job insecurity. *J Occup Health Psychol* 2014; **19**(3): 269-90. 10.1037/a0036743.

241. Herbig B, Dragano N, Angerer P. Health in the long-term unemployed. *Dtsch Arztebl Int* 2013; **110**(23-24): 413-9. 10.3238/arztebl.2013.0413.

242. Hoving JL, van der Meer M, Volkova AY, Frings-Dresen MH. Illness perceptions and work participation: a systematic review. *Int Arch Occup Environ Health* 2010; **83**(6): 595-605. 10.1007/s00420-010-0506-6.

243. Milner A, Page A, LaMontagne AD. Cause and effect in studies on unemployment, mental health and suicide: a meta-analytic and conceptual review. *Psychol Med* 2014; **44**(5): 909-17. 10.1017/S0033291713001621.

244. Milner A, Page A, LaMontagne AD. Long-term unemployment and suicide: a systematic review and meta-analysis. *PLoS One* 2013; **8**(1): e51333. 10.1371/journal.pone.0051333.

245. Henkel D. Unemployment and substance use: a review of the literature (1990-2010). *Current drug abuse reviews* 2011; **4**: 4-27.

246. Montano D, Hoven H, Siegrist J. A meta-analysis of health effects of randomized controlled worksite interventions: does social stratification matter? *Scand J Work Environ Health* 2014; **40**(3): 230-4. 10.5271/sjweh.3412.

247. Kaspin LC, Gorman KM, Miller RM. Systematic review of employer-sponsored wellness strategies and their economic and health-related outcomes. *Popul Health Manag* 2013; **16**(1): 14-21. 10.1089/pop.2012.0006.

248. Jensen JD. Can worksite nutritional interventions improve productivity and firm profitability? A literature review. *Perspect Public Health* 2011; **131**: 184-92.

249. Cashman CM, Ruotsalainen JH, Greiner BA, Beirne PV, Verbeek JH. Alcohol and drug screening of occupational drivers for preventing injury. *Cochrane Database Syst Rev* 2009; (2): CD006566. 10.1002/14651858.CD006566.pub2.

250. van der Molen HF, Lehtola MM, Lappalainen J, et al. Interventions to prevent injuries in construction workers. *Cochrane Database Syst Rev* 2012; **12**: CD006251. 10.1002/14651858.CD006251.pub3.

251. van Rijn RM, Robroek SJ, Brouwer S, Burdorf A. Influence of poor health on exit from paid employment: a systematic review. *Occup Environ Med* 2014; **71**(4): 295-301. 10.1136/oemed-2013-101591.

252. Golics CJ, Basra MK, Finlay AY, Salek S. The impact of disease on family members: a critical aspect of medical care. *J R Soc Med* 2013; **106**(10): 399-407. 10.1177/0141076812472616.

253. Campos-Serna J, Ronda-Perez E, Artazcoz L, Moen BE, Benavides FG. Gender inequalities in occupational health related to the unequal distribution of working and employment conditions: a systematic review. *Int J Equity Health* 2013; **12**: 57. 10.1186/1475-9276-12-57.

254. Furnee CA, Groot W, Pfann GA. Health and income: a meta-analysis to explore cross-country, gender and age differences. *Eur J Public Health* 2011; **21**(6): 775-80. 10.1093/eurpub/ckq166.

255. Gunasekara FI, Carter K, Blakely T. Change in income and change in self-rated health: Systematic review of studies using repeated measures to control for confounding bias. *Soc Sci Med* 2011; **72**(2): 193-201. 10.1016/j.socscimed.2010.10.029.

256. Kondo N, Sembajwe G, Kawachi I, van Dam RM, Subramanian SV, Yamagata Z. Income inequality, mortality, and self rated health: meta-analysis of multilevel studies. *BMJ* 2009; **339**: b4471. 10.1136/bmj.b4471.

257. Health Development Agency. Social Capital. London 2004. http://bit.ly/1J5yFWl.

258. Murayama H, Fujiwara Y, Kawachi I. Social capital and health: a review of prospective multilevel studies. *Journal of epidemiology / Japan Epidemiological Association* 2012; **22**: 179-87. 10.2188/jea.JE20110128.

259. Gilbert KL, Quinn SC, Goodman RM, Butler J, Wallace J. A meta-analysis of social capital and health: A case for needed research. *Journal of Health Psychology* 2013; **18**(11): 1385-99. 10.1177/1359105311435983.

260. Vyncke V, De Clercq B, Stevens V, et al. Does neighbourhood social capital aid in levelling the social gradient in the health and well-being of children and adolescents? A literature review. *BMC Public Health* 2013; **13**: 65. 10.1186/1471-2458-13-65.

261. Uphoff EP, Pickett KE, Cabieses B, Small N, Wright J. A systematic review of the relationships between social capital and socioeconomic inequalities in health: a contribution to understanding the psychosocial pathway of health inequalities. *Int J Equity Health* 2013; **12**: 54. 10.1186/1475-9276-12-54.

262. Egan M, Tannahill C, Petticrew M, Thomas S. Psychosocial risk factors in home and community settings and their associations with population health and health inequalities: a systematic meta-review. *BMCPublic Health* 2008; **8**: 239. 10.1186/1471-2458-8-239.

263. Santini ZI, Koyanagi A, Tyrovolas S, Mason C, Haro JM. The association between social relationships and depression: a systematic review. *J Affect Disord* 2015; **175**: 53-65. 10.1016/j.jad.2014.12.049.

264. Harrop E, Addis S, Elliott E, Williams G. Resilience, coping and salutogenic approaches to maintaining and generating health: a review: Cardiff Institute of Society Health and Ethics 2007. http://bit.ly/1IYUK7c.

265. Community Cohesion Review Team. Community Cohesion: A report of the Independent Review Team. London: Home Office 2001. http://bit.ly/1f38Iso.

266. National Institute for Health & Clinical Excellence. Community engagement. London, UK 2008. http://bit.ly/SXmlyt.

267. Sellström E, Bremberg S. Review Article: The significance of neighbourhood context to child and adolescent health and well-being: A systematic review of multilevel studies. *Scandinavian Journal of Public Health* 2006; **34**(5): 544-54. 10.1080/14034940600551251.

268. McConnell D, Breitkreuz R, Savage A. From financial hardship to child difficulties: main and moderating effects of perceived social support. *Child Care Health Dev* 2011; **37**(5): 679-91. 10.1111/j.1365-2214.2010.01185.x.

269. McPherson KE, Kerr S, Morgan A, et al. The association between family and community social capital and health risk behaviours in young people: an integrative review. *BMC Public Health* 2013; **13**: 971. 10.1186/1471-2458-13-971.

270. Bhugra D, Becker MA. Migration, cultural bereavement and cultural identity. *World Psychiatry* 2005; **4**: 18-24.