



Forth Replacement Crossing

Health Impact Assessment

November 2009





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Executive Summary

This Health Impact Assessment (HIA) presents a high-level appraisal of the possible health effects of the Forth Replacement Crossing project (the proposed scheme). The purpose of an HIA is to assess any potential health consequences of the proposals, to use this information to make recommendations to reduce the risk of adverse health effects and, where possible, to improve the health outcomes resulting from the proposal.

Issues that can influence health and wellbeing include changes to people's environmental, social and economic conditions. This HIA identifies the potential for effects on human health and wellbeing based on currently available information on the proposed scheme. It draws from the output and findings of a number of other studies on the proposed scheme, including in particular the Environmental Impact Assessment reported in the Environmental Statement and the Design Manual for Roads & Bridges (DMRB) Stage 3 Scheme Assessment Report.

The HIA takes into consideration the positive impacts of the proposed scheme which, by providing a replacement traffic crossing and thereby negating the risk of a closure or severe restriction in crossing capacity, would prevent widespread socio-economic impacts which would otherwise have adverse consequences for health and wellbeing.

Other positive and negative health effects have been identified during construction and operation. These are generally of negligible to minor magnitude. Effects may be more likely in the areas close to the proposed new road connections to the north and south of the Main Crossing.

Mitigation measures from the Environmental Statement considered relevant to this HIA have been acknowledged and any further mitigation considered necessary based on the results of the HIA has been identified.

1 Introduction

1.1 Introduction

Following the completion of the Forth Replacement Crossing Study as part of the Strategic Transport Projects Review (STPR), the Cabinet Secretary for Finance and Sustainable Growth announced to Parliament on 19 December 2007 that the Forth Replacement Crossing would be a new cable-stayed bridge located immediately upstream of the Forth Road Bridge.

The decision to progress with the development of the project was based on the findings of the Forth Replacement Crossing Study, Reports 1 to 5 (Jacobs et al., 2007) and addressed ongoing concerns over the continued availability of the Forth Road Bridge as an unrestricted crossing for general road traffic. The policy objective is to provide, in the light of uncertainties about the future availability of the Forth Road Bridge, a continuing and reliable primary road link between Edinburgh, the Lothians, and Fife and beyond in order to safeguard the economy, particularly of the east coast of Scotland.

Following the above announcement, the Jacobs Arup Joint Venture was appointed in January 2008 to work as a development partner with Transport Scotland to take the project forward. With the need, form and location for a replacement crossing having been identified, Jacobs Arup were engaged to carry out the detailed development of all aspects of the Forth Replacement Crossing Project, including the Main Crossing and its connecting roads infrastructure. This included the associated environmental studies and the Environmental Impact Assessment (EIA) and the production of an Environmental Statement (ES), a Sustainability Appraisal and Carbon Management Report and this Health Impact Assessment (HIA).

This HIA report presents a high-level appraisal of the possible health effects of the Design Manual for Roads and Bridges (DMRB) Stage 3 engineering design.

1.2 Purpose of Health Impact Assessment

The purpose of an HIA is to assess any potential health consequences of the proposals, to use this information to make recommendations to reduce the risk of adverse health effects and, where possible, to improve the health outcomes resulting from the proposal. HIA is a multi-disciplinary activity that cuts across the traditional boundaries of health, public health, social sciences and environmental sciences.

There is no statutory basis for HIA, although its use is advocated in Government policy and guidance documents. Non-statutory guidance on HIA has been produced by numerous organisations including Health Scotland, as described in Section 3.3 of this report.

The most commonly used definition of HIA is given in the World Health Organisation (WHO) Gothenburg Consensus Paper (1999) which describes it as:

‘a combination of procedures, methods and tools by which a policy, programme or project may be judged as to its potential effects on the health of a population, and the distribution of those effects within the population’.

This HIA draws from the findings of a number of other studies on the FRC proposals other studies including in particular the ES and the DMRB Stage 3 Scheme Assessment Report. It collates and assesses facts relating to potential health impacts from these various reports, considers them in the context of relevant baseline health information and consolidates this information in a concise report. References are provided as appropriate.

2 The Proposed Scheme

2.1 Introduction

The proposed scheme can be separated into three main sections:

- the proposed new bridge (hereafter referred to as the 'Main Crossing');
- road connections north of the Main Crossing to Admiralty Junction (M90 Junction 1); and
- road connections south of the Main Crossing to Scotstoun Junction (A90/M9 Spur), together with enhancement to M9 Junction 1a.

Traffic management measures supported through the use of an Intelligent Transport System (ITS) which would be provided along a 22km corridor extending from the M90 Halbeath Junction over the Main Crossing to the M9 north of Newbridge Roundabout (M9 Junction 1). Overhead signal gantries along the corridor will provide lane control, variable mandatory speed control and incident detection. Strategic and tactical traffic information would be provided to drivers via variable message signs (VMS).

A full description of the proposed scheme can be found in Chapter 4 of the ES (Jacobs Arup, 2009a) and in the DMRB Stage 3 Scheme Assessment Report (Jacobs Arup, 2009b). A plan of the proposed scheme is shown in Figure 4.1 of the ES and a summary is provided below.

2.2 The Main Crossing and the Forth Road Bridge

The Main Crossing would comprise a new 2.7km bridge incorporating a dual two lane motorway with hard shoulders running on a cable stayed bridge with approach viaducts to the north and south. It would be located upstream of the existing Forth Road Bridge.

The Forth Road Bridge would become a public transport crossing alongside the Main Crossing. It would cater for bus and taxi services, and pedestrians and cyclists, with possibility for future adaption to accommodate a Light Rapid Transit (LRT) system in the form of a high quality bus network, guided bus way or tram system.

2.3 North of the Main Crossing (to Admiralty Junction)

Departing the Main Crossing, a new section of dual carriageway motorway would run northwards to Ferrytoll Junction supported by a viaduct.

Ferrytoll Junction would be fully reconstructed to cater for all local and longer-distance traffic movements, pedestrian and cyclist movements, whilst also maintaining access to the existing Forth Road Bridge. The B981 would be realigned in order to maintain access to North Queensferry during the construction period and improve the operation and safety of Ferrytoll Junction. Castlandhill Road would be realigned to separate local traffic from A90 traffic.

2.4 South of the Main Crossing (Scotstoun Junction to A90/M9 Spur)

A new 3.1km section of dual carriageway would be constructed around the west and south of South Queensferry, providing a link from the Main Crossing to the A90 and M9 Spur at Scotstoun Junction.

A new Queensferry Junction would link local roads (including the A904) to the new road infrastructure and the Main Crossing, whilst maintaining pedestrian and cyclist routes. From Queensferry Junction to Scotstoun Junction, the road would be dual three-lane carriageway with hard shoulders, constructed to motorway standard.

Dedicated public transport links would be provided from the Forth Road Bridge eastwards in the direction of Edinburgh using the A90, and from the A90 to the A8000 westwards to join a proposed bus priority scheme on that road.

2.5 M9 Junction 1a and Associated Improvements

Junction 1a on the M9 would be redeveloped to improve traffic flows and make better use of the existing junction. The improvements include new west-facing slip roads to better serve West Lothian traffic. The southbound section of the M9 would be widened to provide four lanes of traffic to complement the proposed improvements to this junction. An additional lane on the northbound direction of the M9 between the River Almond Bridge and Junction 1a would help diverging traffic.

2.6 Construction

The construction programme will be determined by the relevant contractors prior to the commencement of the works. Three contracts are proposed:

- the principal contract for the new crossing and approach roads north and south of the Firth, along with the ITS to be installed over these sections;
- a concurrent contract to improve Junction 1a on the M9 and the installation of ITS from Newbridge to South Queensferry; and
- a contract to install ITS between Halbeath and Admiralty Junctions on the M90 in Fife.

The construction works are scheduled to start in 2011 and are likely to take approximately five and a half years in total, although some elements would be completed more quickly. The timing of the connecting roads and for Junction 1a are more flexible. An outline of the possible timing for the works is indicated in Table 1.

Table 1: Works Timescales

Road Connections North	
Ferrytoll Junction and Mainline North	2012 – 2016
Road Connections South	
M9 Junction 1a	2011 – 2014
Queensferry Junction and Mainline South	2013 - 2016

A Code of Construction Practice (CoCP) has been developed which sets out a series of objectives and measures which the Contractor must comply with throughout construction of the proposed scheme. The CoCP sets out a requirement for the Contractor to prepare and implement an Environmental Management Plan (EMP). The EMP would provide the mechanism for the practical delivery of environmental commitments, including compliance with relevant legislation and best

practice guidance. This would include specific management plans including (but not limited to) the following:

- Area Management Plan covering overarching site management issues;
- Noise and Vibration Management Plan;
- Dust and Air Pollution Management Plan;
- Geology, Land Contamination and Waste Management Plan;
- Surface and Ground Water Management Plan;
- Ecological Management Plan;
- Agricultural Management Plan;
- Cultural Heritage Management Plan;
- Landscape Management Plan; and
- Pollution Incident Response Plan.

The Contractor is also required to develop a Traffic Management Plan and Marine Traffic Management Plan although these will not form part of the EMP.

Proposed locations for site compounds have been identified in close proximity to the principal works areas, namely Ferrytoll Junction, South Queensferry / Echline and M9 Junction 1a. It is envisaged that the main compound for the principal works, including the construction of the Main Crossing and its approach roads, would be located within Echline Fields, west of South Queensferry. Where appropriate, the Contractor will provide haul roads through the works for use by construction vehicles to minimise the need to use public roads. The Scottish Ministers will consult with local road authorities regarding access routes that may be used by the contractor to access the construction site.

3 Policy and Guidance

3.1 Government Policy

The Scottish Government's Action Plan, Better Health Better Care (2007) sets out the Government's programme to deliver a healthier Scotland. Section 2, Helping People to Sustain and Improve their Health, Particularly in Disadvantaged Communities, sets out four key actions to:

- increase healthy life expectancy in Scotland;
- break the link between early life adversity and adult disease;
- reduce health inequalities, particularly in the most deprived communities; and
- reduce smoking, excessive alcohol consumption and other risk factors to a healthier life.

Section 2.4 of the Action Plan, Tackling Health Inequalities states that *'poor mental and physical health is both a cause and consequence of social, economic and environmental inequalities. Risk factors include ... aspects of the wider social, economic and physical environments including educational achievement, income / relative poverty, the work environment and unemployment'*.

A Ministerial Task Force on Health Inequalities led by the Minister for Public Health has been established to identify and prioritise practical actions to reduce the most significant and widening health inequalities. The Task Force has adopted some key principles including:

- improving the whole range of circumstances and environments that offer opportunities to improve people's life circumstances and hence their health; and
- reducing people's exposure to factors in the physical and social environment that cause stress, that are damaging to health and wellbeing, and that lead to health inequalities.

In December 2008, the Task Force published its report 'Equally Well' (Scottish Government, 2008), which aims to take the emerging understanding of the deep-seated causes of health inequalities and turn it into practical action. Actions and recommendations are arranged under five headings:

- Smarter Scotland: Early Years and Young People.
- Wealthier and Fairer Scotland: Tackling Poverty and Increasing Employment.
- Greener Scotland: Physical Environments and Transport.
- Safer and Stronger Scotland: Harms to Health and Wellbeing: Alcohol, Drugs and Violence.
- Healthier Scotland: Health and Wellbeing.

Of relevance to this HIA Report are the recommendations identified in the Task Force's report under the heading of 'Greener Scotland' which include:

- "28. *The Government and local agencies and partnerships should apply the "precautionary principle" across policy development affecting green space in environment, education and health. It should increase the priority given to the creation, retention and promotion of green*

spaces as essential for health improvement, especially in communities at risk of poor health.

34. *The Government should take forward action targeting children from disadvantaged areas who are at greater risk of injury in road accidents and to encourage local authorities to follow existing good practice in this area.*
35. *New Government whole-community initiatives should be measured on their impact on health and health inequalities, these include for example, sustainable transport demonstration projects, designed to engage the whole community."*

3.2 Local Policy

3.2.1 Fife

Fife's Joint Health Improvement Plan, 'A Healthier Future for Fife, 2007-2010' was developed by the Fife Health and Wellbeing Alliance (FHWA). The Plan aims to provide a strategic framework which would enable community planning partner organisations to work with the communities they serve to continue to improve health and wellbeing and reduce health inequalities in Fife. The key themes of the plan are:

- reducing health inequalities (including reducing discrimination and promoting equality);
- creating healthier environments; and
- supporting healthier lifestyles.

3.2.2 West Lothian

The West Lothian Health Improvement Team has been set up to integrate health improvement and well-being, and address inequalities through the development and implementation of relevant policies and strategies across West Lothian.

The Health Improvement Team is involved in the development of the 'Life Stage Outcome Planning Programme' which integrates health improvement into a Community Planning Partnership approach to tackling health and social inequalities. This process replaces the previous Joint Health Improvement Plan.

3.2.3 Edinburgh

The 2003 – 2006 Joint Health Improvement Plan for Edinburgh was developed by an interagency Health Action Team set up by the Edinburgh Partnership. The purpose of the joint plan is to bring together the interconnecting factors which contribute to a healthier city and establish a common commitment to achieving good health in the City of Edinburgh.

The overall vision of the plan is '*maintained and improved health and wellbeing for Edinburgh's residents, together with sustained action to reduce health inequalities*'. The plan states that '*the objectives of improved community health and wellbeing and reduced health inequalities can only be achieved when health impacts are prioritised ... by the main community planning partners, by organisations in all sectors, and by individuals themselves – to work towards a healthier Edinburgh*'.

In 2008, the Edinburgh Community Health Partnership published a consultation paper on the revised Edinburgh Joint Health Improvement Plan. The vision set out in this paper is *‘for Edinburgh (city) to show steady improvement in the health and wellbeing of its people and a reduction in the health inequalities experienced by its disadvantaged communities’*.

Key actions include:

- to improve the physical environment and infrastructure of the city to ensure physical activity is the easy option for people (e.g. by identifying mechanisms to ensure physical activity is included in spatial planning); and
- to increase physical activity of adults of working age (e.g. by encouraging active commuting to work).

3.3 HIA Guidance

3.3.1 Health Scotland Guidance

Health Scotland advocates the use of HIA and has produced Guidance on Health Impact Assessment of Transport Projects (Health Scotland, 2007). The guidance highlights the importance of transport to health and wellbeing, and refers to data linking poor transport with health and social exclusion issues.

The Guidance states that *‘Health impact assessment is a way of applying the evidence in this document, and other relevant evidence, to a transport proposal in order to inform decision making. This should be done at a stage of planning when the proposal is clear enough to be assessed but there is still the opportunity to make changes that would improve the health impacts that would arise from that proposal. The evidence must be applied to the specific proposal and local context.’*

3.3.2 West Lothian Supplementary Planning Guidance

West Lothian has produced Supplementary Planning Guidance (SPG) on ‘Health Impact Assessment’. The SPG provides guidance on the preparation of HIAs for major new developments in West Lothian. The aim is to assist decision making by taking into account key determinants to protect human health.

3.3.3 The Merseyside Guidelines for Health Impact Assessment

The Merseyside Guidelines for Health Impact Assessment (2001) prepared by Liverpool Public Health Observatory, set out a staged process for undertaking HIA and include criteria to describe the significance of potential health effects (see Section 4.6). This is the only guidance which provides criteria to describe the nature of health effects, and is widely used in HIA.

The HIA scope and approach described in Section 4 below incorporates elements from each of the above guidance documents.

4 HIA Methodology

4.1 HIA Process

A staged HIA process is outlined in Health Scotland's Guidance on Health Impact Assessment of Transport Projects (Health Scotland, 2007). This HIA has followed this process, as outlined in Table 2 below.

