

18. Climate Change

This chapter considers the potential impacts of the Proposed Scheme on the climate and the vulnerability of the Proposed Scheme to climate change.

Proposed mitigation measures will minimise greenhouse gas (GHG) emissions. However, there will be unavoidable GHG emissions resulting from the construction of the Proposed Scheme. These effects are likely to be minor and not significant. Total GHG emissions from construction are estimated to be in the order of 33,830 tCO₂e. Over the 60-year design life of the Proposed Scheme, there is expected to be a beneficial impact on total GHG emissions from operation. These are estimated to be in the order of 318,500 tCO₂. However, it should be noted that government policy for the move to electric vehicles and net-zero carbon are not factored into the assessment for estimating GHG emissions from vehicle use.

The Proposed Scheme has the potential to be impacted by a changing climate during construction and operation; however, mitigation measures are in place to reduce these risks.

The Proposed Scheme aligns with applicable legislation and national, regional and local planning policy to minimise GHG emissions and support the transition to a low carbon economy and to reduce the vulnerability of the Scheme to the impacts of climate change, such as flooding.

18.1 Introduction

18.1.1 This chapter of the Environmental Statement (ES) reports the findings of an assessment of the likely significant effects on the climate as a result of the changes to the A720 Sheriffhall Roundabout (hereafter referred to as 'the Proposed Scheme'), located to the southeast of Edinburgh. It also considers the vulnerability of the Proposed Scheme to climate change.

18.1.2 To align with the requirements of The Roads (Scotland) Act 1984 (Environmental Impact Assessment) Regulations 2017 as discussed in Chapter 6 - Overview of Assessment, consideration has been given within this chapter to the following aspects of climate change assessment:

- **Greenhouse Gas (GHG) Impact Assessment:** The effects on the climate of GHG emissions arising from the Proposed Scheme, including how the scheme would affect the ability of government to meet its carbon reduction plan targets;
- **Climate Change Risk (CCR) Review:** The resilience of the Proposed Scheme to future climate change impacts.
- **In-combination Climate Change Impact (ICCI) Assessment:** The combined impact of the Proposed Scheme and future climate change on receptors in the surrounding environment.

18.1.3 This chapter of the ES has been prepared by competent experts with relevant and appropriate experience. The technical lead for the climate change assessment has 18 years of relevant work experience. Further details are provided in Appendix 1.2 – Table of Expert Competencies.

18.2 Approach and Methodology

DMRB Guidance

18.2.1 DMRB guidance on climate change was published on 31 October 2019 under the heading LA 114 – Climate. This guidance aligns the DMRB assessment process more closely with the 2017 EIA Regulations.

- 18.2.2 It should be noted that the Climate Change assessment had been completed prior to the publication of this guidance. A review of the new guidance, LA 114, has been undertaken and it is not anticipated that the application of the guidance would substantially alter the assessment results.

GHG Impact Assessment

- 18.2.3 The study area for the GHG impact assessment is set by the redline boundary of the Proposed Scheme but also encompasses a wider extent to include GHG emissions arising outside of this boundary, including for embodied GHG emissions from products and materials, and GHG emissions associated with the transport of materials and people to site.
- 18.2.4 This GHG impact assessment adopts a lifecycle approach to calculate projected GHG emissions and to identify GHG emission 'hot spots' i.e. emission sources likely to generate the largest amount of GHG. This approach is consistent with the principles set out in IEMA guidance (IEMA, 2017).
- 18.2.5 The key anticipated GHG emissions sources during construction of the Proposed Scheme are presented in Table 18-1 'Key Anticipated GHG Emission Sources – Construction' and have been categorised in line with guidance set out in PAS 2080:2016 (British Standards Institution, 2016).

Table 18-1 Key Anticipated GHG Emission Sources – Construction

Lifecycle stage	Activity	Primary emission sources
Product stage	Raw material extraction and manufacturing of products/ materials	Embodied GHG emissions
	Transport of products/ materials to site	Emissions from fuel used for the transportation of products/materials to site
Construction process stage	On-site construction activity	GHG emissions from fuel consumption by vehicles, plant and equipment for construction of the Proposed Scheme
	Transport of construction workers	Emissions from fuel used for worker commuting
	Disposal of construction waste	GHG emissions from fuel used for the transport and disposal of waste

- 18.2.6 Although, there will be loss of existing carbon sink, it is assumed that proposed new planting will be sufficient to replace this.
- 18.2.7 The key anticipated GHG emissions sources during the operational, maintenance and use phases of the Proposed Scheme are presented in Table 18-2 'Key Anticipated GHG Emission Sources - Operation'.

Table 18-2 Key Anticipated GHG Emission Sources - Operation

Lifecycle stage	Activity	Primary emission sources
Operational stage	Vehicle journeys	GHG emissions per vehicle kilometre

- 18.2.8 It has been assumed that energy use for lighting and signage during operation will be no worse than the existing situation at Sheriffhall roundabout. This is because there will be a decrease in traffic signals as none are being proposed, and a small increase in lighting columns and signs.

GHG emissions from maintenance activities have not been assessed as they are not expected to be significant. It is anticipated that the Proposed Scheme will use similar volumes of materials and produce similar amounts of waste as

the current arrangements. It is therefore assumed that there are unlikely to be additional impacts when compared to the current baseline.

18.2.9 It is anticipated that whilst the Proposed Scheme will have a design life of 60 years, in practice it will be maintained beyond this timeframe and therefore emissions associated with the decommissioning have not been included within the GHG impact.

18.2.10 Where activity data has allowed, GHG emissions have been quantified using a calculation-based methodology as per the following equation as stated in the Defra 2019 emissions factors guidance (Defra, 2019):

$$\text{Activity data} \times \text{GHG emissions factor} = \text{GHG emissions value}$$

18.2.11 Embodied carbon emissions have been calculated using Transport Scotland's Carbon Management System (CMS). Total embodied carbon emissions have been estimated using predicted materials quantities outlined in the Stage 3 design for the Proposed Scheme.

