

CLIMATE READY SCOTLAND: Draft Second Scottish Climate Change Adaptation Programme Strategic Environmental Assessment Environmental Report

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Report prepared by:



Scottish Government
Riaghaltas na h-Alba
gov.scot

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Non-Technical Summary

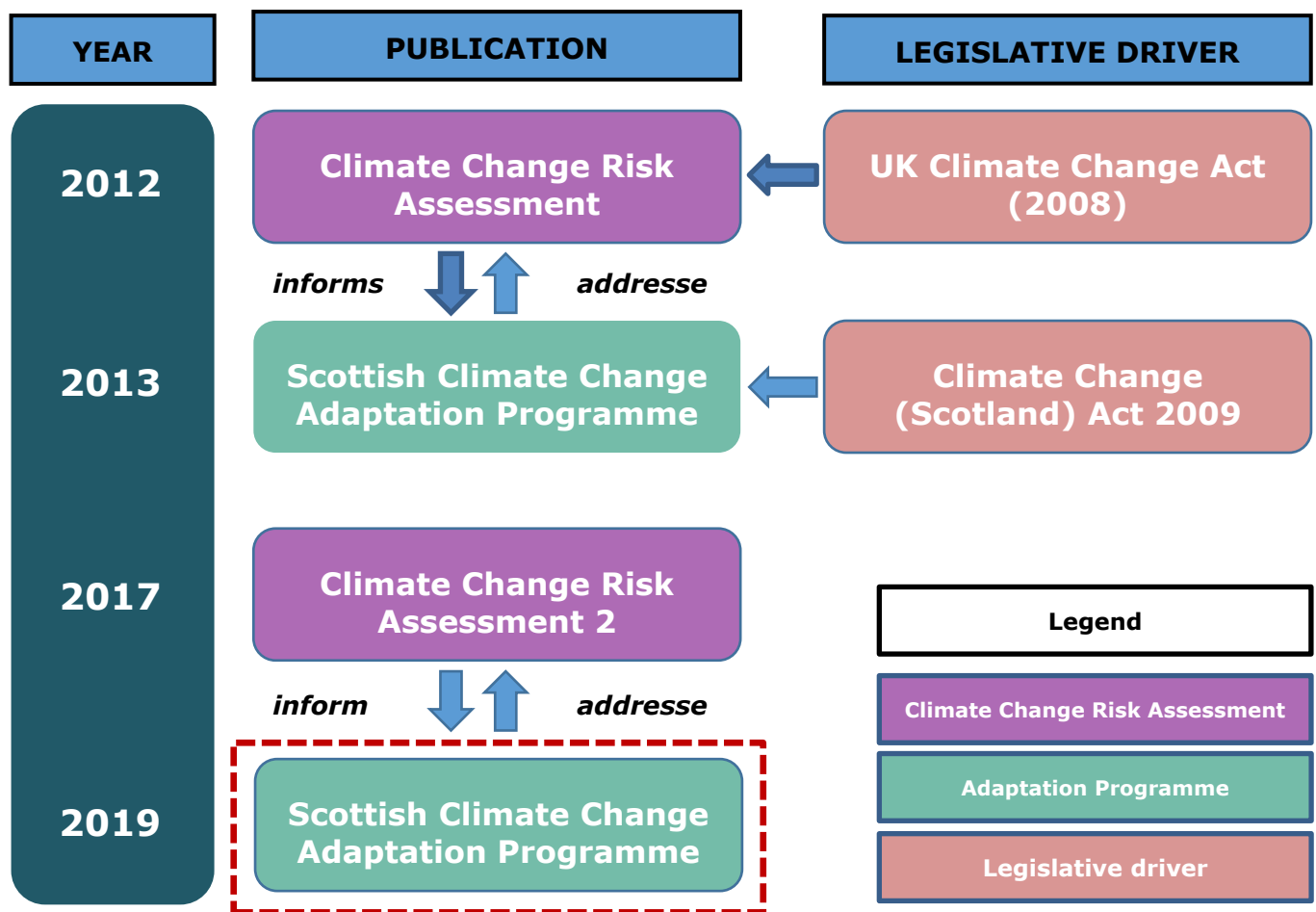
Introduction

The Climate Change (Scotland) Act 2009 (The 2009 Act) places a duty on Scottish Ministers to lay a programme for climate change adaptation before the Scottish Parliament as soon as reasonably practicable after each UK Climate Change Risk Assessment (CCRA) is published. The second CCRA¹ report was published in January 2017 and includes a summary report for Scotland setting out the Scotland-specific evidence.

The draft Second Scottish Climate Change Adaptation Programme ('the draft programme') is part of an iterative process, which builds on existing adaptation work including through the first Scottish Climate Change Adaptation Programme. Each successive programme is required to set out Scottish Ministers' objectives for adaptation to climate change and their proposals and policies for meeting those objectives. The draft programme's policy context is illustrated below:

¹ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report - Summary for Scotland [online] Available at: <https://www.adaptationscotland.org.uk/application/files/4314/7792/6358/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 04/12/2018)

Figure 1 The draft programme's policy context



The draft programme is intended to address the impacts identified in the second CCRA report made under the UK Climate Change Act (2008) (the 2008 Act). It is structured around a vision and seven high level outcomes which are underpinned by sub-outcomes and key policies. The draft programme does not itself set out new policies or proposals, but rather provides a high-level framework that draws together existing Scottish Government policies relating to climate change adaptation, and seeks to ensure that they take account of climate change adaptation. Where any future policies and proposals are developed, these will themselves be subject to consideration in accordance with the requirements of the Environmental Assessment (Scotland) Act 2005.

What is Strategic Environmental Assessment (SEA)?

Strategic Environmental Assessment (SEA) is a means of systematically assessing the likely impact of a public plan on the environment and to seek ways to avoid, or minimise where possible adverse effects, if likely to be significant. SEA provides an opportunity for the public to consider this information and to use it to inform their views on the emerging draft programme.

This Environmental Report has been published alongside the draft Scottish Climate Adaptation Programme and has been prepared in accordance with the Environmental Assessment (Scotland) Act 2005. Views are invited on both the Environmental Report and the Position Statement.

What is the environment like today and how is it changing?

A summary of the environment and how it is changing is provided below

CLIMATIC FACTORS

- The climate is changing and projections suggest observed trends will continue to intensify into the future. These include:
 - projected increases in temperature;
 - drier summers and wetter winters;
 - more seasonal rainfall; and
 - increased risk of flood, drought, and extreme weather events.

AIR

- Urban air quality has improved significantly since the 1950s; however, poor air quality continues to affect human health and the environment in some areas.
- Air pollution can contribute to a number of health problems and climate change may exacerbate these issues.
- Climate change could alter current patterns and concentrations of air pollution.

MATERIAL ASSETS

- Agriculture is the most common type of land use in Scotland.
- Other significant land and water based industries are aquaculture, forestry, transport, and energy.
- Agriculture and forestry are closely linked to climate and climate change poses both risks and opportunities.
- Energy generation (particularly from renewable sources) could be negatively impacted.
- An increase in extreme weather events could damage transport infrastructure and disrupt operations.

POPULATION AND HUMAN HEALTH

- Scotland's population is approx. 5.4 million and the majority of people live in urban areas.
- Climate change may impact different groups of people in different ways. Some communities are recognised as being more vulnerable to negative impacts of climate change.
- The health-related impacts of climate change are likely to be disproportionately felt by deprived areas.
- Warmer winters and increase participation in outdoor activities could result in health benefits.

WATER

- Scotland's water provides a range of benefits including the provision of drinking water, recreation, and support for industries.
- It also hosts a range of habitats and nationally and internationally important species.
- The water environment is at risk from physical modifications, declines in water quality, and increased water demand.
- Climate change may exacerbate flooding, poor water quality, damage water habitats and species, and threaten industry and health.

CULTURAL HERITAGE

- Includes some assets protected through designation; however, most (90-95%) are undesignated.
- Key pressures include development, maintenance, and land use change.
- Climate change may accelerate weathering and erosion processes, increasing maintenance demands
- There is a need to protect cultural heritage assets and their settings from direct and indirect impacts of climate change.
- Rising sea levels mean that coastal erosion is becoming an increasing threat to heritage assets.

LANDSCAPE

- Scotland is famous for its distinctive and diverse landscapes.
- Landscapes of the highest quality have been designated and include 40 National Scenic Areas and two National Parks.
- Key risks to the landscape include climate change, development, and changes in land use.
- The magnitude of predicted climate change effects and responses to it will be a key factor influencing further change.

BIODIVERSITY, FLORA AND FAUNA

- Both designated sites and undesignated areas (such as urban parks and gardens) in Scotland contain important biodiversity assets.
- Climate change could result in the loss of certain habitats and species, alter migration and breeding cycles, and affect food supplies.
- Other indirect impacts on biodiversity are also likely (for example, due to changes in land use) as society adapts to face a changing climate.

SOIL

- Scotland's soils store over 3,000 million tonnes of carbon.
- Soil is at risk from a number of threats which could impact its functionality or result in its irretrievable loss. These include erosion, changing vegetation, acidification, compaction, loss of organic matter, and sealing by development.
- Climate change threatens to promote soil carbon loss.
- Certain soil management interventions can be used to slow or even reverse climate change.

What are the conclusions of the assessment?

This assessment concludes that the high-level outcomes based approach is likely to have **significant positive effects on climatic factors** by drawing together relevant adaptation measures to maximise their impact, capitalise upon synergies and address any gaps.

This approach to climate change action can also optimise environmental benefits across the range of SEA Topics and **positive effects** on all other **SEA topics (including biodiversity, population and human health, air, soil, water, material assets, cultural heritage and landscape)** are considered likely, the effects of which are only likely to be fully realised in the medium to long term.

The potential for effects in combination with other plans, programmes and strategies has also been considered. The draft programme has the potential to **positively** and **cumulatively** contribute across a wide range of Scottish Government policy areas within the context in which it sits. Adaptation is captured across the breadth of a range of national plans, policies and programmes and these are recognised under the adaptation framework. Taking into account the high-level nature of the draft programme there is however an inherent degree of uncertainty regarding the environmental impacts that may arise as a result of future actions undertaken to support adaptation outcomes. The assessment also identifies the potential for **mixed / uncertain effects** arising from future actions at a local level, across the majority of the **SEA topics**.

What are the opportunities for enhancement?

The SEA findings support the greater policy alignment of action with wider Scottish Government policy objectives to maximise potential benefits from climate change action.

The SEA findings also support the inclusion of outcomes that support cross sector cooperation and opportunities to realise multiple environmental benefits.

The SEA findings support the inclusion of an outcome with a focus on marine and coastal environments as these areas are likely to be more vulnerable to the negative impacts of climate change.

The following specific opportunities for enhancement are identified:

To obtain the maximum environmental benefits of **Outcome 1** a focus could be given to actions which support consideration of differing needs of communities and which seek to protect vulnerable cultural heritage assets. Specifically, a focus could be given to actions that support the differing needs of remote rural, coastal communities

and deprived areas that are recognised as being more vulnerable to negative impacts of climate change due to pre-existing inequities and flood disadvantage.

Measures identified under **Outcome 1** that support adaptation of buildings in response to climate change have the potential to help address existing risks to people from cold temperatures through addressing fuel poverty. This is also relevant to **Outcome 2** below.

To obtain the maximum environmental benefits of **Outcome 2** a focus could be given to actions which support people living in deprived and isolated areas which may be more vulnerable to negative impacts due to pre-existing health problems and inequalities.

To obtain the maximum environmental benefits of **Outcome 3** a focus could be given to actions which support locations and infrastructure which are recognised as more vulnerable to the impacts of climate change including coastal and isolated locations and power, fuel supply and Information and Communications Technology (ICT) Infrastructure.

To obtain the maximum environmental benefits of **Outcome 4** a focus could be given to supporting systems which may be more vulnerable to the identified negative impacts of climate change. For example isolated communities, systems at risk from increased flooding, and those at growing risk from heat, water scarcity and slope instability.

To obtain the maximum environmental benefits of **Outcome 6**, a focus could be given to actions which support measures for marine heritage to adapt to climate change.

What are the proposals for mitigation?

Where future actions have the potential to result in uncertain/mixed adverse effects further consideration should be given to opportunities to mitigate any such effects at individual project level. There are existing controls in place through the relevant consenting procedures that can help to address these.

Six outcomes identify adaptation behaviours. This is the idea that individuals and organisations can alter their behaviour to help increase their resilience to, and reduce the severity of, some of the worst climate change impacts affecting Scotland. Whilst it is recognised that adaptation behaviours vary hugely in scale and scope, they are broadly likely to contribute to positive effects on climatic factors. This is because these behaviours, to make informed decisions on how to adapt to climate change, support a greater understanding of climate change and its impacts (as well as providing direct mitigation to its impacts).

Finally, the SEA findings support outcomes that focus on increased understanding and awareness of climate change adaptation. This is because adaptation strategies will benefit from relevant research and awareness raising to ensure resources continue to be appropriately directed and to help avoid unintended secondary adverse environmental effects.

What are the proposals for monitoring?

A wide range of existing programmes are in place at the national and local level to report on environmental status and assess performance against established environmental indicators. For example, Scottish State of the Environment Reports are produced every three years.²

Further, given that the programme itself seeks to coordinate the delivery of existing plans, programmes and strategies across various sectors monitoring of these existing plans, programmes and strategies is also relevant. The Climate Change Plan, for example, includes a monitoring framework that includes output and implementation indicators across a range of environmental topics.

Requirements for monitoring the Adaptation programme are set out in the The 2009 Act which requires an annual report on progress.

The 2008 Act includes provision that a UK CCRA must take place every five years. Under the 2009 Act, a Scottish adaptation programme is required to address impacts and opportunities identified in progressive CCRA's and hence this adaptation programme will be reviewed on a five year basis. This will identify changes in the evidence base for the impacts of climate change to be reflected in future Adaptation programmes.

In its recommendations in the 2016 assessment of progress on climate change adaptation in Scotland, the Adaptation Committee of the UK Committee on Climate Change (ACC) said that the Scottish Government, in preparing the second adaptation programme, should 'introduce an effective monitoring regime to allow impact of actions and delivery of each objective to be properly assessed'.

The first Scottish Adaptation programme established a framework of over 100 indicators to assist monitoring and evaluation and independent assessment. The intention is to establish a comprehensive new framework for the second programme. This new framework for monitoring and reviewing the Adaptation programme provides a mechanism for assessing progress and identifying any additional impacts. It is therefore proposed that the monitoring for the SEA is an integral part of the monitoring for the Adaptation programme.

² Scottish Government (2014) Scotland's State of the Environment Report, 2014 [online] Available at: <https://www.environment.gov.scot/media/1170/state-of-environment-report-2014.pdf> (accessed 07/02/2019)

What reasonable alternatives have been considered?

The 2005 Act requires the Environmental Report to identify, describe and evaluate the likely significant effects on the environment of the reasonable alternatives to the plan or programme, taking into account its objectives and geographical scope. The extent to which alternatives for the programme could be considered reasonable was influenced by the relevant legislative requirements, the inherent uncertainty associated with predicting the impacts of climate change, and the significant proportion of committed policy and action embodied in the draft programme. The following alternatives were not considered reasonable:

- **‘Do nothing’ scenario:** This is not a reasonable alternative because the requirement for the programme is established in legislation and because it would not address the risks posed by climate change.
- **Theme based approach** (in keeping with SCCAP1) or a **sector based approach:** These approaches were not considered as reasonable alternatives because the actual content of the programme would not be sufficiently different to generate different environmental effects.

In keeping with the Scottish Government’s general move to an outcomes focus, the draft programme takes an outcome-led approach. This approach was recommended by the Committee on Climate Change’s Adaptation Committee as an opportunity to build on and improve upon the framework set by SCCAP1, and to align with the most recent consultation on national outcomes.