Table 2: Staged Approach to HIA

HIA Stage	Key Tasks	Comments
Screening	Decide whether to do an HIA	Transport Scotland identified the need for HIA at an early stage to ensure recognised best practice was followed.
Scoping	Set up the geographical, population and time boundaries over which to predict impacts and identify affected population groups	A review was undertaken of environmental and engineering assessments during route corridor option appraisal. This allowed an initial identification of the scope of the HIA. The scope was refined during the ongoing design development and consultation process.
Local profile	Collate relevant data on the local populations and features of the local area	Available published data were collated to prepare a population profile (see Section 5).
Involve stakeholders	Consult with local people and other stakeholders to identify their views on possible impacts	Health sector stakeholders were consulted and the HIA was informed by responses to consultation and engagement activities.
Identify and assess impacts	Identify the likely health impacts from the proposal. Carry out further review if this would help make recommendations	See Sections 6 to 11 of this report.
Make recommendations	Use findings to recommend measures that would improve health outcomes	This HIA Report refers to mitigation identified in the ES and recommends further measures as appropriate.
Monitor impacts	Monitor actual impacts that arise after the implementation of the proposal	To be taken forward by Transport Scotland at appropriate times during and after construction.

4.2 Scope of HIA

4.2.1 Nature of the Proposed Scheme

The proposed scheme is basically transferring general road traffic from the Forth Road Bridge crossing the Forth to a replacement crossing some 300m upstream, with public transport and pedestrian use on the existing bridge being maintained and enhanced.

Although the proposals do result in some changes to the population affected by the proposed scheme, this is only evident at a fairly detailed level. Fundamentally the same local populations that would be affected by the proposed scheme are affected by the existing road network.

One important aspect of the proposed scheme is that the existing crossing, the Forth Road Bridge, may not continue to function as a viable crossing without major repair.

The most recent focus of concern in relation to the Forth Road Bridge being able to continue to provide an unrestricted crossing has been the condition of the main suspension cables upon which the stability of the bridge depends. Internal inspection of the main suspension cables between 2004 and 2008 have reported that the main cables are estimated to have lost 10% of their strength. On that basis, and assuming that this rate of deterioration continues, restrictions to HGV traffic may be required at some point between 2017 and 2021 unless current preventative measures are successful.

4.2.2 Do-Minimum Scenarios

The ES has been undertaken on the basis of a Do-Minimum (i.e. the situation in the absence of the proposed scheme) scenario comprising the continued use of the Forth Road Bridge. Given that, in the absence of the proposed scheme, major works comprising cable replacement or augmentation works would be required in order for the Forth Road Bridge to remain operational, a supplementary assessment of impacts associated with these works was also carried out and reported as part of the ES. Full or partial closure of the Forth Road Bridge for the duration of these works would have severe impacts on the local transport system and economy.

For consistency, and unless otherwise stated, the ES Do-Minimum scenario is assumed as the basis for comparison within the HIA. Where relevant the effects of the proposed scheme are also qualitatively compared against the potential effects of the Forth Road Bridge maintenance works.

4.2.3 Scope and Level of Detail

As noted above, the proposed scheme is unlikely to give rise to impacts affecting very different populations compared to those affected by the existing road network.

It was not considered appropriate or relevant to undertake HIA at the level of detail required to capture fine changes and focus on very small discrete geographical areas. However, the HIA can very usefully capture the possible health impacts of the proposed scheme when compared to the scenario of the existing bridge being unfit to continue as a viable unrestricted crossing. The focus of this HIA therefore tends to be on the larger scale effects which can more confidently be described. The relevant determinants are described in the following section.

4.2.4 Health Determinants

Issues that can influence health and wellbeing (termed 'health determinants') include changes to people's environmental, social and economic conditions. The health determinants included within the scope of this HIA are listed below.

Economics and Employment

- Regional economic effects associated with the maintenance of a key transport link.
- Direct and indirect effects on local business and employment during the operation of the proposed scheme.

- Effects of the construction of the proposed scheme on business and employment.

Air Quality

- Changes in levels of nitrogen dioxide (NO₂) and particulate matter (PM₁₀) resulting from changes in traffic movements.
- Contributions towards greenhouse gas emissions.
- Dust and emissions associated with the construction process.

Noise

- Changes in noise levels resulting from changes in traffic movements.
- Noise and vibration during construction.

Access to Services and Facilities

- Changes in the accessibility of services and local community facilities, via cycle and pedestrian routes, car and public transport.

Social Capital

- Effects on people's ability to maintain social networks, resulting from changes in travel opportunities, severance and environmental effects.

Green Space and Physical Activity

- Effects on public footpaths and cycle paths.
- Effects on public open space (including designated areas such as public parks as well as informal amenity areas).
- Accessibility and quality of leisure and sports facilities.

This HIA does not address occupational health and safety issues in relation to the construction and operation of the proposed scheme. The Health and Safety Plan for the proposed scheme would provide actions to ensure all relevant health and safety issues are addressed.

The effects of the proposed scheme on road safety are discussed in Section 6.4 of the DMRB Stage 3 Scheme Assessment Report (Jacobs Arup, 2009b) and are not addressed in this HIA.

4.2.5 Geographic Scope

Health effects of the proposed scheme are likely to be limited to within the following areas:

- the local areas directly affected by the physical infrastructure of the Main Crossing, approach roads and other works; and
- the wider region of Fife, West Lothian and Edinburgh, which would experience economic and transport related effects.

This assumption is based on the outcome of the Traffic and Economic Assessment, reported in the DMRB Stage 3 Scheme Assessment Report (Jacobs Arup, 2009b),

and also on the assessed areas of impact for relevant environmental impacts such as noise and air quality, as reported in the ES.

4.2.6 Health Inequalities

Different groups within a community would experience the beneficial and adverse effects of an intervention in different ways. There is evidence for this in relation to socio-economic class and transport initiatives. For example:

- Those in higher income groups are more likely to own a car and are therefore more likely to benefit from road infrastructure investment projects.
- Those in lower income groups are more likely to suffer the adverse effects of traffic, including road traffic accidents, and are more likely to live in areas blighted by traffic noise and poor air quality.

HIA considers the potential disparities in impact between people in different socio-economic groups as well as other vulnerable groups such as children, the elderly and those with disabilities (see Section 6.2.3).

4.3 Evidence Linking Health Determinants with Health Effects

Utilising available literature, including previous health studies and recent research, an evidence base has been collated to identify links between the health determinants and health effects. Effects may be direct or indirect and links may be causal or compounding. Key reference material has included:

- government health policies, programmes and strategies;
- previous health impact assessments;
- indicators developed by the London Health Commission; and
- research undertaken by the NHS, Medical Research Council and other organisations.

A review of available relevant research and evidence of the health effects associated with each health determinant is summarised as appropriate within the relevant sections of this HIA. Where the evidence base contains gaps, it should be noted that an absence of or insufficient evidence does not constitute evidence of no link between the determinant and health effects. The degree of certainty in the assessment reflects the availability of evidence for a health link.

4.4 Baseline and Population Profile

Baseline conditions for health determinant were largely drawn from other assessments undertaken for the proposed scheme, including the ES (Jacobs Arup, 2009a) and the DMRB Stage 3 Scheme Assessment Report (Jacobs Arup, 2009b).

A profile of the population affected by the proposed scheme has been drawn from published data sources including:

- the Scottish Index of Multiple Deprivation (SIMD);
- Community Health Profiles (NHS Health Scotland);
- Scottish Public Health Observatory (ScotPHO);
- Scottish Transport Statistics;
- Scottish Household Survey; and
- Information Services Division Scotland (ISD).

The purpose of this exercise is to provide information on the social and health status of the affected communities, and to identify any issues that may be relevant to the assessment, such as:

- vulnerable groups that may be disproportionately affected (either positively or negatively) by the proposed scheme;
- links between health and social deprivation in the affected population;
- links between health and transport/access issues in the affected population; and
- health issues that could be improved or impacted by the scheme (e.g. levels of physical activity).

4.5 Stakeholder Involvement

Consultation was undertaken with the Public Health Directors at NHS Lothian and NHS Fife during the preparation of the HIA Report.

Responses received from the public consultations for the proposed scheme were reviewed in order to obtain information on the issues of concern to local communities and summarised in the Forth Replacement Crossing Public Information Exhibitions: Feedback and Outcomes Report prepared by Transport Scotland (2009a).

A separate report setting out Transport Scotland's commitment to encouraging public interest and involvement will be reported in the evolving Consultation & Engagement Report (Transport Scotland, in press).

4.6 Impact Assessment

4.6.1 Effects on Health Determinants

The HIA has utilised information from a number of other assessments undertaken for the proposed scheme. Table 3 identifies the sources of information for each health determinant.

Table 3: Application Documents Relating to Health Determinants

Health Determinant	Relevant Documents
Economics and employment	DMRB Stage 3 Scheme Assessment Report <ul style="list-style-type: none"> • Part 2: Engineering, Traffic and Economics DMRB Stage 3 ES <ul style="list-style-type: none"> • Chapter 7 - Land Use • Chapter 19 - Disruption due to Construction • Appendix A5.1: Supplementary Do-Minimum Assessment
Air Quality	DMRB Stage 3 ES <ul style="list-style-type: none"> • Chapter 15: Air Quality • Chapter 19: Disruption due to Construction • Appendix A19.1: Code of Construction Practice
Noise	DMRB Stage 3 ES <ul style="list-style-type: none"> • Chapter 16: Noise and Vibration • Chapter 19: Disruption due to Construction • Appendix A19.1: Code of Construction Practice

Health Determinant	Relevant Documents
Access to services and facilities	DMRB Stage 3 Scheme Assessment Report <ul style="list-style-type: none"> Part 2: Engineering, Traffic and Economics DMRB Stage 3 ES <ul style="list-style-type: none"> Chapter 17: Pedestrians, Cyclists, Equestrians and Community Effects Appendix A5.1: Supplementary Do-Minimum Appendix A19.1: Code of Construction Practice
Physical Activity and Green Space	DMRB Stage 3 Scheme Assessment Report <ul style="list-style-type: none"> Part 2: Engineering, Traffic and Economics DMRB Stage 3 ES <ul style="list-style-type: none"> Chapter 17: Pedestrians, Cyclists, Equestrians and Community Effects Chapter 12: Landscape Chapter 13: Visual Chapter 16: Noise and Vibration
Social Capital	DMRB Stage 3 ES <ul style="list-style-type: none"> Chapter 17: Pedestrians, Cyclists, Equestrians and Community Effects

4.6.2 Assessing Health Effects

Conclusions on the potential impacts on health and wellbeing effects are based on available research demonstrating causal links between environmental and socio-economic factors and health (see Section 4.3). It should be noted that the existence of a causal link between a particular factor and health does not necessarily mean that changes in such a factor caused by a road scheme will produce a health effect.

Changes in population health have a wide and complex range of contributory factors many of which are likely to be unrelated to the proposed scheme. The purpose of the assessment is to identify where improvement or worsening of health determinants is likely to take place, and qualitatively assess the implications of these changes for the health and wellbeing of the affected individuals or communities.

The significance of potential health effects was assessed using a system based on the criteria described in the Merseyside Guidelines for Health Impact Assessment (Liverpool Public Health Observatory, 2001). This system involves the classification of effects in three different ways:

- determining the nature of the impact (classified either as positive or negative);
- assessing its measurability (defined on a three point scale of qualitative, estimable or calculable); and
- estimating the degree of certainty in the assessment using the terms speculative, probable and definite as described below:
 - speculative effects occur where either the causal link between the determinant and the health effect is unproven; or linkages between the determinant and health effects have been established but action is required to bring about the potential health effect;
 - probable effects are those where causal linkages between the determinant and health have been established and where the effects do not require individuals or organisations to take a particular course of action; and

- definite effects are those which are considered to be inevitable – this term is not utilised in this study.

In addition to the Merseyside criteria above, the following categories have been used to describe the magnitude of health effects arising:

- Negligible: where any health effects are expected to be too small to measure;
- Minor: where it is considered likely that the health or wellbeing of isolated individuals would be mildly affected;
- Moderate: where it is considered likely that the health or wellbeing of a proportion of the community would be mildly affected, or isolated individuals would be particularly affected; and
- Major: where it is considered likely that a proportion of the community would be significantly affected.

The Guidelines note that definite, quantifiable effects are not necessarily more important in the assessment than speculative and qualitative effects.

4.7 Mitigation

Mitigation from the ES which is relevant to the HIA has been summarised in this report and these mitigation measures have been taken into account in the consideration of health impacts. Where appropriate, further HIA-specific mitigation to reduce adverse health effects and, where possible, improve health outcomes has been identified as a result of the HIA findings. Transport Scotland has reviewed the HIA-specific mitigation measures in this report and is committed to their implementation.

4.8 Limitations and Assumptions

Consultation has been limited to correspondence and meetings with stakeholders within the health sector. Public consultation has not been undertaken specifically for the HIA, although feedback from the consultation and engagement activities has informed the appraisal.

Baseline data on health and socio-economic conditions are limited to publicly available data. Local level data have been used wherever possible. However in many cases information is only available at the national or regional level.

Commentary level assessment has been provided on the effects of the proposed scheme on vulnerable groups. More detailed assessment of these impacts has been limited by a lack of available data on the presence of vulnerable groups within the study area.

5 Existing Population Profile

This section describes the health profiles of regions and communities within the study area.

5.1 National Context

5.1.1 Health and Social Inequalities

The Edinburgh Community Health Partnership has prepared a Discussion Paper entitled Towards a Joint Health Improvement Plan (April 2008). This document sums up health issues in Scotland as follows:

‘Scotland as a whole has a poor health record in relation to most European nations, but national trends for health and health related behaviours are positive, with steady improvement across a range of indicators. However, over the last 20 years more advantaged social groups have seen a faster improvement in health, leading to an increase in the health gap between those at the top and the bottom of the social scale. The lowest socio-economic groups still have very poor health by national and international comparisons.’

5.1.2 Neighbourhoods and Communities

The Scottish Government National Indicator on the proportion of adults who rate their neighbourhood as a good place to live (2007) found that 93% of adults in Scotland rated their neighbourhood as a fairly or very good place to live.

Results from the 2007 Scottish Household Survey showed that, while the most deprived areas are similar to the rest of Scotland in terms of what residents like about them, there are marked differences in terms of what they dislike, with much greater dissatisfaction with quality of life issues such as the unpleasant or unsafe environments, problem residents and lack of sense of community.

5.1.3 Physical Activity

The Scottish Health Survey shows that 72% of women and 59% of men in Scotland are not active enough for health. The scale of physical inactivity makes this the most common risk factor for coronary heart disease in Scotland, above smoking and obesity. The proportion of sedentary adults (below 30 minutes physical activity per week) from the lowest socio-economic groups is twice that of those from the highest socio-economic groups.

Scottish Transport Statistics on the Scottish Public Health Observatory (ScotPHO) website (Scottish Public Health Observatory, 2009) show that in terms of active travel, the proportion of journeys made by private motor transport has increased slightly over the period 1995/96 – 2005/6. Survey data from 2001-2007 show that around 14% of adults aged 16 years and over usually walked to work, 1% cycled, and over 60% usually drove or were passengers in a car or van.

5.2 Regional Context

5.2.1 Health and Social Inequalities

The Scottish Government's Annual Population Survey shows that the City of Edinburgh, Fife and West Lothian have above average levels of economic activity compared with Scotland as a whole (National Statistics, 2007).

Data from the 2001 Census, displayed on the ScotPHO website, shows that in the City of Edinburgh, the percentage of adults in households classified as Social Grade AB (higher and intermediate managerial / administrative / professional) is significantly higher than the national average at 27.2% compared with a national average of 19%. However, in Fife and West Lothian the percentage of adults in social grade AB drops to below the national average.

5.2.2 Neighbourhoods and Communities

According to the Scottish Government's Scottish Household Survey, the percentage of respondents that rate their neighbourhood as a 'good' or 'fairly good' place to live is the same as the national average for Scotland in West Lothian and the City of Edinburgh, but just below average for Fife (Scottish Government, 2009).