18.2.12 Calculation of GHG emissions from the operation of the Proposed Scheme considers a do-minimum scenario, assuming the Proposed Scheme is not implemented; and a do-something scenario, assuming the Proposed Scheme is implemented and the GHG emission reductions from embedded mitigation measures are taken into account.

18.2.13 A comparison of the GHG emissions for the do-minimum and do-something scenarios has been undertaken between the years 2024 and 2084 (which represents the 60-year design life, post opening of the Proposed Scheme in 2024), in accordance with DMRB, Volume 11, Section 3, Part 1 'Air Quality' (HA207/07) (Highways Agency et.al, 2007).

18.2.14 A set of standard data quality principles as detailed in 'The GHG Protocol' (WRI & WBCSD, 2015) have been applied so that the results from the GHG emissions assessment are as accurate and representative as possible:

- **Age:** The GHG impact assessment has been based on activity data and GHG emissions factors applicable to the study period;
- **Geography:** Activity data reflects the design of the Proposed Scheme. GHG emissions factors are representative of the UK construction industry and UK transport sector;
- **Technology:** The default solution has been to apply data which is representative of the UK construction industry and transport sector;
- **Methodology:** Activity data has been gathered directly from the Proposed Scheme's design teams to enable consistency and completeness of data collection; and
- **Competency:** Activity data has been generated by design teams in-line with applicable industry standards. Data gaps have been replaced with industry specific literature (for example, plant equipment specifications). GHG emissions factors have been sourced from source including the Defra/ BEIS Conversion Factors 2019 which are widely accepted industry specific and government sources.

18.2.15 In line with 'The GHG Protocol' (WRI & WBCSD, 2015), the seven Kyoto Protocol GHGs have been considered when reporting emissions, specifically:

- Carbon dioxide (CO₂);
- Methane (CH₄);
- Nitrous oxide (N₂O);
- Sulphur hexafluoride (SF₆);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs); and

- Nitrogen trifluoride (NF₃).

18.2.16 These GHGs are broadly referred to in this assessment under an encompassing definition of 'GHG emissions', with the unit of tCO₂e (tonnes CO₂ equivalent) or MtCO₂e (Megatonnes of CO₂ equivalent).

18.2.17 The impact from GHG emissions is a national and global issue. Consequently, the potential impact of the Proposed Scheme on GHG emissions will be assessed by comparing the Proposed Scheme's estimated GHG emissions against the annual Scotland carbon budgets.

18.2.18 The global climate has been identified as the receptor for the purposes of the GHG emissions assessment. However, to enable the significance of the estimated GHG emissions arising from the Proposed Scheme to be evaluated, the annual Scotland carbon budgets were used as a proxy of the level of effect on the global climate.

18.2.19 There is no published standard definition for receptor sensitivity of GHG emissions, set out in the IEMA guidance (IEMA, 2017) or, elsewhere. The sensitivity of the receptor, the annual Scotland carbon budgets (as a proxy for the global climate), has been defined as 'high'. The rationale for this approach is as follows:

- Any additional GHG impacts could compromise Scotland's ability to reduce its GHG emissions and therefore the ability to meet its future carbon budgets; and
- The extreme importance of limiting global warming to below 2°C this century, as broadly asserted by the International Paris Agreement (UNFCCC, 2015) and the climate science community. Additionally, a recent report by the IPCC highlighted the importance of limiting global warming below 1.5°C (IPCC, 2018).

18.2.20 Due to the absence of any defined industry guidance for assessing the magnitude of GHG impacts for EIA, standard GHG accounting and reporting principles have been followed to assess impact magnitude. In GHG accounting, it is common practice to consider exclusion of emission sources that are <1% of a given emissions inventory on the basis of a de minimis contribution. Both Department of Energy and Climate Change (DECC) (DECC, 2013) and the PAS 2050 Specification (British Standards Institution, 2011) allow emissions sources of <1% contribution to be excluded from emission inventories, and these inventories to still be considered complete for verification purposes. This would therefore suggest that a development with emissions of <1% of the relevant annual Scotland carbon budgets would be minimal in its contribution to the wider national GHG emissions.

18.2.21 A further reference is that the International Finance Corporation (IFC) includes a GHG reporting threshold for projects that it contributes funding to of over 25,000 tCO₂e in any year (IFC, 2011). These have been used to assess the magnitude of the GHG impact and the associated criteria are outlined in Table 18-3 'Magnitude Criteria for GHG Impact Assessment'.

Table 18-3 Magnitude Criteria for GHG Impact Assessment

Magnitude	Magnitude criteria
High	Annual GHG emissions are more than or equal to 1% of the relevant annual National Carbon Budget or are more than 25,000 tCO ₂ e in any year.
Low	Annual GHG emissions represent less than 1% of the relevant annual National Carbon Budget or are less than 25,000 tCO ₂ e in any year.

18.2.22 The appropriate annual Scotland carbon budgets that span the construction programme for the Proposed Scheme are for the years 2021 to 2024.

- 18.2.23 The operational phase of the Proposed Scheme (fully operational by 2024) has been compared to all the appropriate and available annual Scotland carbon budgets within the design life of the Proposed Scheme. As the budgets have only been calculated to 2032, this assessment uses the annual Scotland carbon budgets from 2024 to 2032.
- 18.2.24 Table 18-4 'Relevant Annual Scotland Carbon Budget for this Assessment' shows the current and future annual Scotland carbon budgets up to 2032, which highlights a reduction in the amount of GHG Scotland can legally emit in the future. This means that any source of emissions contributing to Scotland's carbon inventory will have a greater impact on the annual Scotland carbon budgets in the future.