How to comment on the Environmental Report

We are inviting responses to this consultation by Tuesday 9 April 2019.

Please respond to this consultation using the Scottish Government's Consultation Hub, Citizen Space (<http://consult.gov.scot>). Access and respond to this consultation online at climatechangeadaptation@gov.scot

You can save and return to your responses while the consultation is still open.

Please ensure that consultation responses are submitted before the closing date of Tuesday 9 April 2019.

If you are unable to respond using our consultation hub, please complete the Respondent Information Form in Annex C and return it, together with your response to:

Climate Change Adaptation Consultation
Climate Change Adaptation Team, 3F South
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

Handling your response

If you respond via our online Consultation Hub (<http://consult.scotland.gov.uk/>), you will be directed to the About You page before submitting your response.

Please indicate how you wish your response to be handled and, in particular, if you are content for your response to be published. If you ask that your response is not published, we will regard it as confidential, and treat it accordingly.

All respondents should be aware that the Scottish Government is subject to the provisions of the Freedom of Information (Scotland) Act 2002 and would therefore have to consider any request made to it under the Act for information relating to responses made to this consultation exercise.

To find out how we handle your personal data, please see our privacy policy: <https://beta.gov.scot/privacy/>

1 Scottish climate change adaptation

1.1 Introduction

- 1.1.1 The Climate Change (Scotland) Act 2009 (The 2009 Act) places a duty on Scottish Ministers to lay a programme for climate change adaptation before the Scottish Parliament as soon as reasonably practicable after publication of each UK Climate Change Risk Assessment (CCRA).
- 1.1.2 The first Scottish Climate Change Adaptation Programme (SCCAP1) was structured around three cross-sectoral themes and addressed the risks identified by the first CCRA³. The draft Second Scottish Climate Change Adaptation Programme ('the draft programme') is part of an iterative process which follows on from SCCAP1, with each successive programme required to set out Scottish Ministers' objectives for adaptation to climate change and their proposals and policies for meeting those objectives. The draft programme is intended to address the impacts identified in the second CCRA,⁴ as well as the related summary report for Scotland⁵ as required by section 56 of the UK Climate Change Act (2008) (the 2008 Act).
- 1.1.3 The 2009 Act also requires the Committee for Climate Change's Adaptation Committee (ASC) to prepare a report, commissioned by Scottish Ministers within two years of each programme, setting out its independent assessment of progress on the Scottish programme. In the ASC's Independent Assessment in 2016 it recognised SCCAP1 as a positive start in taking steps to prepare for climate change. A further independent assessment will report in March 2019.
- 1.1.4 The draft programme's policy context and legislative drivers are illustrated by **Figure 2** below.
- 1.1.5 The draft programme is structured around a vision and seven high-level outcomes which are underpinned by sub-outcomes, policies and proposals.

³ Defra (2012) UK Climate Change Risk Assessment: Government Report [online], Available at: <https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report> (accessed 18/12/2018)

⁴ Defra (2017) UK Climate Change Risk Assessment 2017 [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf (accessed 06/08/2018)

⁵ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report - Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 10/12/2018)

1.1.6 This outcomes-based approach is derived from both the UN Sustainable Development Goals and Scotland’s National Performance Framework. The draft programme will coordinate the delivery of existing plans, programmes, and strategies across relevant sectors to maximise their impact, capitalise upon synergies, and address any gaps. The programme’s structure and approach is illustrated by the following figure:

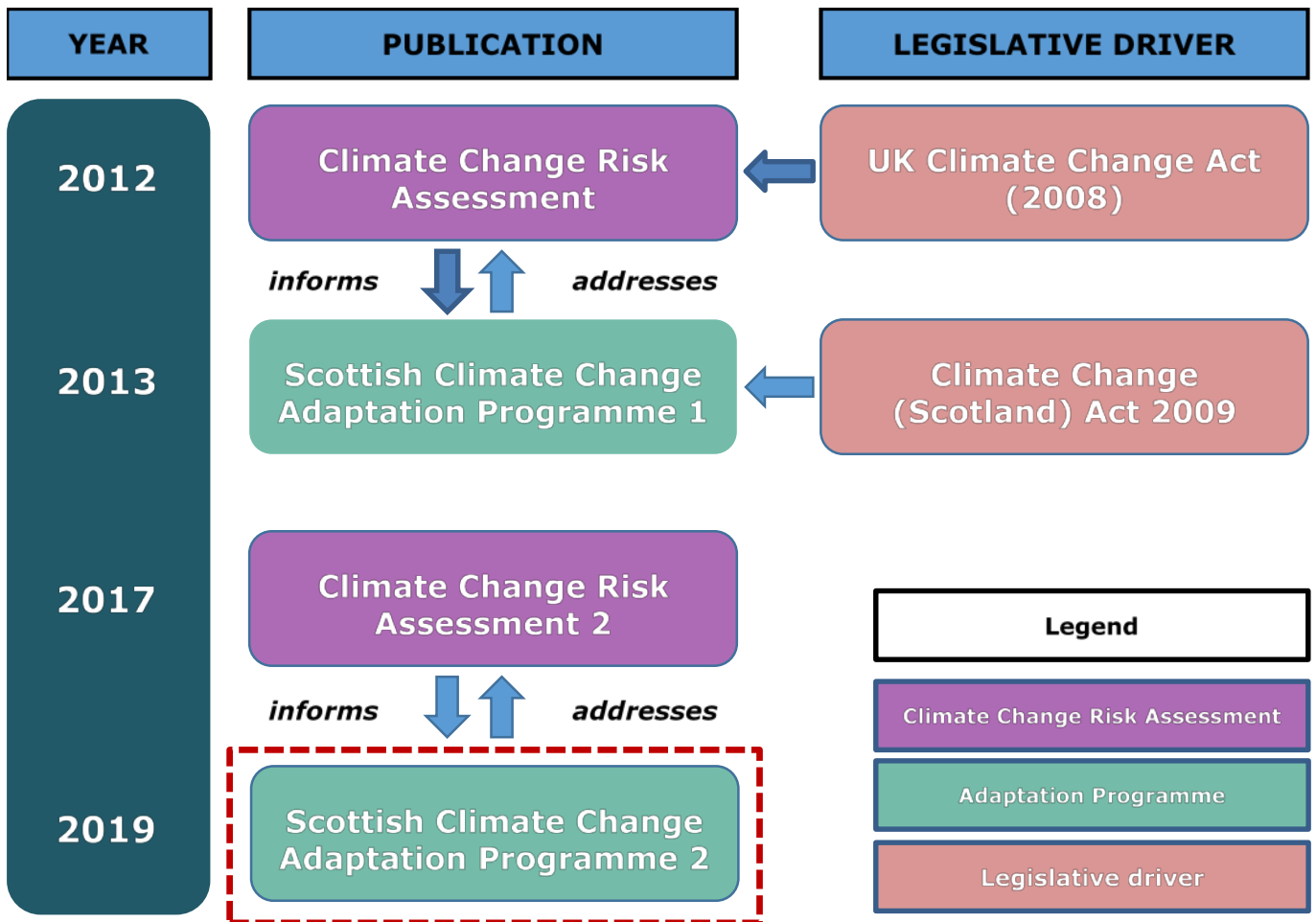


Figure 2 The draft programme's policy context



Figure 3 Structure and approach of the draft programme

2 Approach to the environmental assessment

2.1 Purpose of the Environmental Report and key facts

- 2.1.1 As part of the preparation of the draft programme the Scottish Government (SG) is carrying out a Strategic Environmental Assessment (SEA) of its proposed content. SEA is a systematic method for considering the likely environmental effects of certain plans, programmes and strategies.
- 2.1.2 SEA is required by the Environmental Assessment (Scotland) Act 2005 (The 2005 Act), and involves the following key stages:

Screening – determining whether the plan is likely to have significant environmental effects and whether an SEA is required;

Scoping – establishing the method for the assessment and setting out the consultation period for the plan;

Environmental Report – assessing the emerging content of the plan and setting out the likely significant environmental effects, and publishing the Environmental Report alongside the consultation on the plan; and

Adoption – preparing and publishing a post-adoption statement.

2.2 SEA activities to date

- 2.2.1 Screening and scoping of the draft programme was undertaken in September 2018 and a combined screening and scoping report was submitted to the SEA gateway inviting views from the consultation authorities. This determined that an SEA was required as due to the potential for significant positive and negative environmental effects. All of the SEA topics (climatic factors, biodiversity including flora and fauna, population and human health, soil, water, air, material assets, cultural heritage and landscape) were scoped into the assessment. The comments received have been taken into account in the preparation of the Environmental Report.

2.3 Developing a methodology

- 2.3.1 The assessment methodology has been refined from that originally identified within the scoping report, which proposed a focused set of SEA objectives. The finalised approach (see table 1 below) has been developed to better reflect the high-level nature of the emerging draft programme. It draws on experience gained from other relevant SEA work including that undertaken on SCCAP1.
- 2.3.2 Key stages in the assessment methodology are illustrated in the following table.

Table 1 Key stages in assessment methodology

Stage 1	1. Identify impacts of climate change from CCRA and other relevant environmental information to inform the Environmental Baseline
Stage 2	2. Review and collate findings of previous relevant SEA Environmental Reports and summarise key findings to provide an overview of known environmental effects.
Stage 3	3. Assess environmental effects of draft programme including identifying: <ul style="list-style-type: none"> • Likely significant environmental effects of the draft programme; and • To what extent the draft Programme addresses key environmental impacts identified.
Stage 4	4. Consider potential cumulative and synergistic impacts.
Stage 5	5. Recommendations for enhancing environmental benefits of the draft programme were used to inform the draft adaptation programme.

2.3.3 Early assessment work considered key environmental impacts of climate change on SEA topics from the CCRA and other environmental information to inform the development of the environmental baseline.

2.3.4 The emerging SEA baseline was used to inform discussions at six outcome workshops held during October, November and December 2018. The written outputs of these workshops were then fed into the development of the draft programme.

2.3.5 A review of the following SEA Environmental reports was undertaken to identify known environmental effects:

- Scotland’s Climate Change Adaptation Framework⁶
- Scotland’s Climate Change Adaptation Framework Sector Action Plans⁷;
- First Scottish Climate Change Adaptation Programme ⁸;
- The Climate Change Bill⁹;

⁶ Land Use Consultants (2009) Preparing for a Changing Climate: Scotland’s Climate Change Adaptation Framework Strategic Environmental Assessment Environmental Report [online] Available at: <https://www2.gov.scot/seag/seagDocs/SEA-00254/6735.pdf> (accessed 03/12/2018)

⁷ Scottish Government (2010) Adapting to the Changing Climate: Consultation on the Environmental Impacts of Adaptation [online] Available at: <https://www2.gov.scot/seag/seagDocs/SEA-00531/10251.pdf> (accessed 03/12/2018)

⁸ Scottish Government (2013) Climate Ready Scotland: Draft Scottish Climate Change Adaptation Programme - Strategic Environmental Assessment Environmental Report [online] Available at: <https://www2.gov.scot/seag/seagDocs/SEA-00708/14347.pdf> (accessed 27/11/2018)

⁹ Scottish Government (2017) Proposals for a New Climate Change Bill Strategic Environmental Assessment Environmental Report [online] Available at: <https://www2.gov.scot/seag/seagDocs/SEA-01269/20084.pdf> (accessed 27/11/2018)

- The Climate Change Plan/Energy Strategy.¹⁰
- 2.3.6 The finalised assessment takes the form of a broad narrative analysis of the draft programme. The key findings consider the likely significant effects of the draft programme and its overall effectiveness in addressing the key climate change impacts. This is discussed in turn for each of the seven high-level outcomes and their sub-outcomes. This approach provides a useful cross-check to ensure climate change impacts are addressed as fully and effectively as possible. Potential cumulative and synergistic impacts have also been considered. Opportunities to enhance environmental benefits have also been included, where identified.

2.4 Alternatives

- 2.4.1 The 2005 Act requires the Environmental Report to identify, describe and evaluate the likely significant effects on the environment of the reasonable alternatives to the plan or programme, taking into account its objectives and geographical scope. The extent to which alternatives for the programme could be considered reasonable was influenced by the relevant legislative requirements, the inherent uncertainty associated with predicting the impacts of climate change, and the significant proportion of committed policy and action embodied in the draft programme. The following alternatives were not considered reasonable:
- **‘Do nothing’ scenario:** This is not a reasonable alternative because the requirement for the programme is established in legislation and because it would not address the risks posed by climate change.
 - **Theme based approach** (in keeping with SCCAP1) or a **Sector based approach:** These approaches were not considered as reasonable alternatives because the actual content of the programme would not be sufficiently different to generate different environmental effects.
- 2.4.2 In keeping with the Scottish Government’s general move to an outcomes focus, the draft programme takes an outcome-led approach. This approach was recommended by the Committee on Climate Change’s Adaptation Committee as an opportunity to build on and improve upon the framework set by SCCAP1, and to align with the most recent consultation on national outcomes.¹¹

2.5 Risks/potential limitations of the assessment

¹⁰ Scottish Government (2017) Draft Climate Change Plan: The Draft Third Report on Policies and Proposals 2017 - 2032 and Draft Scottish Energy Strategy: The Future of Energy in Scotland Strategic Environmental Assessment Environmental Report [online] Available at: <https://www2.gov.scot/seag/seagDocs/SEA-01225/19468.pdf> (accessed 27/11/2018)

¹¹ Committee on Climate Change Adaptation Committee, Letter-ASC-to Scottish Government – SCCAP [online], Available at: <https://www.theccc.org.uk/publication/asc-writes-to-scottish-government-about-outcomes-based-approach-for-the-sccap> (accessed 10/02/2019)

- 2.5.1 As the assessment progressed, the approach taken was simplified in order to provide clear findings and the assessment underwent continual adjustment to reflect the emerging content of the draft programme.
- 2.5.2 Given the subject matter and taking into account the high-level nature of the draft programme there is an inherent degree of uncertainty regarding both the effects of climate change and of the draft programme across all the SEA topics.

3 Baseline and environmental problems

3.1 Introduction

- 3.1.1 The 2005 Act requires that the Environmental Report includes a description of the relevant aspects of the current state of the environment and its likely evolution without implementation of the draft programme. It also requires that a description of existing environmental problems be provided, in particular those relating to any areas of environmental importance.
- 3.1.2 Section 3 presents high-level summaries of the key existing environmental problems relevant to the plan for each of the SEA topic areas, as well as how the environment is likely to evolve in the absence of the draft programme. A more detailed account of the environmental baseline is provided in **Appendix B**.
- 3.1.3 In addition, previous relevant SEA work (listed in paragraph 2.3.5) was reviewed to see what could be learnt. A summary of this desk study is presented in Table 2; a more thorough compilation of relevant findings under each SEA Topic headings can be found in **Appendix C**.

Table 2 Summary of relevant findings from recent SEA work of relevance

Summary of relevant findings from previous SEA Environmental Reports
<ul style="list-style-type: none">• Aspects of the environment that are under pressure from climate change may benefit from focused activity that not only reduces the negative impacts of this change, but also gives rise to further benefits. (SCCAP1 SEA)• In many cases, impacts arising from adaptation actions will be indirect in nature. (Climate Change Adaptation Framework SEA)• The cross-cutting nature of climate change and the implications of adaptation actions across the SEA topics can result in significant interplay. Cooperation between sectors can enhance benefits and help to harmonise potentially competing outcomes. (Climate Change Adaptation Framework SEA)• Adaptation strategies should involve an element of data gathering and awareness raising to ensure resources continue to be appropriately directed and to help avoid unintended secondary adverse impacts. (Climate Change Adaptation Framework SEA)• Environmental benefits can be optimised by climate change action being brought into line with overarching Scottish Government objectives. (Climate Change Bill SEA)

3.2 Climatic Factors

3.2.1 The following tables summarise key environmental problems by SEA topic. Further detail is provided in Appendix C, in relation to each SEA topic area.