5.2.3 Community Health and Wellbeing Profiles

Community Health and Wellbeing Profiles have been produced by the Scottish Public Health Observatory. The Community Health Partnership (CHP) areas have been characterised according to 61 indicators covering health (e.g. life expectancy and self assessed health), health related behaviours (e.g. active commuting) and the wider determinants of health (e.g. education and employment). Each indicator is compared to the Scottish average and identified as being significantly better, significantly worse or not significantly different.

The HIA focuses on the following CHP areas:

- Dunfermline and West Fife (population 139,242);
- West Lothian (population 165,700); and
- Edinburgh (population 463,510).

It is recognised that the effects of the proposed scheme in terms of economic and transport impacts would extend beyond these areas therefore reference is also made to the following CHP:

- North of the Firth of Forth: Glenrothes and North East Fife; Perth and Kinross; Kirkcaldy and Levenmouth; and Clackmannanshire; and
- South of the Firth of Forth: Falkirk; Midlothian; and East Lothian.

Each CHP area covers a wide geographic area and includes a large and diverse population. Data at this level would mask significant variations in local conditions within the CHP areas. The review below is intended to provide a broad context for the health impact assessment.

The CHP area boundaries are shown in Figure 1 below.

Figure 1 – Community Health Partnership Areas



CHP Profiles: Within Scheme Footprint

Table 4 provides a summary of the indicator scores for the three CHP areas within which the scheme would be constructed, indicating the overall level of health and wellbeing in each area within the national context.

Table 4: Summary of indicator scores for local CHP areas

CHP Area	Better than average scores	Not significantly different	Worse than average scores
Dunfermline and West Fife	28	22	8
West Lothian	24	19	15
Edinburgh	36	11	11 □

Edinburgh is the most urban of these CHP areas, and is significantly better off than Scotland as a whole in terms of the majority of health and wellbeing indicators. West Lothian and Dunfermline & West Fife are largely rural, although both contain significant urban settlements. These CHP areas are also significantly better than average compared to the rest of Scotland, but not to the extent of Edinburgh.

All three CHP areas are significantly better than average in terms of the number of people living within the 15% most 'access deprived' areas of Scotland. As with all locations, smaller pockets of relatively more deprived areas will be found within the overall CHP area.

CHP Profiles: Wider Areas – South

The CHP areas along the south side of the Forth Valley are largely rural, although there are significant urban areas within Falkirk. All three CHP areas show a high

proportion of indicators in the 'better than average' category. All three CHP areas are significantly better than average in terms of the number of people living within the 15% most 'access deprived' areas of Scotland.

Table 5: Community Health and Wellbeing Profiles for Wider Areas South

CHP Area	Better than average scores	Not significantly different	Worse than average scores
East Lothian	39	14	5
Midlothian	29	20	9
Falkirk	28	16	14

CHP Profiles: Wider Areas – North

The wider CHP areas to the north are more varied than to the south, with Perth and Kinross and Glenrothes and North East Fife being significantly better off than Scotland as a whole in terms of the majority of socio-economic and health indicators. However both these areas have a greater than average number of people living within the 15% most 'access deprived' areas in Scotland. In contrast to this, the Kirkcaldy and Levenmouth CHP area has a high proportion of indicators in the 'worse than average' category.

Table 6: Community Health and Wellbeing Profiles for Wider Areas North

CHP Area	Better than average scores	Not significantly different	Worse than average scores
Glenrothes & North East Fife	39	12	7
Kirkcaldy & Levenmouth	14	18	26
Clackmannanshire	17	20	21
Perth & Kinross	42	7	8

5.3 Local Profile

The communities most local to the proposed scheme are described below.

5.3.1 Around Ferrytoll Junction and the Northern Approach Viaduct

To the west of the M90 is the community of Rosyth, built around the coastal port south of Dunfermline. It is separated from neighbouring Inverkeithing by the M90. Rosyth is a town with a population of 12,865 (Fife Council, 2007). Rosyth has a relatively young population, with below average aged numbers over 45. The majority of the population (67%) rate their general health as good (Scotland's Census results, 2001), which is just below the Scottish average (see Table 7 below).

East of the M90 is Inverkeithing. Established as a port town, Inverkeithing is a growing town with many new housing sites and a population of 5,265. Although the majority of the population of Inverkeithing rate their general health as good, the percentage is below the Scottish average.

North Queensferry, with a population of 1,095, lies to the south east of the proposed northern alignment beyond the Forth Road Bridge (Fife Council, 2007). The percentage of the population rating their general health as 'good' is above the national average for Scotland.

Further to the north lies the larger town of Dunfermline. With a population of 45,462 (Fife Council, 2007), this is the second largest settlement in Fife. Traditionally an industrial town producing textiles, the economy is largely dependent on financial and service sector jobs. Self-rated health is just above the national average.

5.3.2 Around the Southern Approach Viaduct, Queensferry Junction and the Southern Alignment

The southern approach viaduct is close to the residential areas on the west side of South Queensferry. There are also a number of properties at Linn Mill, located west of the southern approach viaduct. South Queensferry has a population of approximately 9,370 people, and self-rated health is significantly above the national average.

The area of the proposed scheme alignment to the west and south of South Queensferry is rural, with scattered farms, dwellings and small villages such as Newton (population approximately 170), which lies approximately 2km west of the alignment.

5.3.3 Around M9 Junction 1a

The proposed works at the M9 Junction 1a would take place close to Kirkliston, a small town with a population of approximately 3,000. Kirkliston is adjacent to the M9 which is located to the south and west of the town. Kirkliston used to be home to a number of industries, including a Drambuie Liqueur factory, and whisky distillery, but is now primarily a dormitory town for Edinburgh. Self-rated health is significantly above average.

Further west, the village of Winchburgh is located approximately 1km from the edge of the M9. The B9080 and B8020 both pass through Winchburgh. According to the 2001 Census, self-rated health for the population of Winchburgh is very similar to the national average. A development plan that aims to create an extension to Winchburgh, providing 3,450 homes, employment space and community facilities is currently in the planning process.

5.3.4 Health Ratings

Table 7 below shows the self-rated health in the towns and villages within the study area.

Table 7: Self-Rated Health Ratings

Location	Self-Rated Health (%)		
	Good	Fairly Good	Not good
Rosyth	66.89	24.00	9.11
Inverkeithing	64.30	25.98	9.72
North Queensferry	72.96	20.42	6.62
Dunfermline	69.10	22.13	8.76
South Queensferry	76.07	18.36	5.57
Kirkliston	74.27	19.78	5.95
Winchburgh	67.43	23.23	9.34
Scottish Average	67.91	21.94	10.15

6 Economics and Employment

6.1 Introduction

This section considers the potential health and wellbeing issues arising from economic effects such as employment and transport related social exclusion, as a result of the construction and operation of the proposed scheme. Economic effects would occur over a range of geographical areas, ranging from local to regional level impacts. Issues considered in this section include:

- regional economic issues associated with the proposed scheme and alternative options – broad effects on economic activity and access to employment and training opportunities; and
- local effects – direct and indirect impacts on businesses resulting from land-take, changes in journey times to employment and economic centres, opportunities for employment and training.

6.2 Evidence of Health Effects

6.2.1 Employment

A review undertaken by the Greater London Authority (2005) has described the health effects of unemployment as follows: *‘[unemployment is] a significant risk factor for poor physical and mental health and a major determinant of health inequalities. It is associated with morbidity, injuries and premature mortality, especially through increased risk of coronary heart disease. It is also related to depression, anxiety, and self-harm’.*

Most documented linkages between employment and health are related to the negative impacts of unemployment, rather than the positive impacts of employment. However, it follows that measures to promote economic growth and employment opportunities would generally be positive and serve to reduce the adverse health effects associated with unemployment and low incomes.

6.2.2 Transport Related Social Exclusion

Health Scotland’s HIA Guidance (Health Scotland, 2007) presents data from Scotland and the UK highlighting the links between poor transport and social exclusion. The guidance reports that two out of five jobseekers cite lack of transport as a barrier to getting a job. Car ownership is closely related to social class and income, and those living in households without a car report finding it harder to access shops, employment, healthcare and other services.

Not only are people from deprived communities less likely to have access to a car, but they are also more likely to experience disproportional exposure to the harmful effects of cars. Since economic factors limit people’s choice as to where to live, areas with less favourable environmental conditions are likely to contain higher levels of deprivation. In its report Tackling Obesities, the UK Government Office for Science Foresight (2007) suggests that people living in more deprived communities may suffer the health impacts of living in less walkable, more degraded environments.

Transport and other infrastructure projects have the potential to influence health and socio-economic inequalities. More deprived communities tend to be more vulnerable to further environmental degradation as they are seen as having lower sensitivity to environmental change and are therefore more likely to be subject to development that gives rise to visual impacts and pollution. Health Scotland's HIA Guidance reports on the health impacts of construction of new roads and/or upgrading of existing roads on access to healthcare, health inequalities or physical activity. However, there is no available research evidence to support the impacts of new roads on respiratory health, mental health, physical activity and access to health services.

The provision of developments that support reliable and affordable public transport can however, benefit those with limited employment options. According to the Report of the Ministerial Task Force on Health Inequalities (Scottish Government, 2008) increasing the accessibility of services can improve people's life chances and reduce social exclusion.

6.2.3 Vulnerable Groups

Development schemes can affect different members of the community in different ways. Groups identified in the Health Scotland's HIA Guidance as being particularly vulnerable to transport-related social and economic exclusion include women, the unemployed, the elderly, people with health problems and those in low income groups. The problems associated with lack of access to a car are compounded for those living in rural areas where fewer local services are available.

Key vulnerable groups identified in relation to the proposed scheme include the following:

Disability and Long Term Illness:

- Mobility impaired people and people with impaired vision would find it more difficult to deal with changes in their local environment, such as footpath diversions during construction.
- Those with hearing problems may suffer more as a result of increased background noise.
- People with respiratory disorders may be more affected by dust and vehicle emissions.
- People suffering from mental illness may have more difficulty dealing with issues such as uncertainty as to the effects of the proposed scheme, and may be more likely to suffer from increased stress and anxiety as a result of disruption and environmental changes.

Older People and Children:

- Older people and children are more vulnerable to the effects of air pollution. Children are more likely to suffer from asthma, which can be exacerbated by traffic-related pollutants.
- Older people are more likely to be affected by impaired mobility, hearing and sight, as discussed above.
- Areas of open space are important for children's development in terms of levels of activity and social interaction. Children may therefore be more vulnerable to changes in the accessibility or amenity value of these areas.

Minority Ethnic Groups:

According to the Scottish Household Survey (2007) between 2001 and 2005, adults from minority ethnic groups are less likely to hold a driving licence (48%) than white

ethnic groups (66%). This implies that minority groups may be less likely to benefit directly from proposed road improvements, whilst being equally affected by associated environmental effects of the proposed scheme.

6.3 Existing Conditions

6.3.1 Employment and Income

According to 2009 statistics published by the Scottish Government (Scottish Government, 2009), the rate of unemployment in Scotland as a whole is 4.7%. Within the study area for the proposed scheme, unemployment is higher on the north side of the Forth, with Fife having a rate of 5.5%, significantly higher than the national average. Unemployment is lowest in Edinburgh, at 3.8%. The Scottish Government data on working age employment and claimant unemployment are presented in Table 8 below.

Table 8: Labour Market Profiles for the Proposed Scheme Study Area (2009)

Indicator	Edinburgh City	Fife	West Lothian	Scotland
Employment rate (working age)	76%	76%	79%	76%
Claimant unemployment rate	3.8%	5.5%	5.0%	4.7%

The highest concentration of employment opportunities in the vicinity of the proposed scheme is located within the City of Edinburgh. There is a high level of commuting into Edinburgh from the surrounding region, including areas to the north of the Forth. The Forth Road Bridge is a major route for commuting into the urban area of Edinburgh from the north of the Firth of Forth.

Current levels of economic activity are higher on the south side of the Forth than the north side, and forecasts suggest that this trend is set to continue. The Transport and Economic Land use Model of Scotland (TELMoS) is a forecasting tool developed by Transport Scotland to assist in the assessment of different policy and strategies on land use and transport provision. The model predicts the highest levels of economic growth on the south side of the Firth of Forth, in West Lothian, Midlothian and Southeast Edinburgh, suggesting that the comparative difference in economic activity to the north and south of the Firth of Forth is set to continue. Given the known causal links between economic circumstances, social inclusion and health, this differential is likely to be linked to existing and future health inequalities.

6.3.2 Local Businesses

There are a number of businesses located within the immediate vicinity of the proposed development including agricultural holdings, leisure facilities, hotels and small to medium sized enterprises.

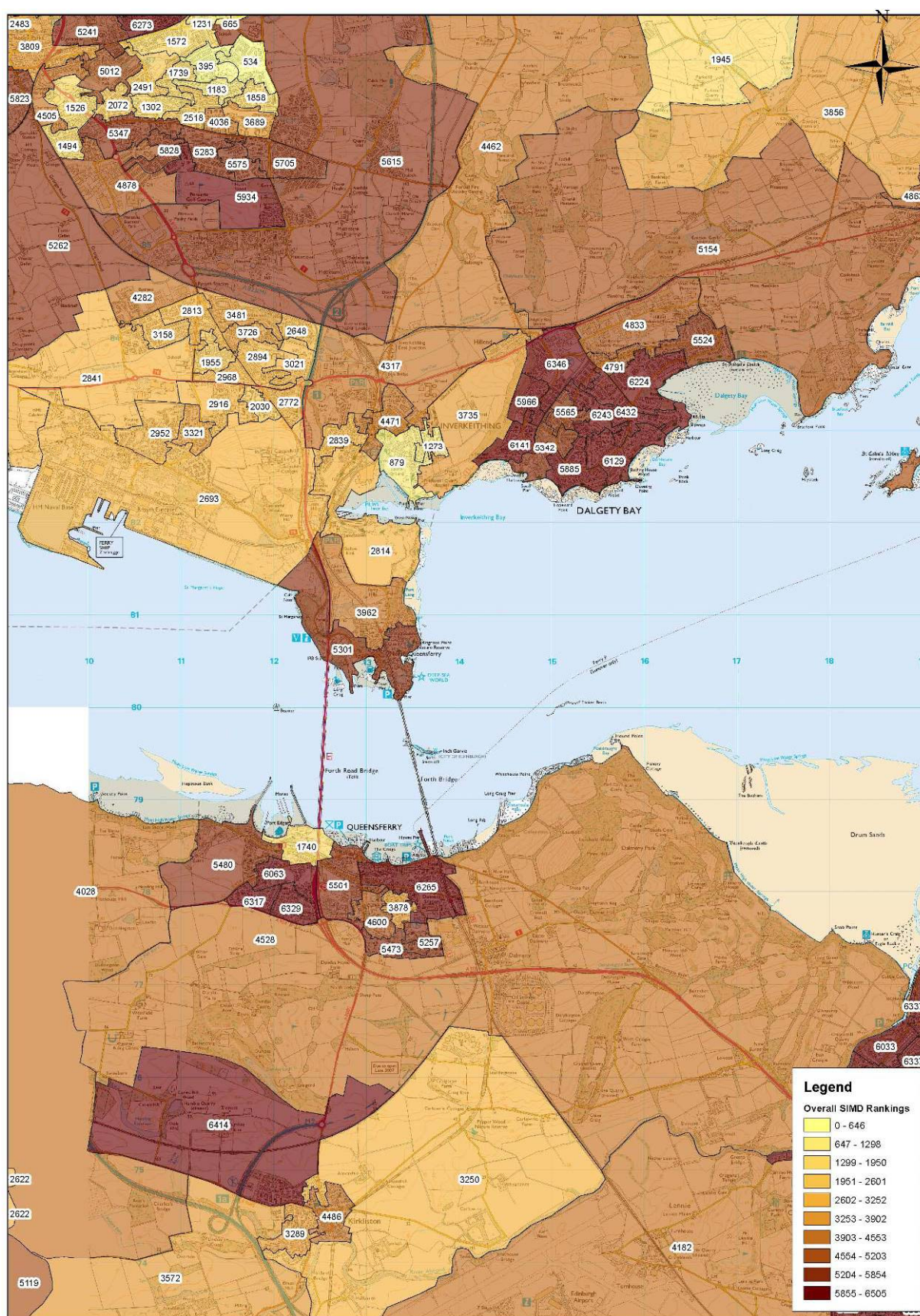
6.3.3 Economic and Social Deprivation

Data on the levels of deprivation within the study area has been obtained from the Scottish Index of Multiple Deprivation (SIMD) (2006). The SIMD combines 37 indicators across 7 domains, namely: current income, employment, health, education, skills and training, housing, geographic access and crime. The data zones, which have a median population size of 769, are ranked from most deprived (1) to least deprived (6,505) on the overall SIMD and on each of the individual

domains. The result is a comprehensive picture of relative area deprivation across Scotland.