Table 18-4 Relevant Annual Scotland Carbon Budget for this Assessment

Carbon budget	Total budget (tCO ₂ e)
2021	39,495,000
2022	38,310,000
2023	37,161,000
2024	35,787,000
2025	34,117,000
2026	32,446,000
2027	30,777,000
2028	29,854,000
2029	28,958,000
2030	28,089,000
2031	27,247,000
2032	26,429,000

- 18.2.25 The classification and significance of effects has been determined using the matrix in Table 18-5 'Classification and significance of Effects Matrix for GHG Impact Assessment'. This differs from the criteria presented in Chapter 6 - Overview of Assessment Process by omitting the 'No Change', 'Low' and 'Medium' categories for sensitivity and omitting the 'No Change', 'Negligible' and 'Moderate' categories for magnitude. This is because the sensitivity of the receptor (global climate) to increases in GHG emissions is considered always 'High', and the magnitude of the impact is determined by a boundary of less than or more than 1% of the carbon budgets, or more than 25,000 tCO₂e in any year. This is in line with the IEMA guidance (IEMA, 2017), which states that the application of the standard EIA significance criteria is not considered to be appropriate for climate change mitigation assessments.

Table 18-5 Classification and Significance of Effects Matrix for GHG Impact Assessment

Magnitude of Impact	Sensitivity of Receptor
	High
Low (<1% of carbon budget or less than 25,000 tCO ₂ e in any year)	Minor (Not Significant)
High (≥1% of carbon budget or more than 25,000 tCO ₂ e in any year)	Major (Significant)

Climate Change Resilience

- 18.2.26 The identification and assessment of climate change resilience within EIA is an area of emerging practice. There is no single prescribed format for undertaking such assessments; therefore, the approach adopted to undertaking and reporting the assessment has drawn on good practice from other similar developments and studies.
- 18.2.27 The assessment of climate change resilience has been undertaken for the Proposed Scheme to identify potential climate change impacts, and to consider their potential consequence and likelihood of occurrence, taking account of the measures incorporated into the design of the Proposed Scheme.
- 18.2.28 The types of receptors considered vulnerable to climate change, are:
- construction phase receptors (i.e. workforce, plant and machinery);
 - the highway assets and their operation, maintenance and refurbishment (i.e. pavements, structures, earthworks and drainage, technology assets, etc.); and
 - end-users (i.e. members of public and commercial operators etc).
- 18.2.29 The 60-year design life of the Proposed Scheme includes its construction and operational phases. As the construction phase would be much shorter in duration than the operational phase, and would be undertaken within the next ten years, future climate change is less relevant to the assessment of construction impacts and effects. Accordingly, the construction assessment has followed a descriptive based approach.
- 18.2.30 For the operational assessment, the likelihood and consequence of impacts and effects on receptors has been assessed based on a future time frame of operation.
- 18.2.31 Criteria used to determine the likelihood of an event occurring, based on its probability and frequency of occurrence, are detailed in Table 18-6 'Measure of Likelihood for Climate Change Resilience Assessment'.

Table 18-6 Measure of Likelihood for Climate Change Resilience Assessment

Likelihood Category Description (probability and frequency of occurrence)

Very high	The event* occurs multiple times during the lifetime of the project (60 years) e.g. approximately annually, typically 60 events.
High	The event occurs several times during the lifetime of the project (60 years) e.g. approximately once every five years, typically 12 events;
Medium	The event occurs limited times during the lifetime of the project (60 years) e.g. approximately once every 15 years, typically 4 events.
Low	The event occurs during the lifetime of the project (60 years) e.g. once in 60 years.
Very low	The event may occur once during the lifetime of the project (60 years).

* The event is defined as the climate event (such as heatwave) and the hazard (such as overheated electrical equipment) occurring in combination

- 18.2.32 The consequence of an impact has been measured using the criteria detailed in Table 18-7 'Measure of Consequence for Climate Change Resilience Assessment'.

Table 18-7 Measure of Consequence for Climate Change Resilience Assessment

Consequence of impact	Description
Very large adverse	National level (or greater) disruption to strategic route(s) lasting more than 1 week.
Large adverse	National level disruption ¹ to strategic route(s) lasting more than 1 day but less than 1 week; or Regional level disruption to strategic route(s) lasting more than 1 week.
Moderate adverse	Regional level disruption to strategic route(s) lasting more than 1 day but less than 1 week.
Minor adverse	Regional level disruption to strategic route(s) lasting less than 1 day.
Negligible	Operational phase: disruption to an isolated section of a strategic route lasting less than 1 day.

18.2.33 The identification of likely significant effects on receptors has been undertaken using professional judgement by combining the measure of likelihood with the predicted consequence of impact, as shown in Table 18-8 'Significance Criteria for Climate Change Resilience Assessment'.

Table 18-8 Significance Criteria for Climate Change Resilience Assessment

Measure of consequence	Measure of Likelihood				
	Very low	Low	Medium	High	Very High
Negligible	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
Minor	Not Significant	Not Significant	Not Significant	Significant	Significant
Moderate	Not Significant	Not Significant	Significant	Significant	Significant
Large	Not Significant	Significant	Significant	Significant	Significant
Very Large	Not Significant	Significant	Significant	Significant	Significant

18.2.34 The assessment of potential impacts and the Proposed Scheme's' vulnerability takes into account the mitigation measures that have been designed into the Proposed Scheme, as discussed in Section 18.7: Mitigation.

18.2.35 The assessment also identifies and accounts for existing climate change resilience measures either already in place or in development for infrastructure and assets, for example, mitigation measures for potential flooding impacts on the Proposed Scheme.

In-combination Climate Change Impacts

18.2.36 Projected changes to average climatic conditions, as well as an increased frequency and severity of extreme weather events have the potential to impact the ability of the natural environment surrounding the Proposed Scheme to adapt to climate change.

18.2.37 The ICCI assessment considers the ways in which projected climate change will influence the significance of the impacts of the Proposed Scheme on the surrounding environment. Table 18-8 'Parameters Considered in the ICCI Assessment' details the rationale for excluding the ICCI assessment.