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> Projections of future climatic change in Scotland highlight increases in temperature, drier summers, wetter winters, more seasonal rainfall, and increased risk of flood, drought, and extreme weather events as key outcomes. 	<p>The main climate change trends are expected to continue. Without adequate planning, adaptation would be ad hoc, reactive, and is likely to lead to worse outcomes than a collaborative approach that focuses on results, performance, and measurement.</p>

3.3 Biodiversity

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> Loss of and changes to certain habitats and species (including designated areas and priority species). Changes in species migration and impact on breeding cycles and food supplies (e.g. risks to coastal habitats from sea level rise and risk to species from flooding and water temperature rise). Indirect impacts on biodiversity (e.g. from changes in land use, as other activities adapt to face a changing climate). 	<p>Without the draft programme, there may be a lack of integration of biodiversity into adaptation activities and poorer coordination and focus in new research. Given the importance of considering biodiversity as a network, and as part of a wider ecosystem this could result in greater habitat fragmentation and biodiversity loss.</p>

3.4 Population and Human Health

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> Climate change may impact different groups of people in different ways (e.g. some remote rural, coastal and deprived communities are recognised as being more vulnerable to negative impacts of climate change due to pre-existing inequities). The health-related impacts of climate change are likely to be disproportionately felt by deprived areas (e.g. algal and fungal growth in poor quality or 	<p>Without the draft programme, there is likely to be a range of activity implemented to address the effects of extreme weather, minimise public health risks from disease, and improve housing quality.</p> <p>However, the absence of a coherent adaptation programme could mean that gaps arise in linking these measures with adaptation activities for</p>

<p>inadequately heated housing could increase).</p> <ul style="list-style-type: none"> • Potential opportunities may include health benefits from warmer winters and increased participation in outdoor activities. 	<p>other sectors, in order to secure more beneficial outcomes.</p>
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3.5 Soil

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> • The future management of our soils is vital because projected climate change threatens to promote conditions in which loss of soil carbon becomes more likely. • Soil is at risk from a number of existing threats including loss of organic matter, erosion, changes in vegetation, and soil sealing from development. • Certain management interventions in peatlands, forests, and agricultural soils could contribute to slowing or even reversing climatic change. 	<p>Adaptation responses will need to support opportunities to keep carbon in our soils.</p> <p>Adaptation responses that support management interventions in soil that could contribute to slowing or even reversing climatic change should be encouraged.</p>

3.6 Water

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> • The water environment is at risk from modifications to water courses, areas with poor water quality and increased water demand. • Climate change impacts have the potential to exacerbate poor water quality, damage water habitats and species and threaten industry and health. 	<p>A range of strategies are in place to improve the water environment, by restoring natural processes, managing non-native species, flood risk, water quality, supply and demand.</p> <p>Without the draft programme, opportunities to link adaptation of the water environment with wider priorities such as health and biodiversity may be missed.</p>

3.7 Air

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> • Air pollution can contribute to a number of health problems and climate change may exacerbate these issues. • Climate change could alter current 	<p>Environmental trends suggest that increasing concentrations of air pollution may take place in the future.</p> <p>Climate changes such as higher</p>

patterns and concentrations of air pollution.	humidity, could increase this risk. The absence of adaptation measures to address impacts could lead to further risks to the environment, population and human health.
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3.8 Material Assets

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> • Changes in climate have the potential to impact on material assets in a number of ways. • Agriculture and forestry are very closely linked to the climate and climatic change may result in risks and opportunities (e.g. risks such as new pests and diseases and opportunities for increased yields and carbon storage from increasing temperatures). • In relation to energy assets, extreme weather changes may pose risks to existing and planned offshore renewable energy infrastructure, although further research is needed to determine what kind of impacts are likely. • An increase in extreme weather events could damage transport infrastructure and cause disruptions to road and rail operations 	<p>Agriculture, forestry, and infrastructure will need to adapt to climate change impacts.</p> <p>Without the draft programme, there is a lack of an overarching framework to bring together impacts of adaptation across these material assets, and to anticipate and address issues before they arise.</p>

3.9 Cultural Heritage

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> • Most of Scotland’s Historic Assets are undesignated. • Key risks affecting the historic environment include development pressures, maintenance, land use and climate change. • Climate changes will potentially accelerate weathering and erosion processes increasing the maintenance demands on historic buildings and structures (both designated and undesignated). • There is a need to protect cultural heritage assets and their settings from direct and indirect impacts of climate change. • Rising sea levels mean that coastal erosion is becoming an increasing threat to heritage assets. 	<p>Increased maintenance demands and physical risks to the historic environment are likely as a result of climate change.</p> <p>Without the draft programme, there is likely to be less co-ordination and management of risks, with more extensive and expensive remediation measures being required at a later stage.</p>

3.10 Landscape

Environmental Problems	Likely evolution without implementation of the draft programme
<ul style="list-style-type: none"> • Key risks to the landscape include the direct effects of climate change, as well as from development and changes in land use. • Landscape may change as a direct result of climate change (e.g. coastal and river flooding and erosion. It may also change as an indirect result of climate change (e.g. spread of pests and pathogens, could alter vegetation and land cover). • Change in land cover and land use will continue to occur into the future and the magnitude of climate change (and responses to it) will be a key factor in influencing this change. 	<p>Landscape change is likely as a result of direct effects of climate change and the indirect effects of adaptation and mitigation.</p> <p>Some actions to support adaptation in other sectors could have impacts on landscapes. Without the programme, opportunities to balance the consideration of landscape with wider objectives could be missed.</p>

3.11 Summary of the likely evolution of the environment without implementation of the draft programme.

- 3.11.1 The Adaptation programme has a key role to play in ensuring that sufficient actions are in place to address climate change risks and opportunities. The draft programme brings together under one overarching framework existing high-level policies and proposals that support adaptation. As a result, the evolution of the environment without the document will not be significantly different in the immediate term. However, in the longer term, each successive Adaptation programme will provide a co-ordinated and systematic approach to addressing the impacts of climate change against which progress can be monitored and reported. The new programme will take an outcomes-based approach, one that is derived from both the UN Sustainable Development Goals and Scotland's National Performance Framework. This approach seeks to deliver a step change in collaboration and bring a focus on results, performance, and measurement and a significant advance on our previous sector-based or risk-based approaches. The new programme will, for the first time, explore behaviour change - how we steer people and businesses towards the more important choices. Behaviour change has been widely used in climate change mitigation and is potentially as relevant to adaptation. Overall, most effects of the programme are expected to be significant, but will emerge more clearly in the medium to long term.

3.12 The Regulatory Framework

- 3.12.1 There are a range of regulatory controls in place which may apply to climate change adaptation measures at the project level. These could include listed buildings and scheduled monuments consent; planning and consenting processes; marine licencing; Environmental Impact Assessment; Habitats Regulations Appraisal. These mitigation measures have been taken into account in the assessment of significant effects as 'assumed mitigation'. Ensuring appropriate design and construction management measures are implemented at project level can also help minimise potential impacts to nearby receptors.

3.13 Relationship with other Plans, Programmes, and Strategies

- 3.13.1 As required by Schedule 3 of the Environmental Assessment (Scotland) Act 2005, the wider plans, programmes and strategies to which the Adaptation programme relates have been reviewed and summarised in the following table.

Table 3 Relationship between the draft programme and other plans, programmes, and strategies

Plan, Programme or Strategy	Summary
UK Climate Change Act 2008 ('the 2008 Act') ¹²	<ul style="list-style-type: none"> • Basis for the UK's approach to tackling climate change mitigation and adaptation. • The Act requires CCRA to be prepared, the latest of which will inform the draft programme.
UK Climate Change Risk Assessment 2012 ¹³	<ul style="list-style-type: none"> • First CCRA produced in response to the requirements of the 2008 Act. • Identified main priorities for adaptation in the UK, focusing on five themes: agriculture and forestry; business, industries, and services; health and wellbeing; buildings and infrastructure; and natural environment.
UK Climate Change Risk Assessment 2017 ¹⁴	<ul style="list-style-type: none"> • Updates the 2012 CCRA. • Outlines UK and Devolved Governments' views on the key climate change risks and opportunities that the UK faces. • Endorses six priority risk areas identified in the independent evidence report by the Adaptation Committee: from flooding and coastal change; to health and well-being from high temperatures; due to water shortages; to natural capital; to food production and trade; from pests and diseases and invasive non-native species. • Scotland-specific evidence has also been collated into a 'Scotland Report'.
UK Climate Projections 2018 ¹⁵	<ul style="list-style-type: none"> • Explores how the UK's climate could change over the next century under three different greenhouse gas emissions scenarios including temperature, rainfall, and sea level rise forecasts. • Serves to equip the UK with information to help adapt to the challenges and opportunities of climate change.
Climate Change (Scotland) Act 2009 ¹⁶	<ul style="list-style-type: none"> • Sets the statutory framework for greenhouse gas emissions reductions. • Scottish Ministers are required to report regularly to the Scottish Parliament on emissions and progress being made towards targets set in the Act and in secondary

¹² Climate Change Act 2008, c. 27 [online] Available at: <https://www.legislation.gov.uk/ukpga/2008/27/introduction> (accessed 31/01/2019)

¹³ Defra (2012) UK Climate Change Risk Assessment: Government Report [online] Available at: <https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-government-report> (accessed 31/01/2018)

¹⁴ Defra (2017) UK Climate Change Risk Assessment 2017 [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf (accessed 31/01/2018)

¹⁵ Met Office (2018) UK Climate Projections [online] Available at: <https://www.metoffice.gov.uk/research/collaboration/ukcp> (accessed 31/01/2018)

¹⁶ Climate Change (Scotland) Act 2009, asp 12 [online] Available at: <https://www.legislation.gov.uk/asp/2009/12/introduction> (accessed 31/01/2019)

Plan, Programme or Strategy	Summary
	<p>legislation.</p> <ul style="list-style-type: none"> • The draft programme is a requirement of the Act.
<p>Low Carbon Scotland – Meeting the Emissions Reduction Targets 2010-2022: Report on Proposals and Policies (RPP1)¹⁷</p>	<ul style="list-style-type: none"> • Laid out specific measures for reducing emissions in line with statutory targets for the period 2010-2022. • Structured around key sectors of energy supply, homes and communities, business and the public sector, transport, rural land use, and waste.
<p>Low Carbon Scotland – Meeting Our Emissions Reduction Targets 2013-2027: Second Report on Proposals and Policies (RPP2)¹⁸</p>	<ul style="list-style-type: none"> • Laid out specific measures for reducing emissions in line with statutory targets for the period 2013-2027. • Structured around the same key sectors as RPP.
<p>Climate Change Plan - Third Report on Proposals and Policies (2018-2032) (RPP3)¹⁹</p>	<ul style="list-style-type: none"> • Sets out actions towards a low carbon economy in the context for the Scottish Government’s climate change proposals and policies and its statutory duties. • Provides information on sector emissions envelopes and reduction trajectories.
<p>Annual Progress Report to Parliament²⁰</p>	<ul style="list-style-type: none"> • Compiled by Committee on Climate Change to report on UK’s progress towards reducing emissions in line with established carbon budgets and the 2050 target, as required by the 2008 Act. • Also describes what further progress is needed to meet those budgets and target and whether they are likely to be met.
<p>The 2020 Challenge for Scotland’s Biodiversity²¹</p>	<ul style="list-style-type: none"> • Aims to protect and restore biodiversity and support healthier ecosystems; and recognises the potential impacts of climate change on the biodiversity resource. • Takes an ‘ecosystem approach’ to conservation and enhancement. • Recognises the pressure on ecosystems that population growth and climate change bring. • Recognises that climate change adaptation can improve

¹⁷ Scottish Government (2011) Low Carbon Scotland – meeting the emissions reduction targets 2010-2022: report [online] Available at: <https://www.gov.scot/publications/low-carbon-scotland-meeting-emissions-reduction-targets-2010-2022-report/> (accessed 31/01/2019)

¹⁸ Scottish Government (2013) Low Carbon Scotland – meeting our emissions reduction targets 2013-2027: second report [online] Available at: <https://www.gov.scot/publications/low-carbon-scotland-meeting-emissions-reduction-targets-2013-2027-second/> (accessed 31/01/2019)

¹⁹ Scottish Government (2018) Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3) [online] Available at: <https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018/> (accessed 31/01/2019)

²⁰ Committee on Climate Change (2018) Reducing UK emissions – 2018 Progress Report to Parliament [online] Available at: <https://www.theccc.org.uk/publication/reducing-uk-emissions-2018-progress-report-to-parliament/> (accessed 31/01/2019)

²¹ Scottish Government (2013) 2020 Challenge for Scotland’s Biodiversity [online] Available at: <https://www2.gov.scot/Resource/0042/00425276.pdf> (accessed 31/01/2019)

Plan, Programme or Strategy	Summary
	ecosystem resilience.
The Scottish Rural Development Programme (SRDP) 2014 – 2020 ²²	<ul style="list-style-type: none"> • Includes economic, environmental and social measures designed to support rural Scotland. • Through SRDP there are a large number of activities which land managers can use in responding to climate change.
Farming For A Better Climate ²³	<ul style="list-style-type: none"> • Works with farmers and land managers in Scotland to encourage and advise on the uptake of practices that will help the sector to become more profitable whilst moving towards a low carbon sustainable future whilst also adapting to a changing climate and securing farm viability for future generations. • Its five key action areas involve are using electricity and fuels efficiently, the development of renewable energy, locking carbon into soils and vegetation, making the best use of nutrients, and optimising livestock management.
The Scottish Forestry Strategy 2006 and 2019 – 29 (Draft) ²⁴	<ul style="list-style-type: none"> • Sets out the long term vision for Scottish Forestry within the context of wider land use aspirations. • Focuses on the sustainable creation and management of Scotland’s woodlands and forests. • Opportunities that will support climate change resilience and adaptation are recognised.
Scotland’s Economic Strategy 2015 ²⁵	<ul style="list-style-type: none"> • Sets out how to achieve a more productive, cohesive and fairer Scotland. • Prioritises boosting investment and innovation, supporting inclusive growth and maintaining focus on increasing internationalisation. • Recognises climate change as a key challenge for economies.
Good Places, Better Health 2008 ²⁶	<ul style="list-style-type: none"> • Promotes partnership working which shares knowledge and understanding of how the physical environment impacts on mental health and wellbeing. • Climate change adaptation responses may impact on the quality of our physical surroundings both positively and negatively.
The Scottish Soil Framework 2009 ²⁷	<ul style="list-style-type: none"> • Sets out the Scottish Government’s vision for soil

²² Scottish Government (2014) United Kingdom – Rural Development Programme (Regional) – Scotland [online] Available at: <https://www2.gov.scot/Resource/0054/00544562.pdf> (31/01/2019)

²³ SRUC (2017) Farming For A Better Climate [online] Available at: <https://www2.gov.scot/Topics/farmingrural/Agriculture/Environment/climatechange/Advice> (accessed 31/01/2019)

²⁴ Scottish Government (2018) Scotland’s Forestry Strategy 2019-29 [online] Available at: <https://consult.gov.scot/forestry/scotlands-forestry-strategy-2019-29/> (accessed 31/01/2019)

²⁵ Scottish Government (2015) Scotland’s Economic Strategy [online] Available at: <https://www.gov.scot/publications/scotlands-economic-strategy/> (accessed 31/01/2019)

²⁶ Scottish Government (2015) Good Places, Better Health: A New Approach to Environment and Health in Scotland – Implementation Plan [online] Available at: <https://www2.gov.scot/resource/doc/254447/0075343.pdf> (accessed 31/01/2019)

Plan, Programme or Strategy	Summary
	<p>protection.</p> <ul style="list-style-type: none"> • Formally acknowledges the important services soil provide to society. • Recognises that climate change and loss of organic matter are the most significant threats to Scottish soils. • Adaptation actions need to recognise the vulnerability of soils to climate change and ensure that they contribute to the protection of the soil resource.
Scotland's National Marine Plan 2015 ²⁸	<ul style="list-style-type: none"> • Covers the management of both Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles). • Considers climate change in terms of how plan actions can mitigate GHG emissions and how actions need to be adapted to account for climate change effects. • Marine planning and conservation measures could provide opportunities to manage conflicting demands on the marine environment as a result of climate change adaptation.
The Flood Risk Management (Scotland) Act ²⁹ and Flood Risk Management Plans (FRMPs) ³⁰	<ul style="list-style-type: none"> • The Act provides a comprehensive flood risk information base which will support the identification of locations where adaptation responses will be required to address flood risk. • Adaptation responses will need to make a positive contribution to flood management and adaptation actions will need to have due regard to FRMPs.
The Water Framework Directive (WFD) ³¹ , The Water Environment Water Services (Scotland) Act 2003 (WEWS) ³² , and River Basin Management Plans (RBMP)s ³³	<ul style="list-style-type: none"> • Scotland fulfils its water protection obligations under the WFD primarily through the WEWS which defines the establishment of RBMPs. • These plans provide an assessment of the condition of Scotland's water environment, and identify where efforts for protection and improvement must be targeted.