Figure 2 below shows an overview of the SIMD rankings for the areas around the proposed scheme. There is a high degree of variation in deprivation levels throughout the study area. Rural areas tend to be in the mid-rankings, whereas urban areas are more polarised with a high proportion of data zones in the top or bottom 20% of the rankings.

Figure 2: SIMD Rankings in the Vicinity of the Proposed Scheme



6.3.4 Transport Related Social Exclusion

The Scottish Index of Multiple Deprivation (SIMD) provides an overall rating for all types of deprivation, and a rating for geographic access. A comparison of these ratings within the study area shows that, in general, areas of high deprivation do not suffer from particularly poor transport access. Transport studies undertaken as part of the FRC Sustainability Assessment have identified areas of transport-related social exclusion, where poor transport accessibility contributes significantly to the experience of social exclusion, based on existing transport studies and SIMD data. The following areas were considered to be affected by transport related social exclusion:

- Cowdenbeath, just north of the immediate study area in Fife;
- Kelty, north of Cowdenbeath, off junction 4 of the M90;
- East Wemyss and Methil, along the Forth coast in East Fife; and
- the Craigshill area of Livingston, west of the study area in West Lothian.

The existence of a traffic route across the Firth of Forth facilitates commuting between the north and south, with the majority of commuters travelling southwards towards employment in and around Edinburgh. Employment opportunities on the south of the Firth of Forth are likely to be more accessible to people in higher socio-economic groups with the advantages of higher educational attainment and access to private transport. Conversely, limited access to local employment as a result of the disparity in levels of economic activity is likely to impact on those lower socio-economic groups, particularly in areas with limited public transport.

6.4 Impact Assessment

6.4.1 Operational Effects

Regional Effects

Reports by the Forth Estuary Transport Authority (FETA) on the structural condition and strength of the Forth Road Bridge indicated that the bridge could not continue to function as the major road crossing of the Firth of Forth without major maintenance works including main cable replacement. These works would require full or partial closure of the Forth Road Bridge with an estimated period of traffic disruption of eight years. If no replacement bridge were provided, cross-Forth travel would reduce, with a consequential impact on the economies to the north and south of the Firth of Forth.

In the case of full closure, road traffic would have to travel via one of the upstream crossing points at Kincardine or in the Stirling area, significantly increasing the distance travelled. Partial closures would create very significant traffic congestion and is considered undesirable in the absence of a replacement crossing as the impacts on the economy, people and communities would be too severe.

FETA undertook a preliminary economic assessment as part of its cable augmentation study (FETA, 2008) addressing the wider impacts of these works on the local economies of Fife and the Lothian's and the national economy of Scotland as a result of traffic disruption, delays and reduced accessibility. This study showed that the works would potentially increase costs to the travelling public, add to distribution costs, affect customer markets, and lead to a competitive disadvantage. The inconvenience and added cost of travel could potentially discourage tourism and reduce recreational travel. The net effect would be to reduce business and

government revenues resulting in a contraction in economic activity and a loss of jobs.

The assessment of the disruptive impacts of these works supports the economic justification for the construction of the proposed scheme. The effect of the proposed scheme would be to maintain the status-quo in terms of the regional economy, avoiding the adverse economic effects of the alternative options. As such the proposed scheme would avoid potential increases in economic deprivation, and associated health and wellbeing impacts, for communities on both sides of the Firth of Forth.

Effects on Local Businesses

Indirect effects on business are likely to be both positive and negative depending on the location of the business and how it is affected by changes in traffic flows and journey times on local roads, with a positive overall balance.

The new bridge will improve the reliability and resilience of the crossing and thus improve accessibility for local businesses. The Main Crossing incorporates a hard shoulder and wind shielding, which together with the improved connecting roads and proposed ITS, will improve journey times and reliability.

Compared with the considerable disruption that would result from major maintenance works expected on the Forth Road Bridge in the absence of the proposed scheme, the disruptive effects of construction on local business will be relatively much smaller. Therefore on this basis the impact of the proposed scheme on local businesses and business in the wider area will, overall, be positive.

Access to Employment

As described in Section 6.3.1 above, there is a disparity in employment opportunities to the north and south of the Firth of Forth.

The proposed scheme maintains free-flow connections for general traffic between the M90 in the north and the M9 and A90 in the south. The replacement crossing will have a wider deck than the Forth Road Bridge, a higher speed limit and hard shoulders. These features are likely to improve speed over the Main Crossing as well as improving journey time reliability. The improved connecting roads with the associated ITS also assist traffic flow and reduce journey time variability. The improved speed and associated improvements will generate journey time benefits which mean that despite the additional distance travelled, journey times are reduced by comparison to the Do-Minimum scenarios. This should improve access to jobs and bring associated benefits for health and wellbeing.

Some additional job creation may result from the operation of the scheme as the Forth Road Bridge and the replacement crossing will increase overall maintenance and operating requirements.

Overall it is considered that the proposed scheme would have a positive impact on health and wellbeing resulting from improved access to local employment.

Transport Related Social Exclusion

In addition to maintaining the transport link across the Forth, the proposed scheme creates a new, high capacity public transport crossing of the Firth of Forth and

incorporates measures such as the ITS and priority bus routes which would provide additional benefits for local public transport. If bus journey times are reduced as a result of these improvements, employment opportunities could be opened up to a wider section of the community including those in lower income groups who may not have access to a car.

Effects on Residential Property

The scheme does not require the compulsory purchase of any residential properties. However, there will be areas of direct land-take and any acquisition of land will be compensated in accordance with Transport Scotland guidance. Guidance to compensation entitlement is available on Transport Scotland's website (Transport Scotland, 2009b).

There is potential for properties within South Queensferry to benefit, particularly those close to the existing A90 where traffic flows would be reduced. Conversely, properties closer to the works will be adversely affected.

The proposed scheme has been designed to minimise adverse effects on property, and measures such as visual screening and noise insulation would be put in place as appropriate. However there remains potential for anxiety among local residents in relation to property values.

6.4.2 Construction Effects

Wider Economic Effects

Major construction projects can have beneficial knock-on effects on the economy as a result of:

- Spend by the construction workforce within the local economy on accommodation, bars and restaurants, leisure facilities, food shops etc.
- Sourcing of materials such as aggregates from local suppliers.

The construction phase has the potential to increase economic activity, which in turn could contribute to incomes and employment. This will provide local benefits. Indirect beneficial effects on social exclusion and health are therefore possible as a result of the construction process.

Effects on Property

During construction, issues such as noise, dust and traffic would reduce the attractiveness of properties close to the works. There is a potential for actual or perceived effects on property values to cause distress to residents, with health effects manifested in the form of stress and anxiety.

Guidance on the entitlement to compensation during construction is available on Transport Scotland's website (Transport Scotland, 2009b).

Effects on of Traffic Disruption

Traffic disruption, particularly during the works to Ferrytoll Junction could result in loss of business for some local employers. Transport Scotland's consultations with local businesses indicated that business owners were concerned about the effects of construction, particularly in relation to increased journey times for potential clients,

tourists and visitors, causing loss of business. These are real and legitimate concerns. However, this effect should also be considered against a baseline of the long scale major disruption from the works required to maintain the Forth Road Bridge in the absence of a replacement crossing which will cause traffic disruption that is much greater than the proposed scheme. Relative to this scenario, business impacts will be lesser for the proposed scheme.

Access to Employment and Training

The works to construct the Main Crossing and connecting roads and bridges will take some five and a half years with works expected to commence in 2011.

The construction phase will create employment and training opportunities for local people. Whilst many construction jobs would require specific skills to be imported from outside the study area, there is also opportunity for less skilled workers. The level of any associated health benefits will depend on the extent of employment opportunities that are accessible to relatively more deprived sections of the community. This can be assisted by measures to remove barriers, such as transport and skills, for vulnerable people. The benefits depend on action being taken by individuals to take advantage of employment opportunities.

The construction programme will allow for significant on-the-job training and skills development, which could benefit people from within local communities, including those more deprived pockets within the local areas. Again these benefits are dependent both on suitable training being made available, opportunities being publicised to local people and barriers to access being addressed.

The construction phase of the scheme will present an opportunity to reduce impacts of unemployment and social exclusion to a small degree. Whilst the construction phase would not affect regional employment levels, there is potential for local people to benefit.

6.5 Mitigation Measures

Mitigation measures for land use and business impacts are listed in Chapter 7, Chapter 19 and Chapter 23 of the ES (Jacobs Arup, 2009a). Of most relevance to the HIA are:

- maintaining access to agricultural land, woodland, residential properties and businesses during construction;
- consulting with landowners and occupiers in advance of construction works;
- adhering to best practice in order to control dust generation and disposal; and
- commitment to implement a Traffic Management Plan with actions to manage traffic and minimise disruption during construction.

6.6 Assessment of Health Effects

The effects on health have been assessed according to the criteria set out in the Merseyside Guidelines (see Section 4.6).

The available evidence (see Section 6.2) indicates an identified causal link between economics and health and the degree of certainty is generally considered to be probable. However, as economic issues related to construction require an action in order to achieve the potential health effect, the degree of certainty is considered to

be speculative. Employment and income have very broad and diverse effects on health, and as such it is not possible to describe the nature of the impact beyond a general beneficial or adverse effect on health and wellbeing. As such the health impacts in this section are considered to be qualitative.

The proposed scheme would secure a viable road crossing of the Forth for the foreseeable future and as such wider area economic benefits are expected in the long term. It is considered therefore that the proposed scheme would have positive effects on unemployment and social exclusion, resulting in moderate health benefits. The proposed scheme would improve public transport journey times thus potentially reducing transport-related social exclusion, reducing health inequalities and providing better access to employment opportunities.

The construction period would involve local disruption and increased journey times, which would have an adverse effect on local businesses. This would have a minor negative effect on individual owners and employees of the affected businesses. However it should be noted that the impacts on local businesses from the major repair works to the Forth Road Bridge in the absence of the proposed scheme would outweigh the adverse effects associated with the construction period.

Positive effects are also expected for local businesses and suppliers during construction. The potential for increased earnings and employment and training opportunities may result in minor positive effects on general wellbeing.

The construction period would give rise to direct employment and training opportunities which would have the potential to benefit people from within the local communities. This would have a minor positive effect on health and wellbeing.

The actual or perceived effects of the proposed scheme on property values may give rise to minor negative health effects for a small number of residents through increased anxiety during construction. Health impacts related to anxiety about property values are not known at this stage, although it is considered that small scale positive and negative property value changes are both possible.

6.7 HIA-Specific Mitigation

Transport Scotland will seek to create local training and employment opportunities during construction.

7 Air Quality

7.1 Introduction

This section considers the potential health and wellbeing effects arising from changes in local air quality during the construction and operation of the proposed scheme.

Chapter 15 of the ES (Jacobs Arup, 2009a) has assessed the impacts of the proposed scheme on air quality resulting from changes in the levels of vehicle emissions on the local and wider local road network during operation. The air quality assessment compares predicted pollutant concentrations against EU air quality limit values (based on human health responses) and Scottish objectives, to determine whether the changes would result in significant impacts.

Construction impacts are assessed in Chapter 19 of the ES (Jacobs Arup, 2009a) and include dust generated by construction site activities and emissions from additional road traffic associated with construction.

The study area for the assessment of local air quality impacts from the proposed scheme is described in the ES and in simple terms includes all areas near roads likely to be subject to significant changes in traffic flow. It covers an area of approximately 9km (east-west) by 18km (north-south).

7.2 Evidence of Health Effects

This section is based on the information contained in Health Scotland's Guidance on HIA of Transport Initiatives (Health Scotland, 2007). This guidance document provides a review of recent evidence linking transport related air pollutants (particulate matter - PM₁₀ and PM_{2.5}), nitrogen dioxide (NO₂) and health.

Of relevance to this report is research on the small but measurable effects of low-level exposure to transport related pollutants. Long term exposure to low-level PM₁₀ and PM_{2.5} has been linked with cardiovascular health effects.

The effects of NO₂ are less well understood than the effects of particulates. NO₂ is a precursor for the formation of ground-level ozone, which is linked with respiratory disease. Health Scotland's evidence review suggests that the effects of NO₂ are proportional to other transport related pollutants.

Health Scotland's evidence review (2007) states that higher air pollution has been shown to potentially worsen the symptoms of pre-existing asthma. However, it has not been established that air pollution initiates the disease.

No research has been found linking construction dust with adverse health outcomes. It is generally accepted that particles greater than 10 microns in diameter (PM₁₀) do not penetrate the lungs to cause respiratory health problems. However, dust can cause eye, nose and throat irritation and lead to deposition on cars, windows and property; this can be a cause of some anxiety and distress.

7.3 Existing Conditions

Air quality is monitored by local authorities and, where current or predicted exceedances of air quality objectives are identified, Air Quality Management Areas (AQMAs) are set up. The study area does not contain any AQMAs, and the nearest one is located approximately 8km east of the proposed scheme at St John's Road in Edinburgh.

Details of the baseline levels of NO₂ and PM₁₀ in the study area are provided in Chapter 15 of the ES. These indicate that air quality in the study area is generally good. The annual average NO₂ and PM₁₀ concentrations are below the relevant air quality objective and limit values.

Air quality in the study area is good and the relative occurrence of pollutant related health problems is likely to be low. However, as shown by the research referred to in Health Scotland's guidance, the low levels of air pollutants present within the study area have the potential to exert small adverse effects on the health of the population.

Through consultation with Fife and West Lothian NHS, it has been established that there are no areas of particular concern relating to existing respiratory health within the air quality study area.

7.4 Operational Impact Assessment

7.4.1 Air quality effects

The air quality impact assessment (Chapter 15 of the ES) has not identified any significant adverse impacts on air quality resulting from the proposed scheme. This assessment is based on:

- the degree of change in pollutant concentrations between the Do-Minimum and Do-Something scenarios; and
- comparison with EU air quality limit values and Scottish air quality objectives (based on factors including human health responses) for NO₂, PM₁₀ and PM_{2.5}.

The air quality model predicted air pollutant levels at 51 receptor locations (these are properties selected on the basis of their proximity to affected road links), and also looked at the total population exposure across the study area.

With the exception of three properties located close to the northern and southern abutments, all future pollutant concentrations, both with and without the proposed scheme, are predicted to be lower than the existing baseline concentrations. This is due to predicted improvements in vehicle technology in the future and associated reductions in emissions from road transport.

When comparing the future Do-Something and Do-Minimum scenarios, the air quality assessment identified slight improvements in air quality around the existing Forth Road Bridge and slight deteriorations around the Main Crossing and new carriageway alignments.

The magnitude of change in NO₂, PM₁₀ and PM_{2.5} at modelled receptor locations was predicted to be 'negligible' or 'extremely small' for the vast majority of receptors and either 'very small', 'small', 'medium' or 'large' for a very small percentage of

receptors.” All areas are predicted to remain within the relevant health-based limit value for all pollutants.

The criteria used to define air quality effects are based on recognised UK guidance on the assessment of air quality impacts. For the purpose of this HIA the predicted levels of change are also compared with evidence-based dose-response relationships for the effects on health of low-level air pollutant concentrations.