Table 18-9 Parameters Considered in the ICCI Assessment

Climate Parameter	Considered in ICCI assessment	Rational
Extreme weather events	Excluded	The impacts of extreme weather events on the water environment discipline are considered as part of the climate change allowances within the Road Drainage Chapter and it would not be proportionate or appropriate to assess such effects within the climate statement solely for the purpose of the ICCI assessment. These impacts are therefore not included in this chapter.
Precipitation	Excluded	The impact of increased seasonality of rainfall due to climate change is considered as part of the Chapter 11 - Road Drainage and the Water Environment. Large areas of SuDS planting, and wet woodland have also been proposed in Chapter 8 - Landscape and Visual Effects, which will be suited to wetter climates. It is therefore not considered proportionate or appropriate to assess precipitation within this chapter solely for the purposes of the ICCI assessment.
Temperature	Excluded	The Proposed Scheme is on the outskirts of the city, and as such will have a negligible heat urban island effect. There is a requirement to plant only native species as this area as it is classed as a 'wild' area, out with the central roundabout area. However, proposed planting has included a wide range of native species which should give flexibility to adapting to changing climatic conditions (Chapter 8 - Landscape and Visual Effects).
Sea level rise	Excluded	The application site is not located in an area that is susceptible to sea level rise.
Wind	Excluded	It is not proportionate to assess wind solely for the purposes of the ICCI assessment due to a lack of wind climate projections.

Assumptions and Limitations

- 18.2.38 Embodied carbon emissions were calculated using Transport Scotland's Carbon Management System (CMS).
- 18.2.39 An average of 50km has been assumed for each two-way HGV trip.
- 18.2.40 It is likely that the Proposed Scheme will be procured by means of a Design and Build (D&B) type contract. Under the terms of this contract type, the Contractor will undertake both the detailed design and construction of the Proposed Scheme.
- 18.2.41 Construction waste data was not available for the construction phase. Therefore, the quantities of waste generated during the construction of the Proposed Scheme were estimated based on the application of good practice wastage; taken from the Net Waste Tool (WRAP, 2008). Wastage rates provide an estimation of the proportion of a component that ends up as waste during the construction process, based on previous comparable project findings.
- 18.2.42 Emissions calculated associated with mobile plant and machinery present a worst-case scenario and are likely to be less than this.
- 18.2.43 For road user emissions, the difference between the do-minimum and the do-something scenarios for 2024 and 2039 have been provided by the Air Quality assessment, which considers the affected road network (Chapter 13 – Air Quality). Based on this, a steady decrease of emissions year on year has been assumed up to the end of the 60-year design life of the Proposed Scheme (2084). This is in line with the UK Government's Road to Zero Strategy (HM Government, 2018) which sets out the Government's strategy for a low carbon transport network. A key ambition in this strategy is ending the sale of conventional petrol and diesel cars and vans by 2040 so that by 2050 all cars and vans on the road will be zero emissions.
- 18.2.44 Limitations associated with the approach taken for the climate change resilience review relate to uncertainties inherent within UK Climate Projections (UKCP18 data) (UKCP, 2018).

- 18.2.45 By its very nature, climate change is associated with a range of assumptions and limitations. To overcome these issues, leading climate change data and science has been incorporated into the assessment and proven effective approaches undertaken for similar project types have been replicated.
- 18.2.46 As the Proposed Scheme is developed at detailed design any refinements to the design should be subject to environmental review to ensure that the residual effects would not be greater (or significantly different) than those reported in this ES. The findings of any such review should be subject to approval by Transport Scotland (TS) and where necessary opinions should be sought from the statutory bodies.

18.3 Legislative and Policy Framework

National Legislation

Climate Change Act (Scotland) 2009

- 18.3.1 The Climate Change (Scotland) Act 2009 (hereafter referred to as the 'Act') (Scottish Government, 2009) sets a legally binding target for Scotland to reduce its GHG emissions from 1990 levels by at least 80% by 2050. The target is supported by a series of five-year 'carbon budgets' and an independent committee monitor the UK's progress.
- 18.3.2 In September 2019, the Scottish Parliament passed the Climate Change Bill to amend the Climate Change (Scotland) Act 2009 (Scottish Parliament, 2009) to set a legally binding target for Scotland to reduce greenhouse gas emissions to net-zero¹ by 2045.
- 18.3.3 However, further policy and guidance on how net-zero carbon will be achieved has not been published, including amendments to the carbon budgets. The assessment therefore considers the current carbon budgets.
- 18.3.4 The Climate Change (Scotland) Act 2009 and the Planning etc. (Scotland) Act 2006 (Scottish Parliament, 2006) place a duty on the Council to act in the best way to reduce emissions, adapt to climate change and prepare development plans to further sustainable development.

National Policy

National Planning Framework 3 (NPF3) (Scottish Government, 2014a)

- 18.3.5 The National Planning Framework (NPF3) was published in 2014 by the Scottish Government (Scottish Government, 2014) and is intended to guide Scotland's spatial development priorities for the next 20 to 30 years. The vision set out in NPF3 is divided into four outcomes, one of which is '*a low carbon place – reducing our carbon emissions and adapting to climate change*'.

Scottish Planning Policy (SPP) (Scottish Government, 2014b)

- 18.3.6 The Scottish Planning Policy (SPP) (Scottish Government, 2014a) document is a statement of the Scottish Government's policy on nationally important land use matters. SPP facilitates development while at the same time "protecting and enhancing the natural and built environment" and is considered to be central to the Scottish Government's purpose of achieving sustainable economic growth (para 2).
- 18.3.7 The SPP sets out how climate change should be addressed through planning, by seizing opportunities to encourage mitigation and adaptation measures, to support the transformational change required to meet emission reduction targets and reduce the vulnerability of existing and future development to climate change.

¹ Net-zero refers to balancing the amount of GHGs emitted with the equivalent emissions that are either offset or sequestered.

Regional Policy

South East Scotland Strategic Development Plan (SDP) (SESplan, 2013)

- 18.3.8 A key aim of the SDP is to contribute to the response to climate change through mitigation and adaptation and promote high quality design / development Delivering high quality, resilient places through good design and master planning. However, there are no policies directly related to climate change.