²⁷ Scottish Government (2009) The Scottish Soil Framework [online] Available at: <https://www.gov.scot/binaries/content/documents/govscot/publications/publication/2009/05/scottish-soil-framework/documents/0081576-pdf/0081576-pdf/govscot%3Adocument> (accessed 31/01/2019)

²⁸ Scottish Government (2015) Scotland's National Marine Plan [online] Available at: <https://www.gov.scot/publications/scotlands-national-marine-plan/> (accessed 31/01/2019)

²⁹ Flood Risk Management (Scotland) Act 2009, asp 6 [online] Available at: <https://www.legislation.gov.uk/asp/2009/6/introduction> (accessed 31/01/2019)

³⁰ SEPA (2019) Flood Risk Management Strategies [online] Available at: <http://apps.sepa.org.uk/FRMStrategies/> (accessed 31/01/2019)

³¹ European Commission (2016) The EU Water Framework Directive – integrated river basin management for Europe [online] Available at: http://ec.europa.eu/environment/water/water-framework/index_en.html (accessed 31/01/2019)

³² Water Environment and Water Services (Scotland) Act 2003, asp 3 [online] Available at: <https://www.legislation.gov.uk/asp/2003/3/introduction> (accessed 31/01/2019)

³³ SEPA (undated) River Basin Management Planning [online] Available at: <https://www.sepa.org.uk/environment/water/river-basin-management-planning/> (accessed 31/01/2019)

Plan, Programme or Strategy	Summary
Cleaner Air for Scotland – The Road to a Healthier Future 2015 ³⁴	<ul style="list-style-type: none"> Notes the importance of clean air for health, wellbeing and the environment and sets out a series of actions and frameworks to improve air quality in Scotland. Adaptation measures have the potential for secondary effects on air quality.
Historic Environment Scotland Policy Statement 2016 ³⁵	<ul style="list-style-type: none"> Sets out how Historic Environment Scotland fulfils its regulatory and advisory roles. How it expects others to interpret and implement Scottish Planning Policy.
Scottish Natural Heritage Landscape Policy Framework ³⁶	<ul style="list-style-type: none"> Sets out an overarching aim for landscape based on four propositions of “to safeguard and enhance the distinct identity, the diverse character and the special qualities of Scotland’s landscapes as a whole, so as to ensure tomorrows landscape contribute positively to people’s environment and are at least as attractive and valued as they are today”.
The Scottish Energy Strategy: The future of energy in Scotland (2017) ³⁷	<ul style="list-style-type: none"> Sets out the Government vision for the future energy system in Scotland. Articulates six priorities that consider both energy use and supply for heat, power and transport. Energy priorities and actions will need to be consistent with adaptation actions where relevant.
The National Transport Strategy (2006) ³⁸	<ul style="list-style-type: none"> Highlights the importance of travel to our society and sets out strategic transport outcomes. Meeting these will require adaptation responses which support the transport network.
A Land Use Strategy for Scotland (2016-2021) ³⁹	<ul style="list-style-type: none"> Sets a framework for sustainable land use. Required to contribute to obligations under the Climate Change (Scotland) Act (2009) on emissions reduction targets, to climate change adaptation objectives and to sustainable development.

³⁴ Scottish Government (2015) Cleaner air for Scotland: the road to a healthier future [online] Available at: <https://www.gov.scot/publications/cleaner-air-scotland-road-healthier-future/> (accessed 31/01/2019)

³⁵ Historic Environment Scotland (2016) Historic Environment Scotland Policy Statement June 2016 [online] Available at: <https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=f413711b-bb7b-4a8d-a3e8-a619008ca8b5> (accessed 31/01/2019)

³⁶ Scottish Natural Heritage (2005) SNH’s Landscape Policy Framework Policy Statement No. 05/01 [online] Available at: <https://www.nature.scot/sites/default/files/2017-06/A147583%20-%20policy%20statement%200501-%20Landscape%20Policy%20Framework.pdf> (accessed 31/01/2019)

³⁷ Scottish Government (2017) The future of energy in Scotland: Scottish energy strategy [online] Available at: <https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/> (accessed 31/01/2019)

³⁸ Scottish Government (2006) Scotland’s National Transport Strategy [online] Available at: <https://www2.gov.scot/Publications/2006/12/04104414/11> (accessed 31/01/2019)

³⁹ Scottish Government (2016) Getting The Best From Our Land: A Land Use Strategy For Scotland 2016-2021 [online] Available at: <https://www.gov.scot/publications/getting-best-land-land-use-strategy-scotland-2016-2021/> (accessed 31/01/2019)

Plan, Programme or Strategy	Summary
National Planning Framework (NPF3) ⁴⁰ and Scottish Planning Policy (SPP) ⁴¹	<ul style="list-style-type: none"> • NPF3 is a long term spatial expression of the Government's Economic Strategy, plans for development and investment in infrastructure. • Identifies national developments and other strategically important development opportunities in Scotland. • It supports development that facilitates adaptation to climate change, reduces resource consumption and lowers greenhouse gas emissions. • SPP is Scottish Government Policy on how nationally important land use planning matters should be addressed.
Making things last: A Circular Economy Strategy for Scotland (2016) ⁴²	<ul style="list-style-type: none"> • Sets out priorities for moving towards a more circular economy. Which will benefit the environment, economy and communities. • It builds on Scotland's progress in the zero waste and resource efficiency agendas. • Waste reduction is fundamental to helping tackle climate change and to preserve national capital. • Climate change adaptation responses should support the protection of waste management facilities and infrastructure.
Realising Scotland's full potential in a digital world: A Digital Strategy for Scotland (2017) ⁴³	<ul style="list-style-type: none"> • Sets out a vision for Scotland as a vibrant, inclusive, open and outward looking digital nation.

⁴⁰ Scottish Government (2014) National Planning Framework 3 [online] Available at: <https://www.gov.scot/publications/national-planning-framework-3/> (accessed 31/01/2019)

⁴¹ Scottish Government (2014) Scottish Planning Policy [online] Available at: <https://www.gov.scot/publications/scottish-planning-policy/> (accessed 31/01/2019)

⁴² Scottish Government (2016) Making Things Last: a circular economy strategy for Scotland [online] Available at: <https://www.gov.scot/publications/making-things-last-circular-economy-strategy-scotland/> (accessed 31/01/2019)

⁴³ Scottish Government (2017) Realising Scotland's full potential in a digital world: a digital strategy for Scotland [online] Available at: <https://www.gov.scot/publications/realising-scotlands-full-potential-digital-world-digital-strategy-scotland/> (accessed 31/01/2019)

4 Assessment findings and recommendations

4.1 Introduction and overall themes

- 4.1.1 This section sets out the likely significant environmental effects that are expected as a result of the draft programme. It brings together the more detailed findings of the assessment work that was undertaken alongside development of the draft programme.
- 4.1.2 The assessment findings reflect the high-level nature of the programme and focus on the 7 high-level adaptation outcomes and their sub-outcomes. To avoid repetition, the following is considered relevant to all the outcomes.
- 4.1.3 All outcomes focus on climate change adaptation and hence are likely to have **significant positive effects** on **climatic factors**.
- 4.1.4 All outcomes identify adaptation behaviours. This is the idea that individuals and organisations can alter their behaviour to help increase their resilience to, and reduce the severity of, some of the worst climate change impacts affecting Scotland. Whilst it is recognised that adaptation behaviours vary hugely in scale and scope, they are broadly considered likely to have **positive effects** on **climatic factors**. This is because these behaviours, to make informed decisions on how to adapt to climate change, support a greater understanding of climate change and its impacts, as well as providing direct mitigation to it impacts.

4.2 Outcome 1

Outcome 1: Our communities are inclusive, empowered, resilient and safe in response to the changing climate.

Sub-outcome 1.1: People in Scotland's diverse communities are informed, empowered and adapting to climate change.

Sub-outcome 1.2: Scotland's buildings and places are adaptable to climate change.

What are the key environmental impacts of climate change relevant to the outcome?

- 4.2.1 Potential risks to **population and human health** from flooding and sea level rise, the impacts of extreme weather on the healthcare system, and risks to health from overheating buildings and transport, poor air quality, pathogens, and poor water quality⁴⁴.
- 4.2.2 There is potential for different communities to be impacted in different ways. For example, some remote rural, coastal communities and deprived areas are recognised as being more vulnerable to the negative impacts of climate change due to pre-existing inequities and flood disadvantage.
- 4.2.3 Potential risks to **cultural heritage** (culturally valued structures and the wider historic environment). There is a need to protect vulnerable cultural heritage assets (including designated and undesignated sites and their settings) from direct climate change impacts such as increased flood risk, hydrological changes, and from extreme weather events as well as from increases in the severity of current threats e.g. soil erosion and vegetation growth. There is also the potential for risks arising from the indirect effects of climate change (such as damage to building fabric as a result of adaptation measures).

What are the likely significant environmental effects of this outcome?

- 4.2.4 This outcome is likely to have **positive effects** on **population and human health**, for example through measures that support safety and community empowerment, including flood management and risk avoidance measures, as well as emergency responses to flooding and disease. **Positive effects** on **cultural heritage** and **material assets** may also occur as a result of building and place adaptation measures.
- 4.2.5 Future actions to support inclusive, empowered, resilient and safe communities have the potential to result in **mixed/uncertain effects** on a **range of SEA topics**. For example there is potential for **negative effects** from adaptation responses such as flood alleviation measures on cultural

⁴⁴ ibid

heritage assets and/or the wider historic environment. Potential effects are considered likely to be localised. Individual projects would be subject to consideration through the relevant applicable regulatory regimes.

Does the outcome address key environmental impacts of climate change?

- 4.2.6 Key policies and measures identified to support place based/local adaptation responses to climate change (targeting diverse communities and supporting safe and resilient places) are likely to contribute to addressing the key impacts of climate change.

Opportunities for Enhancement

- 4.2.7 To obtain the maximum environmental benefits of this outcome a focus could be given to actions which support consideration of differing needs of communities and which seek to protect vulnerable cultural heritage assets. Specifically, a focus could be given to actions that support the differing needs of remote rural, coastal communities and deprived areas that are recognised as being more vulnerable to negative impacts of climate change due to pre-existing inequities and flood disadvantage.
- 4.2.8 Measures that support adaptation of buildings in response to climate change have the potential to help address existing risks to people from cold temperatures through addressing fuel poverty. This is also relevant to **Outcome 2** below.

4.3 Outcome 2

Outcome 2: The people in Scotland who are most vulnerable to climate change are able to adapt and climate justice is embedded in climate change adaptation policy.

Sub-outcome 2.1: The most vulnerable to climate change in Scotland are informed, empowered and able to adapt to climate change.

Sub-outcome 2.2: Scotland's health and social care is ready and responding to changing demands as a result of the changing climate.

Sub-outcome 2.3: Scotland's people have equal access to high standards of air quality ensuring our population's health.

What are the key environmental impacts of climate change relevant to the outcome?

- 4.3.1 Potential opportunities for **population and human health** include health benefits to be derived from warmer winters, however more action is needed to manage current risks to people from cold temperatures through addressing fuel poverty.
- 4.3.2 The impacts of climate change on **people** will not be evenly spread across society, and deprived areas are recognised as being more vulnerable to negative impacts due to pre-existing health problems and inequities. Isolated communities are also recognised as being most vulnerable to infrastructure damage from flooding. Adverse impacts on **population and human health** could include risks to health from increased temperatures, vector borne pathogens, and food-borne disease.
- 4.3.3 **Air** pollution can contribute to a number of health problems and climate change may exacerbate these issues and alter current patterns and concentrations of air pollution.
- 4.3.4 Extreme weather events can affect the ability of the health and social care sector to deliver services due to impact on **material assets** (infrastructure) as well as increased demand from incidents associated with the events themselves. More research is needed to assess to what extent adaptation action is already underway to manage risks to **population and human health** from flooding and sea level rise, extreme weather impacts on the health care system, risks to health from overheating buildings, poor air quality and pathogens.

What are the likely significant effects of this outcome?

- 4.3.5 This outcome is likely to have **positive effects** on **population and human health, air and material assets**. A number of measures could also have secondary **positive effects** on **other SEA topics**. For example measures that

support improving air quality through the decarbonisation of transport are likely to have **positive secondary effects** on **climatic factors**.

- 4.3.6 Future actions that occur to support climate justice have the potential to result in **mixed/uncertain effects on a range of SEA topics**. For example there is potential for **negative effects** from adaptation responses such as infrastructure resilience measures. Potential effects are considered likely to be localised. Individual projects would be subject to consideration through the relevant applicable regulatory regimes.

Does the outcome address key environmental impacts of climate change?

- 4.3.7 Key policy and measures identified to support climate justice are likely to contribute to addressing key impacts of climate change.

Opportunities for Enhancement

- 4.3.8 To obtain the maximum environmental benefits of this outcome a focus could be given to actions which support people living in deprived and isolated areas which may be more vulnerable to negative impacts due to pre-existing health problems and inequalities.

4.4 Outcome 3

Outcome 3: Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate.
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Sub-outcome 3.1: Scotland's businesses based on natural resources are informed and adaptable to climate change
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Sub-outcome 3.2: Scotland's manufacturing, services and wider economy are informed and adaptable to climate change
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Sub-outcome 3.3: Scotland's economy is innovative and harnesses the opportunities created as a result of climate change

What are the key environmental impacts of climate change relevant to this outcome?

- 4.4.1 **Material assets** (Businesses) are at risk from climate change impacts including site flooding, impacts on coastal locations and infrastructure, reduced employee productivity (for example from infrastructure disruption and higher temperatures in working environments). Other risks include possible water scarcity, reduced access to capital and disruption to supply chain and distribution networks.
- 4.4.2 Flooding and extreme weather events which damage **material assets** and disrupt business operations pose the greatest threat to Scottish businesses now and in the future. Supporting resilient infrastructure (in particular power, fuel supply and ICT) is crucial in enabling businesses to minimise disruption to their operations from climate change risks.
- 4.4.3 Risks and opportunities for **material assets** (businesses) may occur from changes in demand for goods and services.
- 4.4.4 Some key **material assets** (agriculture and forestry) are closely linked to climate, and climate change poses both risks and opportunities through changes in agricultural and forestry productivity and land suitability. Examples include potential negative impacts from a warmer climate arising from an increased likelihood of pest infestation, wildfire, invasive species and water scarcity, as well as potential positive effects from greater productivity for some species.
- 4.4.5 **Landscape, biodiversity, and cultural heritage** assets and their settings may change as an indirect result of climate change. For example from land use change in support of business adaptation activities.