The predicted NO₂, PM₁₀ and PM_{2.5} concentrations (µg/m³) at the 51 modelled receptor locations for the Do-Something and Do-Minimum scenarios in the years 2017 and 2032 are set out in Tables 15.15, 15.18 and 15.22 of the ES. The strongest causal link between health and air pollutants relates to PM_{2.5} concentrations.

Table 15.22 of the ES (Jacobs Arup, 2009a) shows that the majority of modelled receptors will see either no change or a reduction in exposure to PM_{2.5}, and predicted increases are identified at 6 receptors. The largest increase takes place at St Margaret’s Hope, a commercial building close to the new carriageway alignment near North Queensferry. In 2017, this receptor would see an increase of 0.6 µg/m³. The largest effect on a residential receptor is at St Margaret’s Hope Lodge, which would see an increase of 0.2 µg/m³. Concentrations at these receptors in 2017 will be lower than the base (2005) concentrations by 2.6 and 2.5 µg/m³ respectively.

The difference in PM_{2.5} concentrations between the Do-Minimum and the Do-Something scenarios at the above receptors is extremely small compared to the change identified as potentially having any health impacts. In addition, PM_{2.5} concentrations for both the Do-Minimum and Do-Something scenarios at the above receptors are significantly lower than the existing base concentrations, reducing risk of associated health effects. Furthermore it should be noted that differences measured at individual receptors do not indicate overall population exposure to background levels of PM_{2.5}. Wider population effects are negligible, as illustrated by the modelled concentrations at other receptors in the vicinity of the proposed scheme.

On the basis of the above analysis it is concluded that changes in air quality associated with the proposed scheme will have no discernible impact on the health of the population within the study area.

7.4.2 Perceived Effects and Behaviours

The feedback received from the project consultation exercise has indicated that the local communities living close to the proposed scheme are concerned about the potential health effects of additional traffic, and that this issue is a source of anxiety for individuals within the community. In addition to causing anxiety, concern over air quality has the potential to discourage some people from utilising outdoor areas such as gardens, parks and footpaths, thereby missing out on the benefits associated with outdoor activities.

Asthma has been raised as a particular concern by local people living in close proximity to the proposed scheme. Whilst there is no evidence that road traffic emissions can initiate asthma, it may exacerbate pre-existing symptoms. Given the low level of change in traffic emissions, it is considered that the scheme will have no discernible impacts on asthma.

7.5 Construction Impact Assessment

7.5.1 Construction Traffic Emissions

The ES has identified the assumed haulage routes leading to the three construction sites. The intention is to keep construction traffic on the main routes that are designed for large flows and heavy loads and to avoid sensitive residential areas where possible. The exact routing restrictions would be discussed with the local authorities. As described in Section 6 of this report, the current assumption is that construction sites would be located at Ferrytoll Junction, South Queensferry / Echline and M9 Junction 1a.

The assessment of construction traffic emissions presented in Chapter 19 of the ES has identified the sensitive receptors closest to these routes and calculated the NO₂ and PM₁₀ contributions from construction traffic, using worst case assumptions. The magnitude of change identified ranges from very small to medium, with the largest impacts occurring around the M9 Junction 1a construction site. These effects would not result in any exceedances of the health-based National Air Quality Objectives. Given the temporary nature of the increases in NO₂ and PM₁₀ from construction traffic, there would be no effect on average annual concentrations in the long term and therefore no adverse health effects are expected.

The feedback from public consultations undertaken by Transport Scotland has indicated that local people are concerned about the impacts of construction traffic, including traffic emissions. There is therefore a potential for concerns about the health effects of construction traffic emissions to cause anxiety among the local community.

7.5.2 Construction Dust

As stated in Section 7.2 above, dust is not linked with respiratory disorders. Construction dust can adversely affect the wellbeing of individuals and communities in terms of:

- enjoyment of outdoor spaces (with potential knock on effects such as a temporary reduction in physical activity or social interaction);
- anxiety relating to perceived health effects; and
- potential minor irritation of the throat and eyes.

Monitoring of construction sites in the UK indicates that any significant elevation in dust deposition rates is usually limited to within 200m of the construction works boundary. Within this distance, there is potential for dust nuisance impacts on sensitive receptors such as homes or schools.

Chapter 19 of the ES provides an assessment of the potential for dust nuisance based on the number of dust sensitive receptors and the distance from the construction activity, as well as the nature and duration of the works. It should be noted that although the Main Crossing works in total are estimated to last more than five years, the duration of land based and potentially dust generating construction works at any one location is likely to be far shorter.

There are various activities with the potential to generate dust during the construction programme. These include topsoil stripping and excavation and handling of soils and other materials, demolition of existing structures at South Queensferry and Junction 1a and blasting for rock cuttings near Ferrytoll. The

number of sensitive properties within 200m of these activities has been counted and is shown in Chapter 19 of the ES and in Table 9 below.

Table 9: Number of sensitive receptors within 200m of dust generating activities

Distance from site boundary	No of sensitive receptors		
	Ferrytoll	South Queensferry	M9 Junction 1A
0-25m	2	66	35
25-50m	19	86	27
50-100m	110	190	48
100-200m	297	520	127
Total	428	862	237

Source: ES Chapter 19 (Jacobs Arup, 2009a)

The receptors comprise residential properties, with Dalmeny Primary School also located approximately 50m from the proposed construction works at South Queensferry. Although Dalmeny Primary School is situated close to the edge of the works area, it is on the eastern periphery of the proposed works, where the risk of dust-generating activities is relatively low.

The ES and CoCP have proposed a number of mitigation measures to minimise the effects of dust. These relate to the way that construction activities are undertaken and managed, and include measures to prevent adverse effects on sensitive receptors such as Dalmeny Primary School. Dust control measures would be set out in a Dust and Air Quality Management Plan prepared as part of the contractor's Environmental Management Plan.

Properties within 200m of the proposed works may suffer from the effects of dust on a short to medium term basis. Outdoor recreational areas and public footpaths may also be affected.

7.6 Mitigation Measures

7.6.1 Operational Phase

No recommendations are made in the ES in relation to mitigation for health impacts relating to operational traffic emissions as the assessment considers the proposed scheme will not have any measurable effect on health.

7.6.2 Construction Phase

The Contractor will be required to apply best practice mitigation measures to control dust. The CoCP includes a section on Dust and Air Pollution. This requires the Contractor to produce an Air Quality Management Plan describing the dust and air pollution control measures to be used during the construction works. This would include measures to prevent or counteract the effects of nuisance caused by construction works and to avoid significant adverse effects of emissions of NO₂ and PM₁₀ in relation to compliance with local air quality objectives. Dust and air pollution monitoring measures will also be detailed.

A dedicated Community Liaison Officer would be available throughout the construction period to respond quickly to any complaints with regard to construction dust and emissions. The Community Engagement Requirements within the CoCP include a requirement for the Contractor to take reasonable steps to notify occupiers of nearby properties two weeks in advance of the nature and anticipated duration of

planned construction works that may affect them. The notification will also provide details of the enquiries and complaints procedure.

7.7 Assessment of Health Impacts

The effects on health have been assessed according to the criteria set out in the Merseyside Guidelines (see Section 4.6).

The available evidence (see Section 7.2) indicates an identified causal link between levels of particulate matter, nitrogen oxides and health. The degree of certainty is therefore considered to be probable. For other anxiety related stress issues associated with air quality impacts, the degree of certainty is considered to be speculative.

Changes in air quality in the study area as a result of the operation of the proposed scheme are generally predicted to be very small, and would not give rise to any health effects.

During construction, the perceived changes in air quality as a result of construction activities may contribute towards anxiety and stress related health issues. Although there is a risk of dust nuisance for residents and sensitive users in close proximity to the construction works, changes in predicted nitrogen dioxide concentrations and fine particulate matter concentrations are low.

The magnitude of health effects during both construction and operation are considered to be negligible for operation and negligible to minor during construction.

7.8 HIA-Specific Mitigation

The following mitigation measures have been identified:

- When notifying communities of planned construction works as required by the CoCP, the Contractor will provide information on proposed air quality monitoring and any other mitigation proposed for during the works.
- The Contractor will be required to demonstrate a commitment to its wider social responsibilities, for example through participation in the Considerate Constructor's scheme.

8 Noise

8.1 Introduction

This section considers the potential health and wellbeing effects arising from changes in noise and vibration levels during the construction and operation of the proposed scheme.

The ES (Jacobs Arup, 2009a) includes a noise assessment (Chapter 16) which has been used as the basis of this section. This has assessed the operational noise and vibration impacts, based on changes in noise and vibration levels arising from traffic using the main crossing and new roads and changes in traffic volumes and flows on the local road network.

The study area for the assessment of operational road traffic noise was defined around 'affected routes' comprising new or altered highways (the proposed scheme), and existing roads predicted to be subject to change in noise levels of more than 1dB(A), identified using traffic forecasts predicting a >25% increase or >20% decrease in traffic flows. Noise calculations were carried out for all properties within 600m of affected routes, up to 2km from the boundary of the proposed scheme.

The ES (Jacobs Arup, 2009a) also qualitatively assesses the construction noise impacts arising from construction activities and construction traffic. Construction noise impacts will occur in the immediate vicinity of the proposed scheme and these are detailed within the Disruption due to Construction (Chapter 19) of the ES.

This section does not consider the effects of noise on occupational health and safety for construction workers. This issue will be dealt with in accordance with the Contractor's Health, Safety, Quality and Environment Plan.

8.2 Evidence of Health Effects

8.2.1 Effects of Noise

The effects of occupational noise on health are well understood. However, whilst there is evidence to suggest links between environmental noise and various mental and physical conditions, the links are less well established and are more likely to be contributory rather than causal.

The main health risks of noise identified by the World Health Organisation (WHO) are:

- pain and hearing fatigue;
- hearing impairment including tinnitus;
- annoyance;
- interferences with social behaviour;
- interference with speech communication;
- sleep disturbance and all its consequences on a long and short term basis;
- cardiovascular effects;
- hormonal responses (stress hormones) and their possible consequences on human metabolism (nutrition) and immune system; and
- performance at work and school.

The World Health Organisation in its Guidelines for Community Noise (Berglund et al., 1999) refers to a definition of annoyance caused by noise, as follows:

'A definition of annoyance is "a feeling of displeasure associated with any agent or condition, known or believed by an individual or group to adversely affect them" (Lindvall & Radford 1973; Koelega 1987). However, apart from "annoyance", people may feel a variety of negative emotions when exposed to community noise, and may report anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation, or exhaustion (Job 1993; Fields et al. 1997 1998). Thus the term annoyance is used for convenience'

The same guidance identifies links between noise and social and behavioural effects include changes in everyday behaviour patterns such as closing windows, not using outdoor space, disengagement and non-participation.

As well as the characteristics of the noise itself, the degree of annoyance experienced relates to factors such as ability to control the noise, and whether the noise is perceived to originate from an important activity.

8.2.2 Effects of Vibration

The WHO Guidelines for Community Noise cites research showing stronger reactions in the above health effects when noise is accompanied by vibration.

8.2.3 Vulnerable Groups

The WHO Guidelines state that some populations may be at greater risk than others from the harmful effects of noise. Vulnerable groups have been identified as people with a hearing impairment, the elderly, babies and children, blind people, people in hospital or rehabilitating at home, people with particular diseases/medical problems (e.g. high blood pressure), depressed people and people doing complex cognitive tasks. However the Guidelines also state that there are no definite conclusions on this topic.

8.3 Existing Conditions

Traffic is currently the main noise source within the study area, with the levels of background noise dependant on distance from major roads. Noise levels are predicted to increase in the future in proportion to the predicted increase in traffic flows on the existing road network.

Figure 16.3 of the ES shows the predicted noise levels in the study area ($dB_{LA10,18h}$) in 2017 without the scheme in place. This illustrates the level of traffic noise generated from the existing road network. Areas immediately adjacent to busier roads, including houses along Stoneyflats Crescent, are subject to a relatively higher level of road noise which would may detract from the enjoyment of outdoor space and cause annoyance. However the level of noise diminishes rapidly with distance from the major roads. Noise levels in the majority of residential areas in South Queensferry range from 47.5 to 53.4 $dB_{LA10,18h}$.

On the north side of the Firth of Forth, properties on the east side of Rosyth are also adversely affected by noise from the A90 and M90.

A number of non-residential properties that are also sensitive to noise because of their use are currently affected by road noise, notably some local schools. In the 2017 opening year without the proposed scheme in place 4 schools are predicted to have noise levels in excess of 65dBL_{A10,18h}.

The areas directly affected by the proposed new road alignments include some areas that currently have relatively low levels of background noise, for example the open countryside to the west and south west of South Queensferry.

8.4 Noise Impact Assessment

This section summarises the findings of the noise and vibration assessment undertaken for the ES.

8.4.1 Operational Noise

Measures have been taken during the design process to minimise the effects of traffic noise where practicable on sensitive receptors such as dwellings, schools, hospitals, care homes, parks and public rights of way. These include the location of the proposed scheme, consideration of topographic and landscape features and the design of earthworks, cuttings and embankments, and use of low noise road surfacing.

The noise model has predicted the current and future traffic noise levels and assessed noise impacts on the affected routes (defined in Section 8.1). An increase of 3 decibels (dB(A)) has been used as the threshold to identify significant effects. This is the level at which a noise increase is considered to be perceptible. The noise assessment also considers the number of sensitive receptors affected by the change in noise levels when considering whether the impact will be viewed as a significant effect and, as such, will require mitigation. Based on the noise assessment results, the need for further mitigation was identified in some areas where the potential for significant effects was identified.

Noise barriers are proposed within the ES as a way to reduce noise at the following five locations where significant adverse effects were identified:

- South Queensferry Barrier: the proposed barrier is located on the east side of the mainline route. It would provide a small benefit to a large number of dwellings in the west of South Queensferry reducing, but not removing, noise impacts in this area.
- Linn Mill Barrier: the proposed barrier is located on the western side of the southern approach viaduct. It would reduce, but not remove, noise impacts at Inchgarvie House and Linn Mill.
- West Dundas Barrier: the proposed barrier is located on the southern side of the mainline route, north of Dundas Castle. It would remove significant adverse effects at Dundas Castle, the residential properties surrounding Dundas Castle and the properties at Dundas Mains.
- East Dundas Barrier: the proposed barrier is located on the mainline route, north of Dundas Home Farm and the mitigated scheme is not considered to result in a significant residual adverse effect.
- Kirkliston Barrier: the proposed barrier is located on the mainline route to the west of Kirkliston and would remove the adverse effect of the proposed scheme at properties on the southwest side of Kirkliston.

‘Significant’ Adverse Effects

The noise barriers will significantly reduce the levels of noise experienced at properties close to the proposed scheme. However, even with noise mitigation in place, significant residual noise effects have been identified at the following locations on the south side of the Firth of Forth:

- properties to the east of the southern approach road in South Queensferry including Clufflat Brae, Springfield Lea, Springfield Place and Society Road;
- the western half of the Echline Estate in the west of South Queensferry; and
- the Linn Mill and Inchgarvie community to the west of the southern approach road.

‘Non-Significant’ Adverse Effects

When determining the significance of noise impacts, the assessment considers the number of receptors subject to the noise impact, the proportion of the community subject to the impact, the magnitude of the impact and existing absolute noise levels. Therefore there are a number of locations north of the Firth of Forth where properties will be affected by noise increases of more than 3dB(A) but this has not been assessed as a significant effect. These include the following locations:

- houses on Mucklehill Park in Inverkeithing, overlooking the M90;
- the westernmost dwellings on Ferry Barns Court, South Queensferry;
- St Margaret’s Hope Gatelodge, a single residential property close to the northern approach viaduct;
- Brock Street in North Queensferry which will receive less topographic shielding as a result of the reconfiguration of Ferrytoll Junction;
- Dales Steading and Dales Farm Cottages in the north of the study area (indirectly affected by traffic changes on existing roads); and
- dwellings facing onto Dunfermline Wynd in Inverkeithing and Hill Street in Rosyth.