Proposed South East Scotland Strategic Development Plan (SDP2) (SESplan, 2016)

- 18.3.9 A proposed update of the SDP was issued in 2016 (SESplan, 2016). One of the outcomes of the plan is to minimise the impacts from climate change and meet carbon reduction targets. For example, by development that will help minimise commuting by car and reduce transport related carbon emissions, as well as making best use of existing infrastructure.
- 18.3.10 As discussed in Chapter 2 - Need for the Scheme, the Proposed SDP was rejected by the Scottish Ministers on 16 May 2019; however, the proposed plan has still been considered within this ES as a draft plan.

Local Policy

Edinburgh Local Development Plan (City of Edinburgh Council, 2016)

- 18.3.11 The City of Edinburgh Local Development Plan fulfils the commitments required by the Climate Change (Scotland) Act 2009 with policies addressing both the reduction of GHG emissions and the ability to adapt to a changing climate for example through, resource efficient design and planting trees to capture carbon, intercept and absorb rainfall.

Midlothian Local Development Plan (Midlothian Council, 2017)

- 18.3.12 One of the strategic aims of the Midlothian Local Plan (Midlothian Council, 2017) is to respond robustly to the challenges of mitigating climate change and adapting to its impacts. For example, Policy DEV 5 Sustainability in New Development sets out the expectation of proposals to:
- Recycle construction materials and minimise the use of non-renewable resources; and
 - Where flood risk has been identified on a development site or where a development proposal will increase flood risk elsewhere, the layout of the site will be designed to reduce flood risk on or off site, in accordance with Policy ENV9.

City of Edinburgh Council - Climate Emergency

- 18.3.13 In February 2019, the City of Edinburgh Council declared a climate emergency and in May 2019, they set a target to become carbon neutral by 2030.

Guidance

Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment Guide to Assessing Greenhouse Gas Emissions and Evaluating their Significance

- 18.3.14 The IEMA guidance for assessing GHG emissions in EIA (IEMA, 2017) provides a framework for the consideration of GHG emissions in the EIA process, in line with the 2014 European Union (EU) Directive. The guidance sets out how to:
- Identify the GHG emissions baseline in terms of GHG current and future emissions;
 - Identify key contributing GHG sources and establish the scope and methodology of the assessment;

- Assess the impact of potential GHG emissions and evaluate their significance; and
- Consider mitigation in accordance with the hierarchy for managing project related GHG emissions (avoid, reduce, substitute, and compensate).

Institute of Environmental Management and Assessment (IEMA) Environmental Impact Assessment Guide to Climate Change Resilience and Adaptation

18.3.15 The IEMA Guidance for assessing climate change resilience and adaptation in EIA (IEMA, 2015) provides guidance for the consideration of the impacts of climate change within project design, and consideration of in-combination impacts of the project with projected climate changes. The guidance sets out how to:

- Define climate change concerns and environmental receptors vulnerable to climate factors;
- Define the environmental baseline with changing future climate parameters;
- Determine the resilience of project design and define appropriate mitigation measures to increase resilience to climate change; and
- Assess the in-combination impacts to a climate change affected baseline and identify mitigation and monitoring measures to reduce the effects of climate change on the environment.

18.4 Consultation

18.4.1 No consultation responses were received in relation to climate change.

18.5 Baseline Conditions

GHG Impact Assessment

18.5.1 The baseline conditions for the GHG impact assessment is a business as usual scenario whereby the Proposed Scheme does not go ahead.

Climate Change Resilience

Current Baseline

18.5.2 The current baseline for the climate change resilience review is the current climate in the location of the Proposed Scheme. Historic climate data obtained from the Met Office website (Met Office, 2019) recorded by the closest meteorological station to the Proposed Scheme (Penicuik Weather Station) for the 30-year climate period of 1981-2010 is summarised in Table 18-10 'Historic Climate Data'.

Table 18-10 Historic Climate Data

Climatic Factor	Month	Figure
Average annual maximum monthly temperature (°C)	-	11.8
Warmest month on average (°C)	July	18.8
Coldest month on average (°C)	December	-0.2
Mean annual rainfall levels (mm)	-	980.3
Wettest month on average (mm)	October	105.8

Climatic Factor	Month	Figure
Driest month on average (mm)	April	59.1

- 18.5.3 The Met Office baseline climate 10-year averages for Scotland identify gradual warming (although not uniformly so) between 1969 and 2018, with increasing rainfall also. Information on mean maximum annual temperatures (°C) and mean annual rainfall (mm) is summarised in Table 18-11 '10-year Averages Demonstrating Climate Variations from 1969 to 2018 in Scotland'.

Table 18-11 10-year Averages Demonstrating Climate Variations from 1969 to 2018 in Scotland

Climate Period	Climate Variables	
	Mean maximum annual temperature (°C)	Mean annual rainfall (mm)
1969-1978	10.43	1291.01
1979-1988	10.15	1472.75
1989-1998	10.72	1506.03
1999-2008	11.29	1571.30
2009-2018	11.09	1595.24

Future Baseline

- 18.5.4 The future baseline is expected to differ from the present-day baseline described above. UK Climate Projections published in 2018 (UKCP18) have been developed by the UK Climate Impacts Programme (UKCIP) (UKCP, 2018) to provide projections for future climate scenarios and trends. The climate projections have been presented to include the 60-year project design life of the Proposed Scheme at the 10%, 50% and 90% probability levels for RCP8.5. UKCP18 uses a range of possible scenarios, classified as Representative Concentration Pathways (RCPs) to inform differing future emission trends. The assessment has considered a scenario that reflects a high level of GHG emissions.
- 18.5.5 The 50% probability levels are the top number presented in each row Table 18-12 'Projected Changes in Temperature Variables (°C) - Probabilistic Projections' and Table 18-13 'Projected Changes in Precipitation' and the 10% and 90% probability levels are shown in brackets.