What are the likely significant environmental effects of this outcome?

- 4.4.6 This outcome is likely to have **positive effects** on **material assets** (businesses and natural resource industries) for example through measures that support business resilience and awareness of climate change risks and opportunities.
- 4.4.7 Future actions that occur to support an adaptable, flexible and resilient economy have the potential to result in **mixed/uncertain effects** on a **range of SEA topics**. For example, there is potential for **negative effects** from adaptation responses such as business site adaptation measures on **landscape** and **material assets**. Potential effects are considered likely to be localised. Individual projects would be subject to consideration through the relevant applicable regulatory regimes.

Does the outcome address key environmental impacts of climate change?

- 4.4.8 The key policies and measures identified to support a flexible, adaptable and responsive economy are likely to contribute to addressing key impacts of climate change.

Opportunities for Enhancement

- 4.4.9 To obtain the maximum environmental benefits of this outcome a focus could be given to actions which support locations and infrastructure which are recognised as more vulnerable to the impacts of climate change including coastal and isolated locations and power, fuel supply and ICT Infrastructure.

4.5 Outcome 4

Outcome 4: Our society's supporting systems are resilient to climate change.
Sub-outcome 4.1: The interdependencies of Scotland's infrastructure assets, systems and sectors are understood, and the risk of cascading failures is managed
Sub-outcome 4.2: Scotland's critical national infrastructure, including essential services, is resilient to climate change.
Sub-outcome 4.3: Scotland's other non-critical infrastructure is adaptable to climate change

What are the key environmental impacts of climate change relevant to this outcome?

4.5.1 Impacts on some **material assets** (infrastructure) have the potential to cascade on to others as part of interdependent networks. Flooding poses the greatest long term risk to infrastructure performance from climate change but the growing risks from heat, water scarcity and slope instability caused by severe weather could be significant.

4.5.2 There may be increased competition for **water** and water quality and quantity problems could be exacerbated by extreme weather brought on by climate change.

4.5.3 There may be risks to **material assets** (including transport, digital and energy infrastructure) from extreme weather and changes in climate.

Some **material assets** including road and rail transport are generally more vulnerable to a changing climate than air and water transport and flooding is anticipated to be the most significant impact on these networks, as well as those arising from extreme weather conditions and landslides. Flooding is expected to increase pressure on healthcare infrastructure, particularly emergency services, with isolated communities being most vulnerable to infrastructure damage. Such impacts could impact on **population and human health** (e.g. operation disruption and risks to passengers from high temperatures on public transport).

4.5.4 **Landscape** may change as an indirect result of climate change. For example from land use change in support of adaptation activities such as renewable energy developments.

What are the likely significant environmental effects of this outcome?

4.5.5 This outcome is likely to have **positive effects** on **material assets** and **population and human health**, for example through measures that support resilience of supporting systems and infrastructure interdependencies and

improve understanding. Additional benefits to **human health** are considered likely from measures that facilitate improved energy security. **Positive effects** on **water** and **air** are also likely, for example through measures that support sustainable water management and clean energy.

- 4.5.6 Future actions to provide more resilient supporting systems have the potential to result in **mixed/uncertain** effects on **a range of SEA topics**. For example, there is potential for **negative effects** on the **landscape** from adaptation responses such as new renewable energy infrastructure. Potential effects are considered likely to be localised. Individual projects would be subject to consideration through the relevant applicable regulatory regimes.

Does the outcome address key environmental impacts of climate change?

- 4.5.7 This outcome seeks to improve resilience of our supporting systems and ensure they are adaptable to a changing climate. Measures that seek to improve understanding, including of the interdependencies between systems, and which support resilience and adaptation are likely to contribute to addressing the impacts of climate change.

Opportunities for Enhancement

- 4.5.8 To obtain the maximum environmental benefits of this outcome a focus could be given to supporting systems which may be more vulnerable to the identified negative impacts of climate change. For example, isolated communities, systems at risk from increased flooding, and those at growing risk from heat, water scarcity and slope instability.

4.6 Outcome 5

Outcome 5: Our natural environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change.

Sub-outcome 5.1: Scotland's biodiversity, ecosystems and landscapes are adaptable to the changing climate.

Sub-outcome 5.2: Scotland's natural environment and its contribution to wider societal adaptation is valued, enjoyed and maintained.

What are the key environmental impacts of climate change relevant to this outcome?

- 4.6.1 Climate change poses risks to Scotland's **soils** including increased seasonal aridity and wetness, and risks to natural carbon stores and sequestration. More action is needed to manage these risks. Opportunities to protect a range of environmental assets such as **soil** through management interventions in peatlands, forests and agricultural soils can be used to help slow or even reverse climatic change.
- 4.6.2 Some **biodiversity** assets (species and habitats) could be at risk because of their inability to respond to changing climatic conditions. Opportunities for **biodiversity** (new species colonisation) could result from changes in climate.
- 4.6.3 Climate change could contribute to changes in **landscape** character. For example from changes in land cover and indirectly through influencing some land uses in specific locations.
- 4.6.4 Warmer winters and increased participation in outdoor activities could result in health benefits for **population and human health**.
- 4.6.5 For **waters** that are already under pressure from nutrient inputs, the higher temperatures predicted as a result of climate change may further stimulate excessive and damaging growth of water plants. The potential increase in extreme rainfall events and flooding may result in more of the soil and nutrients from agricultural land being washed into surface waters and impact on freshwater species and water quality.

What are the likely significant environmental effects on this outcome?

- 4.6.6 This outcome is likely to have **positive effects** on **all SEA topics** including **biodiversity, population and human health, air, soil, water, landscape, and cultural heritage**. Measures that support ecosystems for example are likely to result in **positive effects** on a **range of SEA topics**.
- 4.6.7 Future actions that occur to support, value, enjoy, protect and enhance the natural environment have the potential to result in **mixed/uncertain effects** on

a range of SEA topics. For example there is potential for **negative effects** from adaptation responses to support improved recreation measures on **biodiversity, landscapes** and **cultural heritage** assets. Potential effects are considered likely to be localised. Individual projects would be subject to consideration through the relevant applicable regulatory regimes.

Does the outcome address key environmental impacts of climate change?

- 4.6.8 This outcome seeks to value, enjoy and maintain our natural environment and is likely to contribute to addressing the impacts of climate change.
- 4.6.9 Notably, the SEA supports the inclusion of measures underneath this outcome that support cross-sector cooperation and opportunities to realise multiple environmental benefits (for example through the continued promotion of the consideration of ecosystems in the decision-making process).

4.7 Outcome 6

Outcome 6: Our coastal and marine environment is valued, enjoyed, protected and enhanced and has increased resilience to climate change.

Sub-outcome 6.1: Scotland's coastal and marine biodiversity, ecosystems and landscapes are adaptable to a changing climate.

Sub-outcome 6.2: Scotland's marine and coastal environment and its contribution to wider societal adaptation is enjoyed, valued and maintained.

What are the key environmental impacts of climate change relevant to this outcome?

- 4.7.1 Some marine **biodiversity and cultural heritage** assets could be at risk because of their inability to respond to changing climatic conditions (for example, some species could be at risk from extreme weather events including sea level rise and loss of natural flood protection and risks to freshwater habitats from saltwater intrusion)
- 4.7.2 Risks to **cultural heritage** in the coastal zone from sea level rise and loss of natural flood protection.
- 4.7.3 Risks to and opportunities for **biodiversity** (marine species), **material assets** (fisheries) and **cultural heritage** (marine heritage) from ocean acidification and higher water temperatures.
- 4.7.4 The combined effects of climate change on **landscape** character are likely to be most obvious in lowland and coastal areas.

What are the likely significant environmental effects of this outcome?

- 4.7.5 This outcome is likely to have **positive** effects on some SEA topics including **biodiversity, landscape, soil, water** (measures that support adaptable ecosystems) and **population and human health** (measures that support enjoyment, value and maintenance of coastal and marine environments).
- 4.7.6 Future actions that occur to support the marine and coastal environment have the potential to result in **mixed/uncertain effects on a range of SEA topics**. For example there is potential for negative effects from adaptation responses such as coastal defence measures on **biodiversity** and **water**. Potential effects are considered likely to be localised. Individual projects would be subject to consideration through the relevant applicable regulatory regimes.

Does the outcome address key environmental impacts of climate change?

- 4.7.7 This outcome seeks to value, enjoy and maintain our coastal and marine environment and is likely to contribute to addressing the impacts of climate change.

4.7.8 Notably the SEA supports the inclusion of measures underneath this outcome that support cross sector cooperation and opportunities to realise multiple environmental benefits (for example through the continued promotion of the consideration of ecosystems in the decision making process).

4.7.9 The SEA also supports the inclusion of a specific marine and coastal outcome as this environment may be more vulnerable to the negative impacts of climate change including potential risks to landscape character. The outcome is likely to contribute to addressing the key impacts of climate change.

Opportunities for Enhancement

4.7.10 To obtain the maximum environmental benefits of this outcome a focus could be given to actions which support measures for marine heritage to adapt to climate change.

4.8 Outcome 7

Outcome 7: Our international networks are adaptable to climate change.

Sub-outcome 7.1: Scotland's international food supply networks are resilient to the effects of climate change.
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Sub-outcome 7.2: Scotland has an internationally open and connected economy which is adaptable to climate change.

Sub-outcome 7.3: Scotland is active in international governance, helping to manage the potential international instability caused by climate change.
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What are the key environmental impacts of climate change relevant to this outcome?

- 4.8.1 Risks to **population and human health** from weather related shocks to international food production and trade, imported food safety risks, climate related international human displacement, and to violent conflict overseas.
- 4.8.2 Risks and opportunities from long term climate related changes to **material assets** (global food production) and opportunities for changes in international trade routes.

What are the likely significant environmental effects of this outcome?

- 4.8.3 This outcome is likely to have **positive** effects on **population and human health** and **material assets** through adaptation measures that support food security and international coordination of climate change responses.

Does the outcome address key environmental impacts of climate change?

- 4.8.4 This outcome is likely to contribute to addressing the key impacts of climate change.
- 4.8.5 Whilst it is acknowledged that this outcome has an international focus it is not considered that this component of the draft programme is likely to lead to significant effects that would require consideration across transboundary areas. Future actions and proposals will themselves be subject to consideration in accordance with the requirements of the Environmental Assessment (Scotland) Act 2005.

4.9 Conclusions Mitigation and Enhancement

Conclusions

- 4.9.1 The draft programme does not itself set out new policies or proposals, but rather provides a high-level framework that draws together existing Scottish Government policies relating to climate change adaptation, and seeks to ensure that they take account of climate change adaptation. Where any future policies and proposals are developed, these will themselves be subject to consideration in accordance with the requirements of the Environmental Assessment (Scotland) Act 2005.
- 4.9.2 This assessment concludes that the high-level outcomes based approach is likely to have **significant positive effects** on **climatic factors** by drawing together relevant adaptation measures to maximise their impact, capitalise upon synergies and address any gaps.
- 4.9.3 This approach to climate change action can also optimise environmental benefits across the range of SEA topics and **positive effects** on all other **SEA topics (including biodiversity, population and human health, air, soil, water, material assets, cultural heritage and landscape)** are considered likely, the effects of which are only likely to be fully realised in the medium to long term.
- 4.9.4 The potential for effects in combination with other plans, programmes and strategies has also been considered. The draft programme has the potential to **positively** and **cumulatively** contribute across a wide range of Scottish Government policy areas within the context in which it sits. Adaptation is captured across the breadth of a range of national plans, policies and programmes and these are recognised under the adaptation framework. Taking into account the high-level nature of the draft programme there is however an inherent degree of uncertainty regarding the environmental impacts that may arise as a result of future actions undertaken to support adaptation outcomes. The assessment also identifies the potential for mixed / uncertain effects arising from future actions at a local level, across the majority of the SEA topics.

Mitigation

- 4.9.5 Where future actions have the potential to result in uncertain/mixed adverse effects further consideration should be given to opportunities to mitigate any such effects at individual project level. There are existing controls in place through the relevant consenting procedures that can help to address these. These are discussed further in **Section 3.12.1**.
- 4.9.6 Six outcomes identify adaptation behaviours. This is the idea that individuals and organisations can alter their behaviour to help increase their resilience to, and reduce the severity of, some of the worst climate change impacts affecting Scotland. Whilst it is recognised that adaptation behaviours vary hugely in

scale and scope, they are broadly likely to contribute to **positive effects** on **climatic factors**. This is because these behaviours, to make informed decisions on how to adapt to climate change, support a greater understanding of climate change and its impacts (as well as providing direct mitigation to its impacts).

- 4.9.7 Finally, the SEA findings support outcomes that focus on increased understanding and awareness of climate change adaptation. This is because adaptation strategies will benefit from relevant research and awareness raising to ensure resources continue to be appropriately directed and to help avoid unintended secondary adverse environmental effects.

Opportunities for Enhancement

- 4.9.8 The SEA findings also support greater policy alignment of action with wider Scottish Government policy objectives in order to maximise potential benefits from climate change action. Additionally, improved policy integration may provide an opportunity at a strategic level to better understand more complex interactions: for example, the link between climate change and air quality, and interactions between the terrestrial and marine environments.
- 4.9.9 The SEA findings also support the inclusion of outcomes that support cross sector cooperation and opportunities to realise multiple environmental benefits (for example, **Outcomes 5** and **6** which support the continued promotion of the consideration of ecosystems in the decision making process).
- 4.9.10 The SEA findings support the inclusion of an outcome with a focus on marine and coastal environments as these areas are likely to be more vulnerable to the negative impacts of climate change.
- 4.9.11 The following specific opportunities for enhancement have been identified:
- 4.9.12 To obtain the maximum environmental benefits of **Outcome 1**, a focus could be given to actions which support consideration of differing needs of communities and which seek to protect vulnerable cultural heritage assets. Specifically, a focus could be given to actions that support the differing needs of remote rural, coastal communities and deprived areas that are recognised as being more vulnerable to negative impacts of climate change due to pre-existing inequities and flood disadvantage.
- 4.9.13 Measures identified under **Outcome 1** that support adaptation of buildings in response to climate change have the potential to help address existing risks to people from cold temperatures through addressing fuel poverty. This is also relevant to **Outcome 2** below.
- 4.9.14 To obtain the maximum environmental benefits of **Outcome 2**, a focus could be given to actions which support people living in deprived and isolated areas which may be more vulnerable to negative impacts due to pre-existing health problems and inequalities.

- 4.9.15 To obtain the maximum environmental benefits of **Outcome 3**, a focus could be given to actions which support locations and infrastructure which are recognised as more vulnerable to the impacts of climate change including coastal and isolated locations and power, fuel supply and ICT Infrastructure.
- 4.9.16 To obtain the maximum environmental benefits of **Outcome 4**, a focus could be given to supporting systems which may be more vulnerable to the identified negative impacts of climate change. For example isolated communities, systems at risk from increased flooding, and those at growing risk from heat, water scarcity and slope instability.
- 4.9.17 To obtain the maximum environmental benefits of **Outcome 6**, a focus could be given to actions which support measures for marine heritage to adapt to climate change.