South of the Firth of Forth effects at the following locations have been reduced to ‘not significant’ by the proposed noise barriers described above:

- a small proportion of dwellings at Dundas Home Farm; and
- dwellings around Dundas Castle and at Dundas Mains – these will still experience significant increases in noise levels but absolute traffic noise levels are reduced to below 50dB_{L_{Aeq}} (WHO guidance indicates that few people are moderately annoyed at this level).

In addition, the following noise effects have been identified for non-residential receptors:

- The Queensferry Hotel would be subject to major adverse effects on its north-western facades and major beneficial effects on its south-eastern facades. The hotel has rooms on both facades and therefore the overall impact is considered neutral.
- Admiralty House/St Margaret’s Hope, a commercial building containing offices close to the northern approach viaduct, would experience a major adverse noise impact but would remain within reasonable levels for office environments as defined by the relevant British Standards.

- North Queensferry Community Centre to the northwest of North Queensferry would be subject to a major increase in noise levels on its northern facade, but since there are no windows in this facade, this is not likely to result in an internal level which would adversely affect the internal noise climate.

Noise increases at Echline Primary School would result in an exceedance of the local authority's guidance noise levels on part of the western facade. However there are no windows in this gable end of the building so the internal environment of the school would not be adversely affected. Existing noise levels on the northern facade already exceed these guidance levels. The remainder of facades with openable windows would be able to open windows whilst still maintaining noise levels within the threshold levels.

Effects on Outdoor Spaces

The noise assessment has considered the impact of noise on accessible outdoor areas. 'Non-significant' noise increases were identified on the south bank of the Forth to the west of the Main Crossing and at Duddingston Wood (north of Dundas).

Significant Beneficial Effects

The noise model has also predicted significant positive effects resulting from reduced traffic flows on parts of the road network. Beneficial effects will occur in the following locations:

- dwellings along the southern edge of the Echline Estate which face directly onto the A904;
- properties west of and within 300m of the Forth Road Bridge approach road in South Queensferry (including the eastern half of the Echline Estate); and
- properties in the area to the east of the Forth Road Bridge approach road bounded by the B924, the B907 and the A8000.

8.4.2 Construction Noise Impact Assessment

A review of the construction activities for the proposed scheme, reported in Chapter 19 of the ES, indicates that the following, in rank order, are likely to give rise to significant noise impacts:

- removal of the 'cap' of Beamer Rock to form the foundations for the central tower of the Main Crossing;
- top driven steel tubular piles to support the temporary jetties used to provide access to the pier locations for the north and south approach structures for the Main Crossing;
- marine (bored) piling off the north and south shore of the Firth of Forth;
- mechanical rock breaking of the northern shore of the Firth of Forth for the construction of the north abutment; and
- sheet piling for the temporary bund off the south shore of the Firth of Forth.

A summary of the results of the construction noise assessment is presented in Table 10 below.

Table 10: Summary of Construction Noise Assessment Results

Receptor Address	No. of receptors	Day	Evening	Night	Duration
St Margaret's Hope (also known as Admiralty House)	1	✓	-	-	4 months
Tigh-na-grian	2		-	✓	5 months
Inchgarvie House	1 (ten flats)	✓	-	-	5 months
St. Margaret's Hope Lodge	1	✓	-	-	1 month

The assessment indicates that construction vibration impacts will occur at the following locations, as a result of disturbance of occupants due to vibro-compaction of highway works:

- Inchgarvie House; and
- St Margaret's Hope Gatelodge.

The construction noise assessment concludes that the adverse noise impact of the proposed scheme is low because there are few receptors close to the major works and because of the mitigation measures set out in the CoCP. These measures include a requirement on the contractor to develop a Noise and Vibration Management Plan and apply 'Best Practicable Means (as defined in the Control of Pollution Act 1974) to minimise noise. Working hours will be controlled, and no impact piling will be undertaken at night. Solid hoardings and bunds or barriers will be used to screen off noise from construction sites. Where noise impacts cannot be avoided through these measures and subject to agreement with property owners, noise insulation work may be carried out.

The construction noise assessment therefore indicates that the construction process is not likely to cause direct health impacts. However, it is considered likely that the construction process will cause considerable anxiety among the local communities with regard to noise. Noise increases that are not considered significant in terms of the criteria used in the noise assessment may be perceived as problematic, and this could be exacerbated if the community feels that noise is not being adequately controlled or that there are insufficient procedures in place to respond to complaints. These issues have the potential to adversely affect the wellbeing of individuals within the affected communities.

8.4.3 Vibration Assessment

No ground-borne vibration impacts are forecast because in accordance with highway construction standards, the surface of the proposed roads would be smooth with no surface irregularities of sufficient size to generate significant levels of ground-borne vibration.

8.5 Mitigation Measures

8.5.1 Operational Phase

The mitigation measures incorporated into the proposed scheme to minimise the effects of road noise are described above and taken into account in the assessment of health effects.

8.5.2 Construction Phase

The CoCP includes a section on Noise and Vibration and this requires the Contractor to produce a Noise and Vibration Management Plan which will describe the measures to control and mitigate noise and vibration during the construction works. It also requires the Contractor to use Best Practicable Means (as defined in the Control of Pollution Act 1974) to control and limit noise and vibration effects in the detailed design of the proposed scheme.

A dedicated Community Liaison Officer will be available throughout the construction period to respond quickly to any complaints with regard to construction noise. The Community Engagement Requirements within the CoCP include a requirement for the Contractor to take reasonable steps to notify occupiers of nearby properties two weeks in advance of any works that may affect them. The notification will include the nature and anticipated duration of the planned construction works as well as details of the enquiries and complaints procedure.

The CoCP also requires that noise and vibration monitoring is undertaken during construction.

8.6 Assessment of Health Impacts

The effects on health have been assessed according to the criteria set out in the Merseyside Guidelines (see Section 4.6).

The available evidence (see Section 8.2) indicates an identified contributory link between noise and health effects and the degree of certainty is generally considered to be probable. The links between health effects associated with anxiety over perceived noise changes are less established. The degree of certainty for these issues is therefore considered to be speculative.

The assessment of operational noise is based on the predicted changes in daytime noise reported in the ES therefore these effects are estimable.

A substantial reduction in road traffic along existing roads, for example, on the southern approach road to the Forth Road Bridge and A904, will reduce operational noise for adjacent properties and nearby open spaces e.g. Echline Community Woodland. This will provide health benefits through a potential increase in use of outdoor space for physical activity and social interaction. Conversely, the occupiers of houses close to the proposed scheme who are affected by noise increases will experience reduced enjoyment of outdoor areas such as gardens. Adverse health effects resulting from this could include increases in levels of stress.

Overall, the health effects for operation of the proposed scheme will be both positive and negative and are considered to be negligible to minor in magnitude.

During construction, there will be adverse noise impacts for receptors in close proximity to the construction works. Although only temporary, the overall construction process is expected to last more than five years and the fear of noise disturbance and lack of control over the noise environment may influence health and wellbeing during this period. There may also be a reduction in the availability of some outdoor spaces used for recreation, particularly the Echline Field area which would be adjacent to the construction compound. Overall, the health effects for construction of the proposed scheme will be negative and are considered to be minor to moderate in magnitude.

8.7 HIA-Specific Mitigation

The following mitigation measures have been identified:

- When notifying communities of planned construction works as required by the CoCP, the Contractor will provide information on details of proposed noise monitoring and any other mitigation proposed for during the works.
- The Contractor will be required to demonstrate a commitment to its wider social responsibilities, for example through participation in the Considerate Constructor's scheme.

9 Access to Services

9.1 Introduction

This section examines the health and wellbeing impacts resulting from the effects of the proposed scheme on access to services, including:

- health and social services;
- local shops and facilities such as post offices, banks, libraries; and
- leisure and recreational facilities such as cinemas, sports and leisure centres.

Local services and facilities have been identified within the Pedestrians, Cyclists, Equestrians and Community Effects assessment, Chapter 17 of the ES. This assessment considers the direct effects of the proposed scheme on access resulting from physical severance and local changes in traffic flows. Direct impacts on the quality of services resulting from environmental change are considered in other sections of this report (Air Quality, Noise).

9.1.1 Study Area

The study area focuses on those communities that are local to the proposed scheme and where the most significant impacts are expected in terms of changes to the length of journeys and access to services. These include the settlements of North Queensferry, Inverkeithing and Rosyth on the north side of the Firth of Forth, and on the south side of the Firth of Forth, South Queensferry, Kirkliston, Winchburgh with smaller communities such as Newton as well as a number of individual cottages and farmsteads.

9.2 Evidence of Health Effects

Access to services has a direct effect on health and wellbeing in terms of the ability to access health and social care. In addition, local facilities and services can influence health determinants such as diet, social interaction, exercise and economic factors.

Health Scotland's Guidance on HIA of Transport Initiatives (2007) states that *'although access to essential services may be linked to health, the potential for a road to have a substantial impact on these factors would depend on the specific nature of the severance and the reliance of the affected population on local services and networks bisected by a new road'*.

The Sustainable Development Commission (2008) in its report 'Health, Place and Nature' states that *'accessible local facilities such as shops, pubs, schools and libraries, can provide opportunities for social interaction and help create a sense of community. The location of shops and services, and the travel connections to them, can determine whether people attend healthcare appointments and influence levels of physical activity and social contact'*.

It is assumed that there is a positive relationship between access to health services and health due to the effects of treatment and preventative medicine, and that access to general services and amenities is likely to have a positive effect on wellbeing and quality of life.

9.2.1 Health Inequalities

It has been shown that people who are socially excluded may experience a number of factors that have a negative impact on gaining access to health services including low income, disability and age coupled with poor transport provision or services sited in inaccessible locations (Health Development Agency, 2004).

9.3 Existing Conditions

9.3.1 Regional Context

Scottish Neighbourhood Statistics website provides data on access to key facilities at local authority level, in terms of average journey times. Access to a hospital is very good for both West Lothian and Fife. Access to GP surgeries is above the Scottish national average for West Lothian, but below it for Fife, and access to dentists is poor for both areas. The data also shows that access to other services, including libraries, police stations, job centres and citizen's advice centres, is generally better than the national average for both areas.

9.3.2 Local Services and Links

A list of community facilities identified within the study area can be found in Chapter 17 of the ES (Jacobs Arup, 2009a). Below is a summary of facilities in the neighbourhoods around the proposed scheme and the key links between these areas.

(a) North of the Firth of Forth

To the north of the Firth of Forth are the village of North Queensferry and the towns of Rosyth and Inverkeithing. North Queensferry has a school, community centre and convenience store. However it relies on Inverkeithing and Rosyth to provide a wider range of shops and services. Inverkeithing has various shops and services along the High Street and Church Street. These include a post office, doctor's surgery, police station, schools, churches and community centres. Services in Rosyth are distributed throughout the town and include two post offices, doctors' surgeries, schools, a police station, a fire station, leisure facilities and churches. All three communities have a train station.

The existing A90/M90 causes severance between Rosyth to the west and Inverkeithing and North Queensferry to the east. Vehicle and pedestrian links from Inverkeithing to Rosyth are via the Dunfermline Wynd road bridge and Admiralty Junction.

Footpaths around Ferrytoll Junction provide a link from North Queensferry to Rosyth, although given the distance of approximately 5km the majority of journeys are made by car or public transport. All modes of transport between North Queensferry and Rosyth travel via Ferrytoll Junction. North Queensferry residents also travel to facilities in South Queensferry across the Forth Road Bridge. The most direct access to the Forth Road Bridge for pedestrians and cyclists travelling from North Queensferry is via a set of steps from the B981 leading to the footpath alongside the A90. Pedestrians and cyclists can also access the A90 footpaths and cycle routes (east and west) off the B981 south of Ferrytoll Junction, where a ramp links to the B981 to the A90.

(b) South of the Firth of Forth

South Queensferry contains a range of facilities which serve both the residents of the town and the wider rural areas. These include a range of shops, doctors' surgeries, a police station, a fire station, several schools, churches, community centres and leisure facilities. The majority of facilities are located around the town centre to the east of the A90.

South Queensferry is severed by the existing A90, which runs through the town. Pedestrians and vehicles can cross beneath the carriageway along Shore Road and Hopetoun / Bo'Ness Roads in the northern part of the town, and vehicles can cross at Echline Junction to the south. High traffic volumes along the A904 Builyleon Road contribute to existing severance by increasing journey times into South Queensferry from rural areas and villages such as Newton to the west of the town.

The majority of journeys into South Queensferry from surrounding rural areas are made by car or bus. However there are also well used pedestrian routes into the town centre from Echline and Linn Mill to the west. Functional and recreational walking routes also exist between South Queensferry and Newton.

Further south, Kirkliston village, adjacent to the proposed M9 Junction 1a, contains a small number of local facilities which also serve residents of Winchburgh, a village to the west along the B9080. These include leisure facilities, schools and a doctor's surgery.

9.4 Impact Assessment

9.4.1 North of the Forth

(a) Operational Effects

The proposed scheme would not result in the direct loss of services and facilities. However it has the potential to affect access through changes in vehicle, pedestrian and cycle journeys. These effects arise from the proposed new road infrastructure which requires the realignment and diversion of several pedestrian and cycle paths around Ferrytoll Junction.

The section of the B981 running parallel to the A90 (on the west side) would be realigned to run further west around the water treatment works to Ferrytoll Road. This would slightly reduce journey times for pedestrians and cyclists using the B981 footpath to travel between Rosyth and North Queensferry. However the realignment would have an adverse impact on journeys from North Queensferry to Inverkeithing along the B981 (via Ferrytoll Junction).

An alternative route for users travelling between North Queensferry and Inverkeithing has been provided which involves utilising a new Disability Discrimination Act (DDA) compliant ramp which would link the B981 to the footpath on the west side of the A90. At this location a new controlled crossing point would also be provided allowing access to the eastern footpath leading to Ferrytoll Junction or the Forth Road Bridge. From here pedestrians can head east to Inverkeithing. Although significantly shorter than the realigned B981, this alternative would still be 361m longer than the existing route. Non-vulnerable users could continue to use the existing steps from the B981 to the east side of the A90 in North Queensferry. However the steps are steep and cyclists and those with impaired

mobility are unlikely to be able to use them. These users would be adversely affected by the resulting increased journey length.

There are two National Cycle Routes running through this area, both of which cross Ferrytoll Junction. NCR 1 runs north/south and connects to the Forth Road Bridge, and NCR 76 runs east/west. Both NCRs would be subject to realignment but would be maintained, most journey times would not be significantly affected. There would be a slight improvement in perceived safety as a result of increased segregation and controlled crossings at Ferrytoll Junction.

Pedestrian access to the Forth Road Bridge footpath from North Queensferry would be maintained, and residents wishing to access services and facilities in South Queensferry would benefit from improved conditions for pedestrians and cyclists on the bridge (see below). Access between the Forth Road Bridge and Rosyth / Inverkeithing would be maintained and there would be some improvement as a result of provision of controlled crossings and segregated paths at Ferrytoll Junction.

The overall effects on community severance and access to services and facilities to the north of the Forth are slight. Access by car between the three communities would not be significantly affected, and access to wider areas, including the south side of the Forth, would be improved. The main adverse effect would be on those people wishing to walk between North Queensferry and Inverkeithing who are unable to use the steps from the B981 footpath to the A90 footpath. However there would be a slight beneficial effect on perceived safety for the pedestrian and cycle routes across Ferrytoll Junction.

(b) Construction Effects

During the reconstruction of Ferrytoll Junction it is anticipated that there would be a temporary increase in congestion resulting from construction traffic, and temporary diversions of key pedestrian and cycle routes including NCR 1, NCR 76 and the B981. Whilst these effects cannot be quantified at this stage it is likely that there would be a significant increase in severance between the communities of Rosyth, Inverkeithing and North Queensferry, since most routes between these communities cross the junction. Residents in North Queensferry are likely to be most affected since this community depends on services in other areas. There may also be impacts on journey times to Dunfermline and cross-Forth journey times, which would also impact on access to services in the wider area.