Table 18-12 Projected Changes in Temperature Variables (°C) - Probabilistic Projections

Climate variable	Time period			
	2020-2039	2040-2059	2060-2079	2070-2099
Mean annual air temperature anomaly at 1.5m (°C)	+1.0 (+0.4 to +1.6)	+1.7 (+0.8 to +2.6)	+2.5 (+1.1 to +4.0)	+3.3 (+1.8 to +5.0)
Mean summer air temperature anomaly at 1.5m (°C)	+1.0 (+0.2 to +1.8)	+1.9 (+0.6 to +3.2)	+2.9 (+0.8 to +5.1)	+4.0 (+1.6 to +6.5)
Mean winter air temperature anomaly at 1.5m (°C)	+1.0 (+0.0 to +1.9)	+1.6 (+0.3 to +2.9)	+2.4 (+0.6 to +4.1)	+3.0 (+1.1 to +5.0)

Maximum summer air temperature anomaly at 1.5m (°C)	+1.2 (+0.3 to +2.2)	+2.2 (+0.7 to +3.8)	+3.2 (+0.8 to 5.6)	+4.4 (+1.7 to +7.3)
Minimum winter air temperature anomaly at 1.5m (°C)	+0.8 (+0.1 to +1.5)	+1.5 (+0.5 to +2.6)	+2.3 (+0.9 to +4.0)	+2.9 (+0.8 to +5.3)

Table 18-13 Projected Changes in Precipitation - Probabilistic Projections

Climate variable	Time period			
	2020-2039	2040-2059	2060-2079	2070-2099
Annual precipitation rate anomaly (%)	+4 (-1 to +10)	+4 (-3 to +11)	+5 (-2 to +12)	+5 (-2 to +12)
Summer precipitation rate anomaly (%)	+0 (-11 to +12)	-10 (-21 to +11)	-14 (-30 to +3)	-18 (-33 to -2)
Winter precipitation rate anomaly (%)	+6 (-4 to +18)	+9 (-2 to +22)	+14 (-6 to +34)	+16 (-2 to +36)

18.6 Potential Impacts

GHG Impact Assessment

Construction Impacts

- 18.6.1 The total GHG emissions from construction are estimated to be in the order of 33,830 tCO₂e. The primary GHG emissions sources and the breakdown of the calculated GHG emissions are shown in Table 18-14 'Construction GHG emissions' which have been rounded to the nearest 10 tCO₂e.
- 18.6.2 GHG emissions from construction activities will be limited to the anticipated duration of the 28-month construction programme where all enabling, construction and landscaping will be taking place. Total annual construction emissions equate to 4,830 tCO₂e in 2021 and 14,500 tCO₂e in 2022 and 2023.
- 18.6.3 The greatest contribution to construction emissions is the embodied carbon within construction products (70% of construction emissions) as shown in Table 18-14 'Construction GHG emissions'.

Table 18-14 Construction GHG emissions

Lifecycle stage	Project activity / Emissions source	Emissions (tCO ₂ e)	% of construction emissions
Construction	Products	23,580	70%
	Transport of materials and waste	6,770	9%
	Fuel use on site	2,970	20%
	Transport of workers	240	1%
	Waste	280	1%
	Total construction emission (tCO₂e)	33,830²	

Operational Impacts

- 18.6.4 Over the 60-year design life of the Proposed Scheme, there is expected to be a beneficial impact on total road user emissions in the operational phase. Savings over the 60-year design life are estimated to be in the order of 318,500 tCO₂ rounded to the nearest 10 tCO₂.

Climate Change Resilience

Construction Impacts

- 18.6.5 During the construction process, receptors may be vulnerable to a range of climate risks. These are addressed by the mitigation measures in Section 18.7. Potential impacts during the construction phase could include:
- Inaccessible construction site due to severe weather events (flooding, snow and ice, storms) restricting working hours and delaying construction;
 - Health and safety risks to the workforce during severe weather events;
 - Unsuitable conditions (due to very hot weather or very wet weather, for example) for certain construction activities; and
 - Damage to construction materials, plant and equipment, including damage to temporary buildings/facilities within the site boundary, such as offices, compounds, material storage areas and worksites, for example for example from stormy weather.

Operational Impacts

- 18.6.6 The Proposed Scheme also has the potential to be impacted upon by a changing climate and, in particular, more frequent severe weather events, in the medium to longer-term. These are addressed by the mitigation measures in Section 18.7. Potential impacts on the Proposed Scheme during the operational phase include:
- Material and asset deterioration due to high temperatures;
 - Health and safety risks to road users;
 - Damage to roads from periods of heavy rainfall; and
 - Flood risk (surface, groundwater, fluvial and snow/ice melt) on the network and damage to drainage systems with the potential for increased runoff from adjacent land contributing to surface water flooding.

Cumulative Impacts

- 18.6.7 As stated by IEMA (IEMA, 2017), all GHG emissions are considered significant and therefore will contribute to climate change. However, the predicted GHG emissions of cumulative schemes, as listed in Chapter 19 - Cumulative Assessment of this ES are not known. Furthermore, the cumulative GHG emissions would not just be limited to the cumulative schemes listed, as the receptor of the GHG emissions assessment is the global climate, with the UK National Carbon Budget used as a proxy. Therefore, whilst any GHG emissions across the UK could be considered to have cumulative effects with the GHG emissions of the Proposed Scheme, the assessment methodology has by default already covered this wider perspective.

18.7 Mitigation

GHG Impact Assessment

- 18.7.1 A series of mitigation measures have been identified to reduce GHG emissions from the Proposed Scheme. These measures include:

- Where feasible, carrying out measures to reduce GHG emissions from material use and waste, including:
 - The sustainable reuse of soil and aggregate materials won from excavation;
 - The reuse, where possible of materials and waste generated from construction works;
 - The use of materials with lower embodied carbon, such as those with a higher recycled content;
 - Procuring locally sourced materials where reasonably practicable; and
 - Careful consideration of material quantity requirements to avoid over-ordering and generation of waste materials, while also reducing transportation-related emissions.
- The appointed contractor will develop and implement a plan to reduce energy consumption and GHG emissions throughout construction, including, for example:
 - Monitoring of fuel use on site;
 - Training of plant operatives in fuel efficient driving techniques; and
 - Consideration of renewable/ and or low carbon energy sources.