5 Monitoring

5.1 Introduction

- 5.1.1 Section 19 of the Environmental Assessment (Scotland) Act 2005 requires the responsible authority to monitor significant environmental effects of the implementation of the PPS. This should be done in a way to enable them to take appropriate remedial action.
- 5.1.2 A wide range of existing programmes are in place at the national and local level to report on environmental status and assess performance against established environmental indicators. For example, Scottish State of the Environment Reports are produced every three years⁴⁵.
- 5.1.3 Further, given that the programme itself seeks to coordinate the delivery of existing plans, programmes and strategies across various sectors monitoring of these existing plans, programmes and strategies is also relevant. The Climate Change Plan, for example, includes a monitoring framework that includes output and implementation indicators across a range of environmental topics.
- 5.1.4 Requirements for monitoring the programme are set out in the 2009 Act. This requires an annual report on progress towards implementing the objectives, proposals and policies set out in the programme. The Act also establishes the requirement to independently assess the Scottish Government's progress towards implementing the objectives, proposals and policies set out in the programme.
- 5.1.5 The 2008 Act includes provision that a UK CCRA must take place every five years. An adaptation programme is required to address impacts and opportunities identified in progressive CCRA's and hence this adaptation programme will be reviewed on a five year basis. This will identify changes in the evidence base for the impacts of climate change to be reflected in future adaptation programmes.
- 5.1.6 In its recommendations in the 2016 assessment of progress on climate change adaptation in Scotland, the Adaptation Committee of the UK Committee on Climate Change (ACC) said that the Scottish Government, in preparing the second adaptation programme, should 'introduce an effective monitoring regime to allow impact of actions and delivery of each objective to be properly assessed'. The UK's CCRA also identified that there is 'no routine collection of data and other evidence to assess whether policies are successful in achieving their objectives'.
- 5.1.7 Establishing a comprehensive monitoring and evaluation framework for the Adaptation programme is vital to ensure the effectiveness of Scotland's efforts

⁴⁵ Scottish Government (2014) Scotland's State of the Environment Report, 2014 [online] Available at: <https://www.environment.gov.scot/media/1170/state-of-environment-report-2014.pdf> (accessed 07/02/2019)

to adapt to the impacts of climate change, identify whether resilience is increasing (and opportunities are being realised), and ensuring that reporting on progress and implementation is evidentially supported.

- 5.1.8 The first Scottish Adaptation programme established a framework of over 100 indicators to assist monitoring and evaluation and independent assessment. The intention is to establish a comprehensive new framework for the second programme which will specifically support the outcomes-based approach. This new framework for monitoring and reviewing the Adaptation programme provides a mechanism for assessing progress and identifying any additional impacts. It is therefore proposed that the monitoring for the SEA is an integral part of the monitoring for the Adaptation programme. A full explanation of the approach to monitoring and evaluation is included in an Annex to the consultation paper.

6 Next steps and consultation

- 6.1.1 Public views and comments are invited on both this Environmental Report and the draft Second Scottish Climate Change Adaptation Programme to which it relates. Details of how to respond are provided below.

When can I respond?

Respondents are asked to submit responses to this Environmental Report directly to the Scottish Government by closing date of Tuesday 9 April 2019

How can I respond?

- **Online:** You can respond online using the Scottish Government's consultation platform, Consultation Hub, at: <https://consult.gov.scot/energy-and-climate-change-directorate/adaptation-programme-2019-2024/>
Consultation Hub allows you to save and return to your responses while the consultation is still open. A copy of your final response will be emailed to you.

By Email or Post: Responses can be submitted by email, with the Respondent Information Form (Appendix E) to: climatechangeadaptation@gov.scot

Climate Change Adaptation Consultation
Climate Change Adaptation Team, 3F South
Scottish Government
Victoria Quay
Edinburgh
EH6 6QQ

How will responses be considered?

Following the consultation, a Post-Adoption Statement will be prepared. The Statement will reflect on the views provided on the findings of the assessment and the proposals in the Consultation Paper and will explain how the issues raised have been taken into account in finalising the Strategy.

Consultation Questions on the Environmental Report

Respondents may find the following questions helpful to provide a focus for their responses to this Environmental Report. Please note that responses do not need to be limited to these questions, and more general comments on this Environmental Report and the proposals set out in the Consultation Paper are also invited.

1. What are your views on the accuracy and scope of the information used to describe the SEA environmental baseline set out in the Environmental Report (Please give details of additional relevant sources).
2. What are your views on the predicted environmental effects as set out in the Environmental Report?
3. What are your views on the findings of the SEA and the proposals for mitigation and monitoring of the environmental effects set out in the Environmental Report?

Appendices

Appendix A Abbreviations

ASC	Adaptation Committee of Committee on Climate Change
AQMA	Air Quality Management Area
CA	Consultation Authorities
CCC	Committee on Climate Change
CCRA	Climate Change Risk Assessment
CO ₂	carbon dioxide
FRMA	Flood Risk Management (Scotland) Act 2009
FRMP	Flood Risk Management Plan
GVA	gross value added
GWh	gigawatt hour
ICT	Information and Communications Technology
km	Kilometre
NMVOG	non-methane volatile organic compounds
NPF3	National Planning Framework 3
NSA	National Scenic Areas
PM ₁₀	particulate matter 10 micrometres or less
PPS	Plans, Programmes and Strategies
RBMP	River Basin Management Plan
RPP	Report on Proposals and Policies
SAC	Special Area of Conservation
The draft programme	Second Scottish Climate Change Adaptation Programme
SCCAP1	First Scottish Climate Change Adaptation Programme
SOC	soil organic carbon
SEA	Strategic Environmental Assessment
SG	Scottish Government
SIMD	Scottish Index of Multiple Deprivation
SPA	Special Protection Area
SPP	Scottish Planning Policy
SRDP	Scottish Rural Development Programme 2014-2020
SSSI	Site of Specific Scientific Interest
The 2005 Act	The Environmental Assessment (Scotland) Act 2005
The 2008 Act	UK Climate Change Act 2008
The 2009 Act	The Climate Change (Scotland) Act 2009
The Scotland Report	The UK Climate Change Risk Assessment 2017 Evidence Report, Summary of Scotland
UK	United Kingdom
UN	United Nations

Appendix B Environmental Baseline

Climatic Factors

The global climate is changing. Since the last century, the atmosphere and oceans have warmed, amounts of snow and ice have reduced, the sea level has risen, and concentrations of greenhouse gases in the atmosphere have increased. Observed national changes in land temperature in Scotland have been similar to the UK average of a rise of around 1°C in recent decades. Annual rainfall over Scotland has also increased in recent decades to a level about 13% above the average for the early decades of the 20th century.⁴⁶

Data on past changes in precipitation and river flow show an upward trend in winter precipitation since 1961, with an increase of almost 70% in northern Scotland. For the same period, the data show that Scotland, as a whole, has become 20% wetter. In contrast, northern areas of Scotland have experienced drier summertime conditions since 1961.⁴⁷

In general, climate change projections suggest observed climate trends will continue to intensify in the future. These include:

- projected increases in mean annual temperature by the 2080s for Scottish regions range from 1.6°C to 4.5°C, with central estimates between 2.6°C and 3.0°C;
- drier summers and wetter winters;
- more seasonal rainfall; and
- increased risk of flood, drought, and extreme weather events.⁴⁸

The key climate change pressures for Scotland as set out in the UK Climate Change Risk Assessment 2017: Evidence Report – Summary for Scotland⁴⁹ include:

- Natural environment and natural assets – climate change poses risks to Scotland's soils, natural carbon stores, agriculture, wildlife, and coastal habitats and seas.
- Infrastructure – infrastructure in Scotland is exposed to a range of climatic hazards. Impacts on some assets have the potential to cascade on to others as part of interdependent networks. Flooding poses the greatest long-term risk to infrastructure performance from climate change, but the growing risks from heat, water scarcity, and slope instability caused by severe weather could be significant.

⁴⁶ Defra (2017) UK Climate Change Risk Assessment 2017 [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf (accessed 06/08/2018)

⁴⁷ Scottish Natural Heritage (2011) Trend note - Climate change and rivers [online] Available at: <https://www.nature.scot/sites/default/files/B1043758%20-%20Natural%20Heritage%20Trends%20-%20Climate%20change%20and%20rivers%20-%20PDF.pdf> (accessed 18/10/2018)

⁴⁸ National Statistics (2016) Key Scottish Environment Statistics 2016 - October 2016 [online] Available at: <https://www.gov.scot/Resource/0050/00508344.pdf> (accessed 06/08/2018)

⁴⁹ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report - Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 10/12/2018)

- People and the built environment – there are potential health benefits to be derived from warmer winters in Scotland, but more action is needed to manage current risks to people from cold temperatures through addressing fuel poverty.
- Business and industry – flooding and extreme weather events which damage assets and disrupt business operations pose the greatest risk to Scottish businesses now and in the future. This could be compounded by a lack of adaptive capacity.
- International dimensions – climate change will impact upon water security, agricultural production, and economic resources around the world. These impacts can compound vulnerability in other countries, which can in turn exacerbate risks from conflict, migration, and human crises. The main risks arising for the UK from climate change overseas are through impacts on the food system, economic interests abroad, and increased demand for humanitarian aid.

Biodiversity

Scotland's rich and varied landscapes and habitats have been shaped by underlying rocks, soils, and landforms; our seas; and the Scottish weather.⁵⁰ Scotland is renowned for the sheer number of plant and animal species that can be found within its borders as well as the complex mosaic of habitats that support them. In particular, Scotland is home to internationally important habitats that include more than 30,000 freshwater lochs as well as blanket bog, which covers 23% of our land area.⁵¹

Designated protected areas include 1,423 Sites of Special Scientific Interest (SSSI), 51 Ramsar Sites, 153 Special Protection Areas (SPAs), and 249 Special Areas of Conservation (SAC).⁵² The UK Biodiversity Action Plan also identified 39 priority habitats and 197 priority species that either occur or are known to have occurred in Scotland in recent times, which later helped to inform the scope and focus of Scotland's Biodiversity Strategy.⁵³ In addition, many undesignated areas such as urban parks and gardens contain a variety of habitats and ecosystems that are important biodiversity assets.⁵⁴

As of March 2018, 79.7% of natural features on protected nature sites were assessed as being in favourable condition. This figure represents a decrease of 0.6% from 2017 and an increase of 3.7% over 2007.⁵⁵ Some popular species are in decline, such as the capercaillie, and another 65 Scottish species are considered critically endangered in

⁵⁰ Scottish Natural Heritage (2017) Landscapes and habitats [online] Available at: <https://www.nature.scot/landscapes-and-habitats> (accessed 07/08/2018)

⁵¹ Scottish Natural Heritage (2017) Scotland's biodiversity [online] Available at: <https://www.nature.scot/scotlands-biodiversity> (accessed 07/08/2018)

⁵² Scottish Natural Heritage (2017) Protected areas [online] Available at: <https://www.nature.scot/professional-advice/safeguarding-protected-areas-and-species/protected-areas> (accessed 07/08/2018)

⁵³ JNCC (2016) UK BAP priority species and habitats [online] Available at: <http://jncc.defra.gov.uk/page-5705> (accessed 27/12/2018)

⁵⁴ Scottish Natural Heritage (2017) Urban habitats [online] Available at: <https://www.nature.scot/habitats-and-ecosystems/habitat-types/urban-habitats> (accessed 08/08/2018)

⁵⁵ Scottish Government (2018) National Indicator: Protected Nature Sites [online] Available at: <https://www.gov.scot/About/Performance/scotPerforms/indicator/naturesites> (accessed 08/08/2018)

Great Britain, such as the pine hoverfly.⁵⁶ Notwithstanding, other species are faring well such as certain butterfly species and otters.⁵⁷

Scotland's landscape and habitats are diverse in nature and range from uplands, wetlands, grasslands, forests and woodlands, the Scottish coast and marine environment, and the river system.

Covering the majority of Scotland, the uplands have some of the most extensive and best examples of near-natural habitats and wildlife associated with northern and remote parts of Europe. A third of uplands is bog, the remainder a mix of grassland, heath, bracken, fen, marsh and swamp, inland rock, and montane habitat. These areas contain an abundance of wildlife, including some species that can only survive in this habitat. Assessments of upland condition carried out in 2005 and 2010 found that the condition of the majority of features was favourable, although upland grasslands were a particular concern.⁵⁸ Later assessments carried out in 2014 show that the condition of the majority of features is continuing to gradually improve as work focuses on remedial action.⁵⁹ However, uplands remain vulnerable to land management changes, atmospheric pollution and afforestation.⁶⁰

Scotland's wetlands (including peatlands) support a range of plants, animals, and birds, the latter including species such as common scoter, golden plover, and dunlin. They also deliver important environmental functions such as carbon storage and sustaining the supply of clean water. It is estimated that approximately 1,600 tonnes of carbon are stored in Scotland's peatlands.⁶¹ Despite their importance, eighty percent of peatlands in Scotland are degraded⁶², hence the government's objective to restore 250,000 hectares by 2032.⁶³

Wetlands (including peatlands) cover large areas of Scotland where poorly drained soils, high rainfall, and low temperatures combine to create permanently or frequently waterlogged areas which support a diverse range of species adapted to these conditions. Bogs (a type of peatland) are one of the most extensive semi-natural habitats in Scotland and cover 23% of our land area.⁶⁴ Although relatively common in

⁵⁶ RSPB (2016) State of Nature 2016 [online] Available at: <https://www.rspb.org.uk/globalassets/downloads/documents/conservation-projects/state-of-nature/state-of-nature-uk-report-2016.pdf> (accessed 27/12/2018)

⁵⁷ ibid

⁵⁸ Scottish Government (2014) Mountains and uplands [online] Available at: <https://www.environment.gov.scot/media/1197/land-mountains-and-uplands.pdf> (accessed 21/08/2018)

⁵⁹ ibid

⁶⁰ ibid

⁶¹ Scottish Government (2014) Wetlands [online] Available at: <https://www.environment.gov.scot/media/1201/land-wetlands.pdf> (accessed 21/08/2018)

⁶² Scotland's soils (2018) Peatland restoration [online] Available at: <https://soils.environment.gov.scot/resources/peatland-restoration/> (accessed 27/12/2018)

⁶³ Scottish Government (2018) Climate Change Plan: third report on proposals and policies 2018-2032 (RPP3) – summary [online] Available at: <https://www.gov.scot/publications/scottish-governments-climate-change-plan-third-report-proposals-policies-2018-9781788516488/> (accessed 27/12/2018)

⁶⁴ Scottish Natural Heritage (undated) Blanket bog [online] Available at: <https://www.nature.scot/landscapes-and-habitats/habitat-types/mountains-heaths-and-bogs/blanket-bog> (accessed 27/12/2018)

Scotland, blanket bog is a globally rare habitat. Scotland's blanket bog accounts for 60% of the UK's total and holds 4% of Europe's peat carbon store.⁶⁵ The current state of wetlands protected for nature conservation (as determined by Scottish Natural Heritage's Site Condition Monitoring Programme) was determined to be largely favourable (70%).⁶⁶ However, work remains to be done, as evidenced by the fact that only 49% of blanket bogs and 27% of raised bogs were reported to be in good condition in 2016, respectively.⁶⁷

Key pressures on wetlands include land use change and land management practices, development, long-term changes in weather patterns, pollution, and water management.⁶⁸

Grasslands cover a third of Scotland and have an important role in feeding cattle, sheep, and wildlife. Unimproved, species-rich grassland is one of our rarest habitats as much area has been improved for agriculture to encourage the grass species that are most suitable for livestock to eat. The best grasslands for wildlife contain short and long patches – a variety of micro-habitats for a variety of species. Birds are a good indicator of biodiversity in grasslands. While some species such as goldfinch and whitethroat have doubled in abundance since 1994, others such as kestrel have experienced substantial long-term declines (i.e. -85% below 1994 levels).⁶⁹ Key pressures on unimproved grasslands includes the intensification of agriculture and the loss and improvement of non-farmed features.⁷⁰

Forests and woodlands support a wide range of important plants and animals. By the early 1900s, human influence and climate change had reduced forests to only 4.5% of Scotland's land area. These factors also altered forest compositions to the point that no woodlands in Scotland can now be considered truly natural. Since this time a huge woodland creation effort has increased our forest area dramatically, and in 2013 Scotland's woodland and forest cover had risen to 18% of Scotland's land area.⁷¹ Rare and threatened species are commonly found in and around semi-natural woodlands, but many have also colonised planted forests.