9.4.2 South of the Forth

(a) Operational Effects

The proposed scheme would not result in the direct loss of services and facilities. Generally, the extent of community severance to the south of the Firth of Forth is greater than to the north due to the extent of the proposed off-line carriageway.

The new carriageway alignment would sever the fields at Echline and the associated network of informal paths that link South Queensferry and Linn Mill, connecting with other paths towards Newton. The alignment would create a barrier between houses located at Linn Mill to the west and South Queensferry to the east, where the majority of community facilities are located. Pedestrians and cyclists would need to divert their route via Society Road, to the north, adding significantly to journey length.

Other pedestrian and cycle routes would be maintained by new crossings and diversions. However, there would be some journey time increases and the amenity value of routes would be adversely affected. The presence of the new road alignment is likely to make residents in rural areas to the west of South Queensferry feel more isolated from the town.

The reduction in traffic on the A90 through South Queensferry would not serve to significantly reduce existing community severance, since no additional crossing points are proposed.

To the west of the proposed Queensferry Junction the A904 through Newton is predicted to experience an increase in traffic flow in 2017 as a result of the proposed scheme. Traffic increases through villages can adversely affect the users of footpaths in terms of ease of road crossing and perceived safety. In addition, several minor roads across the study area are predicted to experience slight increases in traffic flow. However, severance is not assessed on these routes due to the existing traffic flows being too low to be considered as resulting in severance, and therefore cannot be considered to be providing relief from existing severance.

The increased flow of traffic across the Firth of Forth has the potential to increase traffic flows and associated congestion in areas beyond the boundaries of the ITS system, such as the west side of Edinburgh. This would have the potential to increase local vehicle journey times and severance in the affected areas.

(b) Construction Effects

The details of construction are not known at this stage but it is expected that construction would have an adverse effect on severance and access to services and facilities on the south side of the Firth of Forth. Specific effects are likely to include reduced pedestrian access across the fields at Echline as a result of temporary land take for the proposed construction compound and severance to the west and south of South Queensferry caused by the construction of the proposed new carriageway alignment. Disturbance to pedestrian and cyclists using Society Road, which is anticipated to be used as access and egress for construction plant during construction. These effects would occur in conjunction with the ongoing severance effects caused by cross-Forth traffic on the A90 within South Queensferry, resulting in a considerable net increase in severance during construction on the south side of the Firth of Forth. It should be noted that non-motorised user routes would be maintained during construction, although diversions would be required.

9.4.3 Across the Forth

(a) Operational Effects

The proposed ITS would improve car journey times across the Firth of Forth. This would improve the accessibility of facilities within Edinburgh for people on the north side.

The Main Crossing would not provide pedestrian and cyclist access. However, the Forth Road Bridge would become a designated public transport corridor and would continue to form part of the National Cycle Network. The bridge would maintain access for pedestrians and cyclists across the Firth of Forth and the reduction in traffic on the bridge would bring significant amenity benefits.

(b) Construction

The Forth Road Bridge would remain operational throughout the construction period and no interruption of access across the Firth of Forth for vehicles, pedestrians or cyclists is anticipated. However cross-Forth journeys would be affected by diversions and congestion to the north and south, as described above.

9.4.4 Public Transport

(a) Operational Effects

The proposed scheme would not introduce any severance of public transport links between communities, as bus services travelling between Fife and the Lothians would be maintained on the Forth Road Bridge. By providing a designated bus route on the Forth Road Bridge and new priority routes to the north and south, the proposed scheme is expected to improve the speed and reliability of public transport journeys.

(b) Construction Effects

During construction, bus services on both sides of the Firth of Forth are likely to be affected by temporary stop relocations and increased journey times due to temporary diversions and congestion.

9.4.5 Vulnerable Groups

Due to the rural nature of the communities within the study area, it is likely that the majority of people access services or facilities by car. These people would benefit from improved car journey times across the Firth of Forth, and would be unaffected by the changes in severance on local footpaths. However, those without access to a car are more likely to walk and would experience disproportionate effects of changes in access to services, particularly during construction. Certain other vulnerable groups such as the elderly and disabled may also fall into this category.

A new DDA compliant ramp linking paths on the B981 and the A90 (west side) will improve disabled access to the bridge from the north side of the Firth of Forth.

9.5 Mitigation Measures

9.5.1 Operational Phase

The ES has proposed a number of mitigation measures, which have been incorporated into the design and taken into account in this assessment. These include:

- ensuring that the requirements of the Disability Discrimination Act are incorporated into the scheme where possible, to reduce barriers to access for disabled people;
- segregation of routes and provision of controlled crossing points for pedestrians and cyclists to improve perceived safety; and
- creation of new pathways linking existing community facilities to decrease severance.

9.5.2 Construction Phase

The CoCP includes a section on Public Access and Traffic Management. This requires the Contractor to produce a Traffic Management Plan which would include (but not be limited to) details of the following:

- procedures for the temporary or permanent closure or diversion of roads or accesses;
- pedestrian and cycle routes;
- measures to reduce construction traffic impacts associated with over-parking on residential streets; and
- permitted access routes for construction traffic.

9.6 Assessment of Health Impacts

The effects on health have been assessed according to the criteria set out in the Merseyside Guidelines (see Section 4.6).

Based on the available evidence (see Section 9.2), the degree of certainty for links between access and health effects is considered to be speculative. The effects on health resulting from access to services and facilities are broad and diverse, and as such it is not possible to describe the nature of the impact beyond a general beneficial or adverse effect on health and wellbeing. The assessment of access to services is assessed in a qualitative way.

The proposed scheme would provide a reliable crossing of the Firth of Forth, improving journey times for both private vehicles and public transport. The proposed scheme therefore supports improved access to services in South Queensferry and Edinburgh for communities north of the Firth of Forth. However, severance effects have been identified for some parts of the study area.

The main severance effects during the operation of the scheme would result from the new carriageway alignment to the west of South Queensferry. The presence of the road would increase cyclist and pedestrian journey times into South Queensferry from the community at Linn Mill. There would also be increased journey times for disabled people using the footpath between North Queensferry and Inverkeithing. During construction, severance would be more significant, particularly around Ferrytoll Junction and communities to the west of South Queensferry.

The proposed scheme would therefore result in both positive and negative changes in access which can influence overall wellbeing. The associated health effects are considered to be minor, with the exception of severance impacts for communities to the west of South Queensferry during construction where effects are considered to be minor to moderate.

There is also potential for changes in traffic outside the study area to have severance effects, however, the magnitude of such changes are unknown.

10 Physical Activity and Green Space

10.1 Introduction

This section considers the effects of the proposed scheme on access to green space and levels of physical activity. The issues considered include:

- changes in access to or quality of walking and cycling routes;
- changes in access to or quality of green space; and
- changes in access to or quality of sports facilities.

Changes in trip lengths for pedestrians and cyclists are discussed in Section 9 above.

10.1.1 Study Area

Effects on physical activity and green space would largely take place within the immediate vicinity of the proposed scheme as a result of land take and amenity impacts. The area can be broken up as follows:

- around the Ferrytoll Junction and the northern approach viaduct;
- around the southern approach viaduct, Queensferry Junction and the southern road alignment; and
- around the M9 Junction 1A.

10.2 Evidence of Health Effects

10.2.1 Green Space

The Sustainable Development Commission (2008) in its report 'Health, Place and Nature' concluded that *exposure to natural spaces, from parks and open countryside to gardens and other green space, is good for health. Green spaces can improve physical health, physical comfort and psychiatric wellbeing, as well as providing opportunities to improve people's quality of life and social interactions.* Benefits cited in other studies include alleviation of symptoms of anxiety and depression, and restored capacity for concentration and attention (Douglas, 2005).

10.2.2 Physical Activity

Strong evidence exists of links between exercise and health. Scotland's Physical Activity Taskforce has identified that the health of two-thirds of the Scottish adult population is now at risk from physical inactivity, making it the most common risk factor for coronary heart disease in Scotland today (Physical Activity Task Force, 2003). The Scottish Executive has identified physical activity levels as one of five key risk areas for improving health in Scotland (Scottish Executive, 2002).

Physical health effects associated with increased exercise include a decrease in the incidence of heart attacks, coronary heart disease, diabetes and strokes, increasing general cardiovascular fitness and mobility (reducing risk of falls, particularly for older people), reduced incidence of obesity, improved musculoskeletal health, prevention of hypertension and osteoporosis, decreasing risk of cancer (particularly colon, breast and lung cancers) and obesity (Department of Health, 2004).

Exercise can improve mental health, aiding conditions such as clinical depression, sleep problems and low self-esteem, and can contribute towards improved physical perception, and general psychological well-being as well as acting as a buffer to stress (Sport England, 2007). Physical activity can also provide an important opportunity for social interaction, which in itself can add to mental well-being (Department of Health, 2004).

A review by Health Scotland found evidence that levels of physical activity and physically active transport can be directly related to characteristics of the local environment such as street connectivity, amenities within walking distance, perceived safety and aesthetics of the neighbourhood. However these factors alone are unlikely to lead to a substantial change in levels of physical activity, which is more strongly linked to individual socio-demographic factors.

10.2.3 Health Inequalities

The poorest people often experience the poorest quality outdoor environments and suffer disproportionately from a lack of access to green space. Recent Dutch research has suggested that there is a positive association between the percentage of green space in a person's residential area and their perceived general health and that this relationship is strongest for lower socio-economic groups (Maas et al., 2006).

NHS Health Scotland's (2007) commentary on NICE public health guidance states that there is a '*dearth of evidence on how environmental interventions affect the physical activity levels of different groups, so it is not clear what impact [this] would have on health inequalities.*'

10.3 Existing Conditions

10.3.1 Physical activity

No data is available on levels of physical activity within the study area. However, general levels of physical activity in the Scottish population are falling and around two thirds of the Scottish population do not participate in enough physical activity to meet current recommendations (Edinburgh South-East Development Department, 2003).

The study area contains numerous features and facilities that offer opportunities for exercise, as described below.

10.3.2 Green Space, Cycleways and Footpaths

(a) Around Ferrytoll Junction and the Northern Approach Viaduct

There are no parks or public open spaces close to the proposed works, with the nearest park located in Rosyth about 1km from the scheme.

Ferrytoll Junction lies in the coastal hills to the north of the Firth of Forth. Although the amenity value in parts of this area is compromised by industrial areas at Rosyth and South Inverkeithing Bay, the remaining open spaces at Castlandhill and Castlandhill Wood, with views across the Firth of Forth, are likely to be highly valued by local people. Hope Street Cemetery, located immediately east of the A90, is also considered to be an area of community land.

South west of the junction where the proposed B981 alignment is located is an area of coastal flats. The site of the proposed viaduct comprises a wooded hillside rising from the waterfront. East of the Forth Road Bridge approach road is the Ferry Hills area comprising rolling hills with high landscape value and views across the Forth.

There are numerous footpaths providing access to the areas of open spaces described above. The Fife coastal path, and the path through Ferry Hills are used for recreational walking. Two footpaths run across Castlandhill linking Rosyth and Inverkeithing, and other local routes are used for journeys on foot between North Queensferry, Inverkeithing and Rosyth.

Two National Cycle Routes (NCR 1 and NCR 76) run through the area. Both routes cross Ferrytoll Junction, with NCR 1 running across the Forth Road Bridge. A local cycle route to Rosyth connects with NCR 1 south of the junction and another local route between Rosyth and Inverkeithing crosses the M90 just north of the junction.

Around the Southern Approach Viaduct, Queensferry Junction and the Southern Alignment

This area, to the west and south west of South Queensferry, comprises rolling farmland with scattered areas of woodland, crossed by a network of lanes and footpaths. This is an attractive area, parts of which have designations to protect their high landscape quality.

The waterfront to the west of the landing point is accessible via the coastal road, which is designated as a core path to be used by pedestrians, equestrians and cyclists. This area is also designated as having local landscape importance.

The area for the proposed road alignment south of the viaduct is known as Echline Fields. This land is well used by the local community as a walking route between South Queensferry and the houses at Linn Mill.

Within South Queensferry there are numerous public parks and an area of community woodland, and to the south of South Queensferry beyond the wooded area around Dundas Castle is Dundas Golf Course.

Footpaths in this area are mainly concentrated around the west side of South Queensferry. These comprise a mixture of public rights of way, core paths and informal paths across Echline Fields. The paths are used as access routes between South Queensferry and residential and employment areas to the west, and for recreation and dog walking. Across the wider area there are numerous cross-country footpaths used for recreational walking.

NCR1 runs across the Forth Road Bridge and east out of Queensferry, and NCR 76 follows the waterfront, crossing the point of the proposed bridge landing.

Around M9 Junction 1a

The area north of Junction 1a consists of rolling countryside crossed by paths and scattered with wooded areas.

Directly south of the junction is a landscape character area referred to as an area of historic wooded landscape. A footpath passes within 200m of the junction in this area but is shielded by a band of woodland.

To the east, between the junction and the village of Kirkliston, there is a public park and an area of community woodland which contains a network of paths around Pikes Pool.

A local path used by pedestrians and cyclists runs along the B8090 to the north of the junction.

10.3.3 Sport and Leisure Facilities

Around Ferrytoll Junction and the Northern Approach Viaduct

There are no formal sport or leisure facilities within this area.

Around the Southern Approach Viaduct, Queensferry Junction and the Southern Alignment

Close to the southern bridge landing is Port Edgar Marina, a major watersports complex and marina which is home to Port Edgar Yacht Club.

Towards the east side of South Queensferry is Queensferry High Recreation Centre, with a gym, pool, indoor and outdoor sports pitches.

Westmuir Riding Centre lies approximately 1.5km south west of the alignment, and Dundas Golf Course lies to the south of South Queensferry near Dundas Castle.

Around M9 Junction 1a

Kirkliston Leisure Centre, with sports halls, gym and outdoor pitches, lies adjacent to the A8000, directly north of Junction 1a.

10.4 Operational Impact Assessment

10.4.1 Ferrytoll Junction and the Northern Approach Viaduct

Castlandhill Road would be realigned and a new cutting created, resulting in the partial loss of fields and woodland from Castlandhill. This would marginally reduce the area of open space, but would not directly affect the footpaths, and the cutting would alleviate visual and noise effects from the road.

The B981 realignment and the proposed viaduct would directly affect the coastal flats and St Margaret's Marsh area, which are accessible to walkers. The proposed scheme would also add new built elements to views of the existing junction, road alignment and bridge from Ferry Hills.

As described in Chapter 17 of the ES (Jacobs Arup, 2009a), several footpaths and cycleways would be directly affected by the new road alignment and works to Ferrytoll junction and its slip roads. The design of the proposed scheme has taken into account the need to maintain access along these routes through the use of diversions and provision of new crossings where appropriate. The design has eliminated significant increases in journey distance, with the exception of certain trips between North Queensferry and Inverkeithing as described in Section 9.4.1.

Cycleways around Ferrytoll junction would be improved through a reduction in traffic on the approach to the Forth Road Crossing and junction design to improve safety,

as described in the Stage 3 Scheme Assessment Report. Walkers on the paths around the west side of North Queensferry would also benefit from reduced traffic.

It is considered that the operation of the proposed scheme would not restrict access to green space in this area, and would not significantly encourage or discourage the use of footpaths and cycleways.

10.4.2 Around the Southern Approach Viaduct, Queensferry Junction and the Southern Alignment

Distant views of the Main Crossing from the waterfront are not expected to adversely affect pedestrians and recreational users on Society Road but views and noise levels would reduce the amenity value of the waterfront in the immediate area of the approach viaduct.

Port Edgar Marina is within 300m of the proposed scheme, and would be located between the Forth Road Bridge and the Main Crossing. Although highly visible, the presence of the Main Crossing would not restrict the use of the marina.