Climate Change Resilience

18.7.2 A number of mitigation and adaptation measures to address the potential impacts associated with climate change are presented below. Many of these have been identified within other topic chapters and through the Scheme design. These measures include:

- Consideration of the dangers associated with working in more extreme weather conditions within the Construction Environmental Management Plan (CEMP);
- Consideration of the use of construction materials with superior properties (such as increased tolerance to fluctuating temperatures) to be included within detailed designs;
- Consideration of climate change projections within maintenance plans and drainage systems to protect against a return period of 1-in-200 years flood event;
- Inclusion of flood compensation areas and compensatory floodplain within the design to account for future climate change;
- Application of engineering design standards for safety of road users and structural stability;
- Procedures in place for severe weather events including, identification of suitable network redundancies and diversion routes; emergency response and contingency plans; and standard operating procedures for use in the event of necessary road closure and/or traffic diversion; and
- Regular maintenance of assets.

Summary of Mitigation Measures

18.7.3 The following table, Table 18-15 'Summary of Climate Change Mitigation Measures', provides a summary of the climate change mitigation measures proposed. This table is also included within Chapter 20 – Schedule of Environmental Commitments which will be used to inform the commitments in the contract document.

Table 18-15 Summary of Climate Change Mitigation Measures

Mitigation Item	Location/ Approximate Chainage	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Potential Monitoring Requirements
CC-1	Throughout Proposed Scheme	Construction	Where feasible, carrying out measures to reduce GHG emissions from material use and waste, including: <ul style="list-style-type: none"> The sustainable reuse of soil and aggregate materials won from excavation; The reuse, where possible of materials and waste generated from construction works; The use of materials with lower embodied carbon, such as those with a higher recycled content; Procuring locally sourced materials where reasonably practicable; and Careful consideration of material quantity requirements to avoid over-ordering and generation of waste materials, while also reducing transportation-related emissions. 	To reduce GHG emissions from material use and waste.	None required.	None required.
CC-2	Throughout Proposed Scheme	Construction	The appointed contractor will develop and implement a plan to reduce energy consumption and GHG emissions throughout construction, including, for example: <ul style="list-style-type: none"> Monitoring of fuel use on site; Training of plant operatives in fuel efficient driving techniques; and Consideration of renewable/ and or low carbon energy sources. 	To reduce GHG emissions from energy and fuel use during construction.	None required.	None required.
CC-3	Throughout Proposed Scheme	Construction	Consideration of the dangers associated with working in more extreme weather conditions within the CEMP.	To reduce the vulnerability of workers to climate change risks.	None required.	None required.
CC-4	Throughout Proposed Scheme	Operation	Consideration of the use of construction materials with superior properties (such as increased tolerance to fluctuating temperatures) to be included within detailed designs.	To reduce the vulnerability of the Proposed Scheme to climate change risks.	None required.	None required.
CC-5	Throughout Proposed Scheme	Operation	Consideration of climate change projections within maintenance plans and drainage systems to protect against a return period of 1-in-100 years flood event.	To reduce the vulnerability of the Proposed Scheme to flooding.	None required.	None required.
CC-6	Throughout Proposed Scheme	Operation	Inclusion of flood compensation areas and compensatory floodplain within the design to account for future climate change.	To reduce the vulnerability of the Proposed Scheme to flooding.	None required.	None required.
CC-7	Throughout Proposed Scheme	Operation	Application of engineering design standards for safety of road users and structural stability.	To reduce the vulnerability of the Proposed Scheme to climate change risks.	None required.	None required.

Mitigation Item	Location/ Approximate Chainage	Timing of Measure	Description	Mitigation Purpose/ Objective	Specific Consultation or Approval Required	Potential Monitoring Requirements
CC-8	Throughout Proposed Scheme	Operation	Regular maintenance of assets.	To reduce the vulnerability of the Proposed Scheme to climate change risks.	None required.	None required.
CC-9	Throughout Proposed Scheme	Operation	Procedures in place for severe weather events including: <ul style="list-style-type: none"> • Identification of suitable network redundancies and diversion routes; • Emergency response and contingency plans; and • Standard operating procedures for use in the event of necessary road closure and/or traffic diversion. 	To reduce the vulnerability of the Proposed Scheme to climate change risks.	None required.	None required.

18.8 Residual Impacts

- 18.8.1 There will be unavoidable GHG emissions resulting from the construction and operation of the Proposed Scheme; however, none of the effects are likely to be significant.
- 18.8.2 The Proposed Scheme has the potential to be impacted by a changing climate during construction and operation; however, mitigation measures are in place to reduce these risks.

18.9 Statement of Significance

Construction

GHG Impact Assessment

- 18.9.1 The annual construction GHG emissions from the Proposed Scheme compared to the annual Scotland carbon budgets from 2021 to 2024 are presented in Table 18-16 'Construction GHG Emissions Compared to the annual Scotland Carbon Budgets'. As the annual GHG emissions from the Proposed Scheme from 2021 to 2024 are all less than 1% of the relevant annual Scotland carbon budgets, and less than 25,000 tCO₂e in any year of construction, the construction GHG impact is **minor** (not significant).

Table 18-16 Construction GHG Emissions Compared to the Annual Scotland Carbon Budgets

Carbon budget	Annual budget (tCO ₂ e)	Annual GHG Emissions from Proposed Scheme (tCO ₂ e)	% of Annual Carbon Budget
2021	39,495,000	4,830	0.0122%
2022	38,310,000	14,500	0.0378%
2023	37,161,000	14,500	0.0390%

Climate Change Resilience

- 18.9.2 Short-term effects during the construction of the Proposed Scheme are not considered likely to be significant due to when the construction period is expected to finish and the nature of the construction activities; which will be mitigated.

Operation

GHG Impact Assessment

- 18.9.3 The annual operational GHG emissions from the Proposed Scheme compared to the annual Scotland carbon budgets from 2024 to 2032 are presented in'. As the annual operational GHG emissions from the Proposed Scheme from 2024 to 2032 are less than 1% of the relevant annual Scotland carbon budgets and less than 25,000 tCO₂ in any given year, the operational GHG impact is **minor** (not significant) when compared against the existing carbon budgets. By 2039, there is likely to be a beneficial impact on GHG emissions from the Proposed Scheme operation, as emissions are expected to decrease due to an increase in speed i.e. reduced congestion and a decrease in vehicle kilometres travelled, as well as the anticipated improvement in vehicle emissions technology in line with Chapter 13 - Air Quality.