⁶⁵ Scotland's soils (undated) International Bog Day 2018: Where are we with the restoration of Scotland's Bogs? [online] Available at: <https://soils.environment.gov.scot/about-us/news/international-bog-day-2018-where-are-we-with-the-restoration-of-scotland-s-bogs/> (accessed 27/12/2018)

⁶⁶ Scottish Natural Heritage (2016) Biodiversity Indicator – Condition of notified habitats [online] Available at: <https://www.nature.scot/sites/default/files/2017-06/Scottish%20Biodiversity%20Indicator%20-%20S011%20-%20Condition%20of%20notified%20habitats%20-%202016%20Update%20-%20pdf.pdf> (accessed 27/12/2018)

⁶⁷ ibid

⁶⁸ ibid

⁶⁹ Scottish Natural Heritage (2016) Index of Abundance for Scottish Terrestrial Breeding Birds, 1994 to 2016 [online] Available at: <https://www.nature.scot/sites/default/files/2018-02/Official%20Statistics%20-%20Terrestrial%20Breeding%20Birds%20-%20Index%20of%20abundance%201994-2016.pdf> (accessed 27/12/2018)

⁷⁰ Scottish Government (2014) Scotland's State of the Environment Report 2014 [online] Available at: <https://www.environment.gov.scot/media/1170/state-of-environment-report-2014.pdf> (accessed 08/08/2018)

⁷¹ Scottish Government (2014) Woodlands and Forests [online] Available at: <https://www.environment.gov.scot/media/1202/land-woodlands-and-forests.pdf> (accessed 08/08/2018)

The condition of our forests and woodlands for wildlife is moderately good, and there are indications that it will continue to improve with sustainable management.⁷²

Native woodlands are recognised as priority habitats and despite much being done in recent times to protect and enhance them, they remain at risk from pressures such as fragmentation, wild herbivores, non-native tree planting, the spread of invasive non-native plants and animals, plant pests and diseases, climate change, and atmospheric deposition of pollutants.⁷³

Scotland has around 18,000km of coastline, with a wide variety of coastal and estuarine habitats that provide places for thousands of species to live. Scotland's coastal waters are among the world's most biologically diverse, hosting plants and animals that vary in size from large charismatic mammals to fingernail-sized shrimps that inhabit rock pools.⁷⁴

Estuarine and coastal ecosystems are complex and changes can have consequences far beyond inshore waters. The loss of living habitats such as kelp forest would not only be biologically and economically damaging, but may also be physically damaging. For example, on the west coast of Scotland, the loss of such habitats would lead to a reduction in physical shelter from prevailing westerly storms that damage Scottish coasts.⁷⁵

There are currently concerns about Scotland's inshore sea life due to pressures on their habitats and supporting food webs, and Scotland's Marine Atlas' overall assessment of species and habitats shows the poor state of marine biodiversity. Further, the overall condition of Scotland's inshore habitats is declining. Inshore sediment habitats directly support particularly fragile assemblages of species that live on them, as well as provide food and nursery areas for more mobile and wider ranging species. Habitats within Scottish inshore waters are declining, or are stable but still of concern. For example, there is concern about their ability to recover from damage and return to a condition that will support all their associated species. Of the 10 areas assessed, no habitats are improving.⁷⁶

More recently, OSPAR's Intermediate Assessment 2017 revealed declines in marine bird numbers, the alteration of benthic habitats by bottom fisheries, the recovery of fish stocks in some areas, and fluctuations in marine mammal populations as the key trends characterising the biodiversity of the North-East Atlantic Ocean, of which Scotland's seas are a part.⁷⁷

⁷² *ibid*

⁷³ Forestry Commission Scotland (undated) Scotland's Native Woodlands - Results from the Native Woodland Survey of Scotland [online] Available at: [https://www.forestry.gov.uk/PDF/FCMS126.pdf/\\$FILE/FCMS126.pdf](https://www.forestry.gov.uk/PDF/FCMS126.pdf/$FILE/FCMS126.pdf) (accessed 15/10/2018)

⁷⁴ Scottish Government (2014) Estuaries and coastal [online] Available at: <https://www.environment.gov.scot/media/1176/water-estuaries-and-coastal.pdf> (accessed 13/08/2018)

⁷⁵ *ibid*

⁷⁶ *ibid*

⁷⁷ OSPAR (2017) Intermediate Assessment 2017 – Key Messages and Highlights [online] Available at: <https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/key-messages-and-highlights/> (accessed 28/12/2018)

Some seabirds that breed in Scotland are also in decline with nine of our most common species having shown sustained declines over the past 20 years. The reasons for these declines are complex and may be a result of changes in fishing effort (resulting in changes to food availability), climate change (altering prey distributions and resulting in mortality of some species due to extreme weather events), and the effects of non-native species (such as rats on islands).⁷⁸

The impact of climate change on riverine species considered important for conservation is a matter of particular concern. For example, freshwater pearl mussel (*Margaritifera margaritifera*) may be particularly at risk. The size, duration, and frequency of floods are likely to have a detrimental effect on this species by removing the gravel substrates in which pearl mussels bury themselves; expected increases in maximum temperatures may also be damaging.⁷⁹

To summarise, some biodiversity assets (species and habitats) could be at risk because of their inability to respond to changing climatic conditions. Opportunities such as new species colonisation could also occur as a direct result of climate change. Other indirect impacts on biodiversity are also likely, such as those arising from changes in land use due to adaptation activities.⁸⁰ For example, risks and opportunities from changes in agricultural and forestry productivity and land suitability such as warmer temperatures that may allow new plants to colonise on mountain slopes that were previously un vegetated.

Population and Human Health

Scotland has a population of around 5.4 million people. Its population density is among the lowest in Europe⁸¹, although there is significant variation between highly urbanised areas in the Central Belt and rural and island areas including the Western Isles, the Highlands, and areas of Fife.⁸² By 2041, Scotland's population is expected to rise to around 5.7 million.⁸³

⁷⁸ Scottish Natural Heritage (2012) Trend note - Seabirds in Scotland [online], Available at: <https://www.nature.scot/sites/default/files/B1163280%20-%20Trend%20note%20-%20biodiversity%20-%20Seabirds%20in%20Scotland%20-%20October%202012%20-%20PDF%20for%20website.pdf> (accessed 18/10/2018)

⁷⁹ Scottish Natural Heritage (2011) Trend note - Climate change and rivers [online] Available at: <https://www.nature.scot/sites/default/files/B1043758%20-%20Natural%20Heritage%20Trends%20-%20Climate%20change%20and%20rivers%20-%20PDF.pdf> (accessed 18/10/2018)

⁸⁰ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 [online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf (accessed 08/08/2018)

⁸¹ House of Commons Scottish Affairs Committee (2016) Demography of Scotland and the implications for devolution - Second Report of Session 2017-17 [online] Available at: <https://publications.parliament.uk/pa/cm201617/cmselect/cm Scotaf/82/82.pdf> (accessed 27/12/2018)

⁸² National Records of Scotland (2017) Mid-Year Population Estimates Scotland, Mid-2016 – Population estimates by sex, age and area [online] Available at: <https://www.nrscotland.gov.uk/files//statistics/population-estimates/mid-year-2016/16mype-cahb.pdf> (accessed 27/12/2018)

⁸³ National Records of Scotland (2017) Population of Scotland [online] Available at: <https://www.nrscotland.gov.uk/statistics-and-data/statistics/scotlands-facts/population-of-scotland> (accessed 07/08/2018)

Life expectancy has generally been increasing in Scotland over the last 35 years. Since 1981, life expectancy has increased to 75.3 years (males) and 77.1 years (females). However, life expectancy in Scotland remains lower than the UK average and is the lowest of all UK constituent countries for both males and females.⁸⁴ The Scottish Index of Multiple Deprivation (SIMD), which identifies small concentrations of multiple deprivation across all of Scotland, shows that the 15% most deprived data zones in Scotland are located predominantly in urban areas, including Glasgow, Dundee, and Edinburgh.⁸⁵

The potential risks and benefits of climate change will not be evenly spread across all segments of Scotland's society, with deprived areas recognised as being more vulnerable to negative impacts due to pre-existing health problems and inequities.⁸⁶ Remote rural areas, some urban areas and coastal areas are recognised as being more vulnerable to social vulnerability and flood disadvantage.⁸⁷ Flooding is expected to increase pressure on healthcare infrastructure, particularly emergency services, with isolated communities being most vulnerable to infrastructure damage.⁸⁸ Adverse impacts on population and human health could include health effects of heat stress, the spread of vector borne disease, and other health problems from air quality. More research is needed to assess to what extent adaptation action is already underway to manage risks to population and human health from flooding and sea level rise, extreme weather impacts on the health care system, risks to health from overheating buildings, poor air quality and pathogens. Potential opportunities include health benefits from increased outdoor activity linked to higher winter temperatures, for example.⁸⁹

Soil

Scotland's soils are young, acidic, carbon rich, and nutrient poor compared to those found in the rest of the UK and mainland Europe. Approximately 90% of Scotland is composed of four major soil types: peats, gleys, brown earths, and podzols. Peat soils cover 22% of the land area in Scotland but hold more than half of the total soil carbon in the country. In general, Scotland's soils store over 3,000 million tonnes of carbon which is sixty times as much as in our vegetation. To put this in context, losing just 0.5% of

⁸⁴ National Records of Scotland (2017), Life Tables for Scotland 2014-2016 [online], Available at: <https://www.nrscotland.gov.uk/files//statistics/life-expectancy-at-scotland-level/nat-life-14-16/2014-2016-nat-life-tabs-report.pdf> (accessed 07/08/2018)

⁸⁵ Scottish Government (2016) Scottish Index of Multiple Deprivation 2016 [online] Available at: <https://beta.gov.scot/publications/scottish-index-multiple-deprivation-2016/pages/7/> (accessed 07/08/2018)

⁸⁶ SPICe (2012) SPICe Briefing - Climate Change and Health in Scotland [online] Available at: http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB_12-26rev.pdf (accessed 27/12/2018)

⁸⁷ Agriculture, Environment and Marine Social research (2015) Mapping Flood Disadvantage in Scotland 2015: Main Report [online], Available at: <https://www.gov.scot/binaries/content/documents/govscot/publications/research-publication/2015/12/mapping-flood-disadvantage-scotland-2015-main-report/documents/00490788-pdf/00490788-pdf/govscot%3Adocument> (accessed 05/02/2019)

⁸⁸ SPICe (2012) SPICe Briefing - Climate Change and Health in Scotland [online] Available at: http://www.parliament.scot/ResearchBriefingsAndFactsheets/S4/SB_12-26rev.pdf (accessed 06/02/2018)

⁸⁹ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report - Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 07/08/2018)

our soil carbon as CO₂ would be approximately the equivalent of Scotland's total annual greenhouse gas emissions.⁹⁰

The future management of our soils is vital as projected climate change threatens to promote conditions in which the loss of soil carbon becomes more likely. Certain management interventions in peatlands, forests, and agricultural soils can be used to slow or even reverse climatic change and could therefore contribute to both climate change mitigation and adaptation. Preserving or enhancing soil carbon stocks is also recognised as critically important to maintaining soil quality and delivering a wide range of ecosystem services. There has been no change in overall total soil organic carbon (SOC) stock across Scotland over the past 25 years⁹¹, with the exception of arable and horticultural soils which between 1998 and 2007 experienced a statistically significant decline of 9.3% in mean SOC concentrations.⁹²

Modelling suggests that annual erosion rates are less than one tonne per hectare per year for the majority of Scotland under recent rainfall patterns and land uses (1971-2000), and at this level it is unlikely to result in deterioration or loss of soil functions. Notwithstanding, losses of two or more tonnes per hectare per year are predicted in arable areas of eastern Scotland, depending on which crops are grown. This is likely to be further exacerbated into the future as the risk of water-based soil erosion is expected to be higher as a result of projected increases in the frequency and intensity of heavy rainfall events.⁹³

Soil is at risk from a number of threats which can result in soil being damaged to such an extent that it can no longer carry out its essential functions, or soil being irretrievably lost. These include erosion, changing vegetation, acidification, compaction, loss of organic matter, and sealing by development. Threats from erosion are generally of localised significance; however, it can also lead to loss of important functions. Changes in vegetation also alter soil biodiversity which can significantly affect soil as a habitat and the functions it sustains.⁹⁴ Soil sealing (covering soil with impervious material or as a result of compaction) affects almost all functions.⁹⁵ Climate change poses risks to Scotland's soils including increased seasonal aridity and wetness and

⁹⁰ Scottish Environmental Protection Agency (undated) Making the case for the environment - Soil [online] Available at: https://www.sepa.org.uk/media/120183/mtc_soil_core_document.pdf (accessed 08/08/2018)

⁹¹ Natural Environment Research Council (2007) Countryside Survey: Scotland Results from 2007 – Chapter 2: The National Picture [online] Available at: <http://www.countrysidesurvey.org.uk/sites/default/files/CS-Scotland-Results2007-Chapter02.pdf> (accessed 27/12/2018)

⁹² Natural Environment Research Council (2007) Countryside Survey: Scotland Results from 2007 – Chapter 4: Enclosed Farmland: Arable and Horticulture and Improved Grassland Broad Habitats [online] Available at: <http://www.countrysidesurvey.org.uk/sites/default/files/CS-Scotland-Results2007-Chapter03.pdf> (accessed 27/12/2018)

⁹³ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report- Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 10/08/2018)

⁹⁴ Scottish Government (2009) Scottish Soil Framework [online] Available at: <https://www.gov.scot/Publications/2009/05/20145602/0> (accessed 10/08/2018)

⁹⁵ Scottish Government (2006) Scotland's Soil Resource - Current State and Threats [online] Available at: <https://www2.gov.scot/Resource/Doc/149337/0039742.pdf> (accessed 10/08/2018)

risks to natural carbon stores and sequestration. More action is needed to manage these risks.⁹⁶

Water

Scotland's water is a valuable resource that provides a range of benefits including the provision of drinking water vital for our health, and industry (e.g. supporting fisheries and hydropower) and for recreation. It also supports a range of habitats and contains nationally and internationally important species. There are approximately 125,000km of river, 25,500 lochs (2,000 km²), 49 estuaries (1,000km²), 19,000km of coastline (48,000km²), and 462,000km² of offshore water found across Scotland and its marine territory. Covering approximately 2% of Scotland's land area, rivers and lochs contain 90% of the UK's surface freshwater.⁹⁷

Significant reductions in pollution have been realised over the last 25 years and 56.1% of our surface waters were recorded as being in good or high overall condition in 2017, despite some localised areas of concern.⁹⁸ The proportion of surface waters in good or high overall condition is predicted to rise to 70.3% by 2021 and 89.2% by 2027.⁹⁹ Key pressures affecting the overall condition of these waters include man-made barriers to fish migration, modifications to physical condition, and pollution.¹⁰⁰

The majority of groundwaters are also in good or high condition (83.1%) and this number is predicted to rise to 84.3% (2021) and 90.0% (2027). Key pressures affecting the overall condition of these waters include rural diffuse pollution and mine and non-waste water discharges.¹⁰¹

The predicted effects of climate change such as increased temperatures and changes in rainfall patterns may impact river flow and water availability. For waters that are already under pressure from nutrient inputs, the higher temperatures predicted as a result of climate change may further stimulate excessive and damaging growth of water plants. The potential increase in extreme rainfall events and flooding may result in more of the soil and nutrients from agricultural land being washed into surface waters and impact on freshwater species and water quality.¹⁰²

Air

⁹⁶ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report - Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 16/08/2018)

⁹⁷ Scottish Government (2014) Scotland's State of the Environment Report, 2014 [online] Available at: <https://www.environment.gov.scot/media/1170/state-of-environment-report-2014.pdf> (accessed 16/08/2018)

⁹⁸ Scotland's environment (2017) Scotland's freshwater - Interactive data analysis application [online] Available at: <https://www.environment.gov.scot/our-environment/water/scotland-s-freshwater/> (accessed 28/12/2018)

⁹⁹ Scottish Environment Protection Agency (2015) Water Environment Hub [online] Available at: <https://www.sepa.org.uk/data-visualisation/water-environment-hub/> (accessed at 16/08/2018)

¹⁰⁰ ibid

¹⁰¹ ibid

¹⁰² Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report - Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 16/08/2018)

Air quality is affected by pollutants released into the atmosphere through human activity as well as from natural sources. Urban air quality has improved significantly since the 1950s; however, in certain areas poor air quality continues to affect human health and the environment. Air pollution can contribute to a number of health problems and climate change may exacerbate these issues and alter current patterns and concentrations of air pollution.