The new road alignment would result in land take at Echline Fields and would sever the informal footpaths that cross this area. This would result in the loss of well used walking routes to the west of South Queensferry. However it should be noted that this area is subject to a planning application that could, in the absence of the proposed scheme, result in the development of this area.

The amenity value of the countryside to the west and south of South Queensferry would be reduced by the noise and visual effects of the new road alignment. Receptors within this area include a number of public footpaths. It is considered that the proposed route alignment would adversely affect the quality and availability of green space for residents of South Queensferry and the surrounding countryside, and could dissuade people from using certain public footpaths. Routes used by the Westmuir Riding Centre are also likely to be affected, although the centre itself would not be affected.

The proposed carriageway alignment would be visible from parts of Dundas Golf Course would be indirectly affected, but it is considered that the presence of the road at a distance of 500m would not discourage the use of this facility.

Public parks and community woodland within South Queensferry would be largely unaffected, and there may be beneficial effects in terms of reduced traffic noise at Echline Community Woodland.

The reduction in traffic on the Forth Road Bridge and the southern approach roads would encourage the use of the bridge by walkers and cyclists. This could result in an increase in the number of longer distance trips made by cyclists and walkers on NCR 1 and NCR 76.

10.4.3 Around M9 Junction 1a

The proposed west facing slip roads at Junction 1a would not directly affect the park and community woodland to the east of the junction, Kirkliston Leisure Centre to the north, or the footpath to the south.

It is considered that the operation of the proposed scheme would have no effect on the availability of green space or opportunities for exercise in this area.

10.4.4 Wider Effects

The proposed scheme would remove traffic from the Forth Road Bridge and maintain this crossing as a public transport corridor with a segregated cycleway and pedestrian route. Segregated cycle lanes would be provided at Ferrytoll Junction. The proposed scheme would improve amenity and safety for pedestrians and cyclists, both on the Forth Road Bridge and on the northern and southern approach routes, as a result of reduced traffic volumes and improved road layouts. There is therefore the potential to increase active travel across the Firth of Forth, both for recreation and commuting.

The use of buses can increase walking, when compared with car use, as users walk to bus stops. An indirect impact of this is the reduction in road traffic, which in turn improves conditions for walkers and cyclists. By providing a dedicated public transport crossing and bus priority routes, the scheme has the potential to facilitate improvements in bus transport provision. Park and ride sites, although not part of the scheme, could also be facilitated by the improved crossing.

10.5 Construction Impacts

The impacts on accessibility and quality of open space, footpaths and cycleways would be greater during construction of the proposed scheme than during operation. Although there is limited specific information on the construction process at this stage, the following impacts area expected:

10.5.1 Ferrytoll Junction and the Northern Approach Viaduct

Works associated with the construction of the new cutting at Castlandhill Roads would reduce the amenity value of the footpaths and fields in this area.

Temporary diversions would be put in place for footpaths around Ferrytoll Junction, potentially resulting in reduced quality and increased journey length. Construction traffic, including HGVs, around the junction and nearby construction compounds could affect amenity and safety, particularly for cyclists.

10.5.2 Around the Southern Approach Viaduct, Queensferry Junction and the Southern Alignment

The amenity effects on the waterfront area during construction of the southern approach viaduct would be significantly greater than during operation of the proposed scheme. It is considered that there is a high potential for construction activities to temporarily discourage the recreational use of Society Road by walkers and cyclists.

Port Edgar Marina would be adversely affected, particularly during easterly winds when the sailing school uses the waters to the west of the marina where construction of the Main Crossing would take place. Although events such as regattas would potentially be disrupted, a programme of effective community engagement process would be implemented. Operations within the Firth of Forth would also be managed through the implementation of a Marine Traffic Management Plan.

Additional temporary land take at Echline fields for a construction compound, as well as the proposed alignment, would reduce access to green space for properties on

the west side of South Queensferry. Temporary footpath diversions to the west and south of South Queensferry would reduce the amenity value of paths and potentially increase journey length.

The adverse effects of construction would not be counteracted by improved conditions for cyclists in South Queensferry due to the continued use of the A90 and Forth Road Bridge by traffic crossing the Firth of Forth.

It is considered that the construction process would result in a temporary reduction in access to green space and opportunities for exercise in this area.

10.5.3 Around M9 Junction 1a

During construction there is a potential for increased noise within the park and community woodland to the east of the junction and Kirkliston Leisure Centre to the north, resulting from the widening of the A8000 embankment and M9 cutting, and construction of the west facing slip roads.

10.5.4 Wider Effects

Construction would largely be undertaken off-line, with traffic movements confined within the proposed alignment wherever possible. On-road haulage routes have not been defined at this stage but it is considered that there would be an increase in traffic flows and congestion, including HGVs, as a result of deliveries and temporary closures and diversions. This has the potential to discourage the use of roads and footpaths by pedestrians and cyclists.

10.6 Mitigation Measures

10.6.1 Operational Phase

The ES includes a wide range of mitigation measures aimed at reducing the adverse effects of construction and operation of the proposed scheme on noise, dust and visual intrusion, and minimising land take. In addition, as described in Chapter 17 of the ES and summarised in Section 9 of this report, the scheme design has maintained core paths and public rights of way, minimised increased journey times for pedestrians and cyclists, and improved safety wherever possible. These measures serve to minimise the adverse effects on cycling, walking and the availability of green space, and have been taken into account in the assessment of health effects.

10.6.2 Construction Phase

The CoCP sets out a wide range of measures to minimise adverse effects on public and private areas close to the construction works, and require the Contractor to develop and implement a detailed Environmental Management Plan. Relevant measures are included in the Dust and Air Pollution, Public Access and Traffic Management, Noise and Vibration, Landscape and Visual and Agricultural Resources sections.

10.7 Assessment of Health Impacts

The effects on health have been assessed according to the criteria set out in the Merseyside Guidelines (see Section 4.6).

The effects of physical activity on health are well established, but in order for these effects to take place, action is required on the part of individuals, which cannot be accurately predicted. Therefore, based on the available evidence (see Section 10.2), the degree of certainty of links between green space, physical activity and health effects is considered to be speculative. The assessment of health effects is undertaken in a qualitative way.

There would be both positive and negative effects on pedestrian and cycle routes resulting from the proposed scheme which may indirectly influence the choices made by the community with regard to active travel. Likewise, the proposed scheme may influence access to green space through the uptake of land, noise and visual effects on nearby green space, and by influencing the accessibility of green space by car in the long term.

The proposed scheme would provide a dedicated public transport crossing on the Forth Road Bridge, resulting in improved perceived safety and amenity for cyclists and pedestrians. The amenity value of public footpaths, community woodland and open space within South Queensferry are also expected to improve as a result of a reduction in traffic flows along the A90 alignment through the town. The health effects of potentially increasing active travel along the NCR1 and local routes and also the use of recreation areas within South Queensferry are considered to be positive and of moderate magnitude.

For pedestrians and cyclists, the slight increase in journey times and reduced amenity for routes west of South Queensferry may discourage active travel in this area. The southern approach to the Main Crossing also results in the permanent loss of an informal amenity area at Echline Field. Although there is some land-take at Kirkliston Leisure Centre, the playing fields and amenity of this area would remain unchanged on operation of the proposed scheme. Overall, the associated health effects of the changes in journey times and amenity are considered to be negative and of minor magnitude.

The construction and operation of the proposed scheme would result in noise and visual impacts which would affect rural walking and cycling routes in areas to the west and southwest of South Queensferry. This could potentially discourage the recreational use of these routes, with minor negative effects on health and wellbeing.

During construction, noise and dust may temporarily discourage the recreational use of open space and footpaths in areas such as Castlandhill, the waterfront at Port Edgar and Kirkliston Leisure Centre. There would be reduced access to informal amenity areas at Echline Fields as a result of the construction compound. Temporary diversions of footpaths and cycleways would also increase the length of some journeys during construction. Overall, the associated health effects during construction are considered to be negative and minor.

11 Social Capital

11.1 Introduction

This section considers the potential effects of the proposed scheme on social capital, or the connections within and between communities.

Social capital has been described as comprising '*trust, reciprocity, local identity, civic engagement and community cohesion*' (Cave et al., 2001). This may be influenced by the effects of the proposed development (both positive and negative) on:

- community space and communities facilities;
- the degree of severance between communities; and
- quality of the rural and urban environment, including factors such as
 - traffic on local roads;
 - visual impacts of construction sites and new infrastructure;
 - lighting; and
 - the presence of construction sites

The issues discussed in this section overlap with issues considered in Section 6 Economics and Employment, Section:9: Access to Services and Section 10: Physical Activity and Green Space.

11.1.1 Study Area

As described above, potential social capital effects are associated with direct effects of the proposed scheme, including environmental effects and severance. Therefore the study area focuses on the communities in the immediate vicinity of the proposed scheme (Main Crossing, junctions and road alignments).

11.2 Evidence of Health Effects

11.2.1 Social Capital

Social capital has been linked with health in a number of studies. Cave et al. (2001) includes a review of recent work on the subject of social capital and health, which reveals divided views on whether a tangible association exists. Those that identify a linkage quote inversely proportional relationships between levels of social capital and issues such as self-assessed health, susceptibility to disease and infection, and the occurrence of accidents, as well as proportional relationships between social capital and good mental health and long life expectancy. Some authors cited in the review suggest that these linkages arise as a result of the influence of social capital on health related behaviour, esteem and health service use.

11.2.2 Security and Fear of Crime

Opportunities for crime and antisocial behaviour, and fear of crime, are affected by the quality of the urban and rural environment (for example derelict sites, lighting and visibility). Direct experience of crime is less consistently related to ill health than fear of crime. Recent research (Jackson et al., 2009)

has identified a correlation between self-reported health and fear of crime. However the same research found that the evidence base with regard to the effect of fear of crime on health and quality of life is scarce.

11.3 Existing Conditions

Data on neighbourhood ratings at the national level is available from the Scottish Household Survey. Table 11 below presents an extract from the neighbourhood survey data.

Table 11: Aspects of Neighbourhood Particularly Liked, by SIMD

Aspects of Neighbourhood	% of respondents who mentioned aspect as a positive factor in neighbourhood rating	
	15% most deprived communities (SIMD)	Rest of Scotland
Pleasant environment	47	63
Safe environment	9	20
Sense of community/friendly people	55	66

These data show that people living in the 15% most deprived areas in Scotland are less likely than those living elsewhere to mention that their local neighbourhood is pleasant, safe, or has a sense of community and friendly people.

No local data on neighbourhoods and communities was found in this study. The overall levels of deprivation are shown in Figure 2 of this report and information on communities and facilities is presented in Section 6.

11.4 Impact Assessment

11.4.1 Operational Effects

(a) Community Severance

Chapter 17 of the ES identifies increases in community severance of slight to moderate significance following mitigation, in the following locations:

- Inverkeithing to North Queensferry;
- South Queensferry to Linn Mill; and
- South Queensferry to Newton.

These impacts arise from the proposed alterations to the roads around Ferrytoll Junction on the north side and the new road alignment on the south side. The increased journey times between these communities has the potential to reduce the ability or inclination to access friends/family or social groups. The overall effects on wellbeing are considered to be extremely small, but individuals who regularly used the affected routes may be disproportionately affected. Particularly vulnerable groups include people without cars, the elderly and mobility impaired people.

Other issues that could give rise to community severance include the loss of green space used by communities for informal recreation, such as the fields at Echline. These impacts are discussed in Section 10 of this report.

(b) Crime and Security

The proposed scheme is not considered to have adverse effects on security and fear of crime during operation. Where public footpaths pass under the proposed new alignment, these would be designed to a high standard to ensure visibility and adequate lighting.

11.4.2 Construction Effects

(a) Community Severance

During construction, community severance could increase as a result of construction traffic and road diversions around Ferrytoll Junction and the west side of South Queensferry.

(b) Crime and Security

Construction sites have the potential to attract crime and antisocial behaviour, including trespass, graffiti, fly tipping and theft. The presence of vacant construction sites and footpath diversions can increase fear of crime, particularly for people walking in darkness or outside construction hours. Fear of crime can have a knock on effect of discouraging participation in social and other activities. However it is anticipated that the construction of the proposed scheme would be well managed and the impacts of construction sites would be minimised.

11.5 Mitigation Measures

11.5.1 Operational Phase

The design of the proposed scheme has aimed to minimise impacts on community severance by maintaining core paths and public rights of way and minimising diversions and journey time increases. The Disability Discrimination Act would be complied with in the design of footpath diversions during both construction and operation.

These measures have been taken into account in the assessment of health effects.

11.5.2 Construction Phase

A CoCP has been developed for the project which includes a section on Public Access and Traffic Management. This includes a requirement on the Contractor to develop a Traffic Management Plan including measures to maintain access and minimise severance. This includes specific requirements for the standard of construction and lighting of temporary diversions.

The CoCP also includes measures that would help to reduce fears about crime and security during the construction process. These include good housekeeping measures to ensure that all construction sites are clean, secure and free from litter and vandalism. Security measures would include the provision and use of lockable site gates, security cameras and secure fencing. Working areas that are no longer required would be cleared promptly.

11.6 Assessment of Health Impacts

The effects on health have been assessed according to the criteria set out in the Merseyside Guidelines (see Section 4.6).

Based on the available evidence (see Section 11.2), the degree of certainty of links between social capital impacts and health is considered to be speculative. The assessment of these impacts is qualitative.

The proposed scheme has been designed to make best use of the existing transport infrastructure where possible and therefore to a large degree avoids the severance of existing communities. However, some severance impacts have been identified at locations near the Ferrytoll and South Queensferry junctions. The associated health effects of severance include reduced opportunities for social interaction for vulnerable individuals. These impacts are likely to be increased during construction as a result of diversions to existing footpaths and road traffic. The increased presence of unknown people in the area during construction, change in routing of footpaths and presence of construction sites may also give rise to concerns regarding safety and security.

Overall, the associated health effects on social capital are considered to be negative and of minor magnitude.

11.7 HIA-Specific Mitigation

Secured by Design principles (Secured by Design, 2009) will be applied to the design of temporary and permanent footpaths, cycle paths and underpasses to ensure that people are not deterred from using either temporary or permanent routes due to safety concerns.

12 Summary and HIA-Specific Mitigation

12.1 Summary

This HIA has identified the main effects on human health and wellbeing that are likely to result from the proposed Forth Replacement Crossing, based on currently available information on the proposed scheme and its economic, transport and environmental effects during construction and operation.

The assessment has acknowledged that, by providing an alternative traffic route in the event of an eventual closure or partial closure of the Forth Road Bridge, the proposed scheme would prevent widespread socio-economic impacts which would otherwise have adverse consequences for health and wellbeing.

The potential for positive and negative health effects have been identified during construction and operation of the proposed scheme. These are generally of negligible to minor magnitude. Effects may be more likely in the areas close to the proposed new road alignments to the north and south of the Main Crossing.

12.2 Mitigation

As described in this report, a wide range of mitigation measures have been incorporated into the design of the proposed scheme through the EIA process. Specific mitigation measures from the ES which relate to the relevant health determinants are identified in this report and were taken into account in the consideration of health impacts. Measures will be put in place during construction to ensure that any impacts are mitigated as far as practicable and a dedicated Community Liaison Officer will be appointed by the contractor to respond quickly to any concerns and complaints raised by the local community.

The following additional mitigation measures have been identified as a result of this HIA.

General measures

- When notifying communities of planned construction works as required by the CoCP, the Contractor will provide information on details of proposed air quality and noise monitoring and any other proposed mitigation.
- The Contractor will be required to demonstrate a commitment to its wider social responsibilities, for example through participation in the Considerate Constructor's scheme.

Transport, Economics and Employment

- Transport Scotland will seek to create local training and employment opportunities during construction.

Community Severance

- Secured by Design principles will be applied to the design of temporary and permanent footpaths, cycle paths and underpasses to ensure that people are not deterred from using either temporary or permanent routes due to safety concerns.

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