Table 18-17 Operational GHG emissions compared to the annual Scotland national budgets

Carbon budget	Annual budget (tCO ₂)	Annual GHG Emissions from Proposed Scheme (tCO ₂)	% of Annual Carbon Budget
2024	35,787,000	13,199	0.037%

Carbon budget	Annual budget (tCO ₂)	Annual GHG Emissions from Proposed Scheme (tCO ₂)	% of Annual Carbon Budget
2025	34,117,000	12,289	0.036%
2026	32,446,000	11,380	0.035%
2027	30,777,000	10,470	0.034%
2028	29,854,000	9,560	0.032%
2029	28,958,000	8,650	0.030%
2030	28,089,000	7,741	0.028%
2031	27,247,000	6,831	0.025%
2032	26,429,000	5,921	0.022%

Climate Change Resilience

- 18.9.4 The assessment of operational impacts and effects has considered the likelihood of climate events and hazards occurring, and the consequence of the potential impacts on disruption to the road network, taking account of the identified embedded and standard mitigation measures.
- 18.9.5 The findings of the assessment are presented in Table 18-18 'Summary of Impacts and Effects from Climate Change on the Proposed Scheme – Operational Phase' and these have concluded that no significant effects would occur to the Proposed Scheme in respect of climate change.

Table 18-18 Summary of Impacts and Effects from Climate Change on the Proposed Scheme – Operational Phase

Receptor	Climate event	Impact (climate event & hazard occurring together)	Embedded/ standard mitigation measure	Likelihood	Consequence	Significance of Effect
End-users (members of the public, commercial operators, etc) The assets and their operation, maintenance and refurbishment (i.e. pavements, structures, earthworks & drainage, technology assets, etc.)	Severe weather events	Health and safety risks to road users and disrupted and/or inaccessible network.	Identification of suitable network redundancies and diversion routes. Emergency response and contingency plans in place. Standard operating procedures in place for use in the event of necessary road closure and/or traffic diversion. Regular maintenance of drainage systems.	Low	Moderate adverse	Not significant
	Gradual climate change	Traffic related rutting and migration of materials	Consideration of the use construction materials with superior properties which offer increased tolerance to fluctuating temperatures.	Low	Minor adverse	Not significant
	Severe weather events					
	Increased frequency of heavy precipitation events	Damage to roads, cuttings and drainage systems due to flooding.	Consideration of climate change projections within maintenance plans and drainage systems to protect against a return period of 1-in-100 years flood event. Inclusion of flood compensation areas and compensatory floodplain within the design to account for future climate change. Regular maintenance of assets to detect deterioration and damage.	Medium	Minor adverse	Not significant
	Snow and ice Increased frequency of heavy precipitation events Increasing average temperatures and increasing frequency of hot days and heatwaves	Reduced pavement friction coefficient.	Consideration of the use of construction materials with superior properties which offer increased tolerance to fluctuating temperatures. Regular maintenance of assets to detect deterioration and damage and sweeping and cleaning to remove debris.	Low	Minor adverse	Not significant
	Increasing average temperatures and increasing frequency of	Material and asset deterioration due to high temperatures.	Consideration of use of construction materials with superior properties which offer increased tolerance to fluctuating temperatures.	Medium	Minor adverse	Not significant

hot days and heatwaves.		Regular maintenance of assets to detect deterioration and damage.			
Increasing average temperatures and increasing frequency of hot days and heatwaves.	Thermal expansion and movement of bridge joints and paved surfaces.	Consideration of use of construction materials with superior properties which offer increased tolerance to high temperatures. Regular maintenance of assets to detect deterioration and damage.	Low	Minor adverse	Not significant
Severe weather events	Reduced safety and visibility as a result of standing water	Regular maintenance and cleaning of drainage systems. Emergency response and contingency plans in place.	Low	Minor adverse	Not significant
Severe weather events	Safety risks due to snow and ice.	Road user warning systems in place. Ensure effective, essential winter maintenance. Emergency response and contingency plans in place. Standard operating procedures in place for use in the event of necessary road closure and/or traffic diversion.	Low	Minor adverse	Not significant

18.10 Compliance with Policies and Plans

18.10.1 An assessment of the compliance of the Proposed Scheme in relation to the policies and plans previously set out in Section 18.3 is summarised below.

Policies Regarding GHG Emissions

18.10.2 The Proposed Scheme aligns with applicable legislation and national, regional and local planning policy to minimise GHG emissions and support the transition to a low carbon economy.

18.10.3 As stated in Section 18.3, in September 2019, the Scottish Parliament passed the Climate Change Bill to amend the Climate Change (Scotland) Act 2009 to set a legally binding target for Scotland to reduce greenhouse gas emissions to net-zero by 2045. At this time, further policy and guidance on how net-zero carbon will be achieved has not yet been published, including amendments to carbon budgets. The assessment has therefore considered the current carbon budgets.

Policies Regarding Climate Change Resilience

18.10.4 The Proposed Scheme complies with applicable legislation and national, regional and local planning policy to reduce the vulnerability of the Scheme to the impacts of climate change, such as flooding. Appropriate mitigation measures have been identified in order to align with these.

18.11 Monitoring

18.11.1 As no significant effects have been identified for the climate assessment, no monitoring of significant effects is proposed.

18.11.2 The CEMP will set out details of the monitoring to be undertaken during the Scheme construction stage to determine whether the mitigation measures embedded in the Scheme design are being appropriately implemented. TS is committed to reducing carbon emissions and working closely with suppliers to reduce emissions from network related activity. As a requirement of the CEMP, energy consumption and materials use would be recorded and reported on an ongoing basis during the Scheme construction phase using the Transport Scotland Carbon Reporting Tool.

18.11.3 It is not considered practical to monitor GHG emissions from road users during the Proposed Scheme operational phase.

18.12 References

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