Key pressures on air quality are emissions from transport, energy production and industry (including agriculture) and in urban areas transport emissions are significant because they increase levels of particulates and nitrogen oxides.¹⁰³

Where air standards are not being met, local authorities have set up Air Quality Management Areas (AQMAs). There are currently 38 AQMAs spanning 32 Local Authorities in Scotland and these have been established primarily as a result of traffic emissions. Between 1990 and 2015 there have been reductions in emissions across all pollutants including ammonia (10%), PM10 (63%), NMVOC (66%), nitrogen oxides (71%), carbon monoxide (83%), sulphur dioxide (92%) and lead (99%).¹⁰⁴

Air quality and climate change are intrinsically linked as they both arise from broadly the same source. Therefore, measures that seek to improve air quality (for example, AQMAs) can also have a positive impact on the climate. However, some measures that seek to reduce the impacts of climate change have the potential to have a negative impact on air quality (for example, the use of biomass for energy).¹⁰⁵

Material Assets

Significant land- and water- based industries in Scotland include agriculture¹⁰⁶, aquaculture¹⁰⁷, woodlands and forestry¹⁰⁸, transport infrastructure¹⁰⁹, and energy.¹¹⁰

Agriculture is the most dominant single use of land in Scotland. Around three quarters of Scotland's land area is used for agriculture, predominantly grassland for rearing livestock, and around a fifth is used for arable farming, with the most productive land

¹⁰³ Air Quality in Scotland (2018) Air Quality Management Areas [online] Available at: <http://www.scottishairquality.co.uk/laqm/aqma> (accessed 10/08/2018)

¹⁰⁴ Scottish Government (2015) Air Quality - Air Pollutant Emissions - High Level Summary of Statistics Trend – Last update: Monday, October 9, 2017 [online] Available at: <https://www2.gov.scot/Topics/Statistics/Browse/Environment/trendairpollutants> (accessed 10/08/2018)

¹⁰⁵ Defra (2010) Air Pollution: Action in a Changing Climate [online] Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69340/pb13378-air-pollution.pdf (accessed 10/08/2018)

¹⁰⁶ NFU Scotland (undated) Farming Facts – Scottish Farming [online] Available at: <https://www.nfus.org.uk/farming-facts.aspx> (accessed 17/01/2019)

¹⁰⁷ Scotland's aquaculture (undated) Scotland's Aquaculture [online] Available at: http://aquaculture.scotland.gov.uk/our_aquaculture/our_aquaculture.aspx (accessed 17/01/2019)

¹⁰⁸ CJC Consulting (2015) The economic contribution of the forestry sector in Scotland [online] Available at: <https://scotland.forestry.gov.uk/images/corporate/pdf/economic-contribution-forestry-2015.pdf> (accessed 17/01/2019)

¹⁰⁹ Transport Scotland (2017) Scottish Transport Statistics No 36 – 2017 Edition [online] Available at: <https://www.transport.gov.scot/media/41863/scottish-transport-statistics-2017-with-correction-to-table-214.pdf> (accessed 17/01/2019)

¹¹⁰ Scottish Government (2018) Energy in Scotland 2018 [online] Available at: <https://www2.gov.scot/Resource/0054/00541605.pdf> (accessed 17/01/2019)

located in the east.¹¹¹ The beef industry is the single largest sector of Scottish agriculture and Scotland holds almost 30% of the UK herd of breeding cattle. Scotland also holds a significant percentage of the UK share of sheep breeding stock (20%) and dairy cows (9%).¹¹²

In 2016, 462,000 hectares of cereals and oilseeds were grown in Scotland, accounting for 12% of the UK cereal area and making Scotland the third largest cereal producer in the EU after France and Germany.¹¹³ The main cereal crop in Scotland is barley. Apart from cereals, potatoes and oilseed rape are the main crops produced in Scotland. Notably, the majority of seed potatoes for the UK potato industry are grown in Scotland. Fruit and vegetable production is also prevalent in some more fertile areas such as Tayside and Angus.¹¹⁴

In addition to land-based agriculture, Scotland's seas provide a variety of food. Aquaculture is an increasingly important industry for Scotland, helping sustain economic growth in the rural and coastal communities of the north and west.¹¹⁵

Woodlands constitute 1.4 million hectares (18%) of Scotland's land area. The consultative draft of Scotland's Forestry Strategy 2019-2029 lists further expanding the area of all types of woodlands and forests as a priority that will help deliver existing government forestry commitments, such as the Climate Change Plan's aim to increase woodland cover from 18% to 21% of the Scottish land area by 2032.¹¹⁶ The forestry sector contributes approximately £1 billion GVA to Scotland's economy every year.¹¹⁷ The quantity of timber harvested has increased relatively steadily over the past 35 years and is currently around seven times the level of the late 1970s.¹¹⁸

In terms of transport infrastructure, the latest figures list the total length of public road in Scotland as 56,250km.¹¹⁹ Since 1975, traffic volume on Scotland's major roads has doubled, reaching its highest ever level in 2016.¹²⁰ The trunk road network makes up 7% of the Scottish road network and carries 38% of all traffic¹²¹ and 60% of all heavy

¹¹¹ SEPA (undated) Agriculture [online] Available at: <https://www.sepa.org.uk/regulations/land/agriculture/> (accessed 10/08/2018)

¹¹² National Farmers Union Scotland (undated) What We Produce - Cattle and Sheep Farms [online] Available at: <https://www.nfus.org.uk/farming-facts/what-we-produce.aspx> (accessed 10/08/2018)

¹¹³ *ibid*

¹¹⁴ *ibid*

¹¹⁵ Scottish Government (2018) Aquaculture [online] Available at: <https://www.gov.scot/Topics/marine/Fish-Shellfish> (accessed 10/08/2018)

¹¹⁶ Scottish Government (2018) Scotland's Forestry Strategy 2019-2029 - A Consultation Draft [online] Available at: https://consult.gov.scot/forestry/scotlands-forestry-strategy-2019-29/user_uploads/sct08184172781.pdf (accessed 24/12/2018)

¹¹⁷ Forestry Commission Scotland (2018) The economic contribution of forestry in Scotland [online], Available at: <https://scotland.forestry.gov.uk/supporting/forest-industries/economic-contribution-report>, (accessed 14/08/2018)

¹¹⁸ Scottish Government (2018), High Level Summary Statistics - Agriculture, Sea Fisheries and Rural [online], Available at: <https://www.gov.scot/Topics/Statistics/Browse/Agriculture-Fisheries/TrendData> (accessed 14/08/2018).

¹¹⁹ Transport Scotland (2017) Scottish Transport Statistics No 36 - 2017 Edition [online] Available at: <https://www.transport.gov.scot/media/41863/scottish-transport-statistics-2017-with-correction-to-table-214.pdf> (accessed 24/12/2018)

¹²⁰ *ibid*

¹²¹ *ibid*

goods.¹²² Our rail network has 2,819km of track, 25% of which is electrified.¹²³ Around 89.2 million passenger journeys were made within Scotland in 2016.¹²⁴ After falling between 1960 and 1994-5, rail freight traffic increased for a period up to 2005 but has since declined.¹²⁵ Scottish ports handled 67 million tonnes of cargo in 2016 and 8.3 million passengers (on ferry routes within Scotland).¹²⁶ In addition to being an important means of distributing goods, the shipping sector also helps deliver lifeline ferry services which are vital to island communities.¹²⁷ There are also five main airports, four of which account for around 94% of total passengers as well as thirteen other smaller airports mainly serving the islands.¹²⁸

Roads, railways, airport runways, shipping terminals, canals, and bridges are examples of the facilities and structures that are required to provide transportation services that enable the movement of people and freight. This infrastructure may be affected adversely though climate change, leading to disruption.

Impacts on some infrastructure have the potential to cascade on to others as part of interdependent networks. Flooding poses the greatest long term risk to infrastructure performance from climate change but the growing risks from heat, water scarcity and slope instability caused by severe weather could be significant. There may be increased competition for water and water quality and quantity problems could be exacerbated by extreme weather brought on by climate change. Extreme weather events will affect the ability of the health and social care sector to deliver services due to impact of events on material assets (infrastructure) as well as increased demand from incidents associated with the events themselves. Some Material assets including road and rail transport are generally more vulnerable to a changing climate than air and water transport and flooding is anticipated to be the most significant impact on these networks, as well as those arising from extreme weather conditions and landslides.¹²⁹

Scotland accounts for around 10% of the UK's total energy consumption.¹³⁰ The majority of the UK's oil production and more than half of its natural gas production comes from fields based in the continental shelf around Scotland.¹³¹ The largest single renewable energy sector in Scotland is onshore wind, followed by hydro, solar, and

¹²² Transport Scotland (undated) The Trunk Road Network [online] Available at: <https://www.transport.gov.scot/transport-network/roads/the-trunk-road-network/#> (accessed 24/12/2018)

¹²³ Transport Scotland (2017) Scottish Transport Statistics No 36 - 2017 Edition [online] Available at: <https://www.transport.gov.scot/media/41863/scottish-transport-statistics-2017-with-correction-to-table-214.pdf> (accessed 24/12/2018)

¹²⁴ *ibid*

¹²⁵ *ibid*

¹²⁶ *ibid*

¹²⁷ Marine Scotland (2018) Scotland's marine economic statistics [online] Available at: <https://www.gov.scot/publications/scotlands-marine-economic-statistics/pages/12/> (accessed 24/12/2018)

¹²⁸ Transport Scotland (2017) Scottish Transport Statistics No 36 - 2017 Edition [online] Available at: <https://www.transport.gov.scot/media/41863/scottish-transport-statistics-2017-with-correction-to-table-214.pdf> (accessed 24/12/2018)

¹²⁹ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 14/08/2018)

¹³⁰ Scottish Government (2018) Energy in Scotland 2018 [online] Available at: <https://www2.gov.scot/Resource/0054/00541605.pdf> (accessed 28/12/2018)

¹³¹ Scottish Government (2018) Oil and Gas Production Statistics 2017-18 – Key findings [online] Available at: <https://www2.gov.scot/Resource/0054/00540205.pdf> (accessed 28/12/2018)

bioenergy.¹³² The Scottish Government seeks to generate 50% of Scotland's overall energy consumption from renewable sources and to have decarbonised our energy system almost completely by 2050. Scotland's wind and seas hold some of the most concentrated potential not only across the UK and Europe but in the world, with an estimated 25% of Europe's offshore wind resources.¹³³

Scotland was one of the first countries to harness electricity from its waters and its ambitious hydro building programme in the 1950s-60s resulted in infrastructure which continues to produce electricity. Hydro generation in 2015 was at a record high level – 5,828 GWh, up 7.2% on 2014.¹³⁴ Further, Scotland is estimated to have significant oil reserves accounting for almost 60% of Europe's total reserves.¹³⁵

Changes in climate have the potential to impact on material assets in a number of ways. Agriculture and forestry are very closely linked to the climate and hence changes in climate are likely to impact on these both positively and negatively. Positive impacts could include potential higher yields and opportunities for carbon storage. Negative impacts could include for example potential for new pests and diseases to establish and for existing ones to become more damaging.¹³⁶

Flooding and extreme weather events which damage material assets and disrupt business operations pose the greatest threat to Scottish businesses now and in the future. Supporting resilient infrastructure (in particular power, fuel supply and ICT) is crucial in enabling businesses to minimise disruptions to their operations from climate change risks. Businesses are at risk from climate change impacts including flooding, impacts on coastal locations and infrastructure, and reduced employee productivity (from infrastructure disruption/higher temperatures in working environments). Other risks include possible water scarcity, reduced access to capital and disruption to supply chain and distribution networks. Other risks and opportunities to Businesses may occur from changes in demand for goods and services.¹³⁷

In relation to energy assets, changes in storm severity and frequency as well as increased wave heights may pose risks to existing and planned offshore renewable energy infrastructure, although further research is needed to determine what kind of impacts are likely. Similarly, increased risk of extreme weather events could damage to transport infrastructure and disruption to road and rail operations.¹³⁸

¹³² National Statistics (2018) Energy Trends: renewables [online] Available at: <https://www.gov.uk/government/statistics/energy-trends-section-6-renewables> (accessed 28/12/2018)

¹³³ Scottish Government (2018) Sectoral marine plan for offshore wind energy: context report [online] Available at: <https://www.gov.scot/publications/sectoral-marine-plan-offshore-wind-energy-encompassing-deep-water-plan/pages/5/> (accessed 28/12/2018)

¹³⁴ Scottish Government (2018) Energy in Scotland: Get the facts [online] Available at: <https://www2.gov.scot/Topics/Business-Industry/Energy/Facts> (accessed 28/12/2018)

¹³⁵ *ibid*

¹³⁶ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 14/08/2018)

¹³⁷ *ibid*

¹³⁸ *ibid*

Cultural Heritage

Scotland's historic environment includes thousands of historic buildings and monuments. Their unique and irreplaceable nature attracts millions of visitors every year and generate income and jobs. Some assets are protected through designation. In 2016, there were 6 World Heritage Sites, 47,288 listed buildings, 8,164 scheduled monuments, 663 conservation areas, 377 designed gardens and landscapes, 8 historic Marine Protected Areas, 7 wrecks, and 39 nationally important battlefields across Scotland.¹³⁹

Most (90-95%) of the historic environment is undesignated. Nevertheless, these sites provide important contextual information which aids in the understanding of designations as well as possessing important cultural, social, and economic values in their own right¹⁴⁰

Key existing pressures affecting the historic environment include development pressures, maintenance, land use, and coastal erosion. Climate change is likely to affect cultural heritage assets and their immediate surroundings, such as parks and gardens may be threatened from the effects of extreme weather (flooding, erosion or land instability) and longer term, chronic damage to building fabric.¹⁴¹ Impacts of climate change including projected wetter autumns and winters mean traditional buildings will be wet for longer periods of time, resulting in increased weathering and corrosion. There is a need to protect vulnerable cultural heritage assets (including designated and undesignated sites and their settings from direct climate change impacts (such as flood risk, hydrological changes, soil erosion and vegetation growth) but also from indirect effects of climate change (such as damage to building fabric as a result of adaptation measures).¹⁴² Similarly, rising sea levels mean that coastal erosion is an increasing threat to maritime heritage assets.¹⁴³

Landscape

Scotland is famous for its distinctive and diverse landscapes. These include urban areas, managed the countryside of central and eastern Scotland to the less intensively managed uplands and coasts of southern Scotland, the Highlands, and the islands.

¹³⁹ Scottish Government (undated) Historic environment [online] Available at: <https://www.environment.gov.scot/our-environment/people-and-the-environment/historic-environment/> (accessed 10/08/2018).

¹⁴⁰ Historic Environment Scotland (2016), Scotland's Historic Environment Audit 2016 - Summary Report 2016 [online] Available at: <https://www.historicenvironment.scot/archives-and-research/publications/publication/?publicationId=315b3f0d-631b-4a24-b12b-a6db00ba1696> (accessed 10/08/2018)

¹⁴¹ Committee on Climate Change (2017) UK Climate Change Risk Assessment 2017 Evidence Report Summary for Scotland [online] Available at: <https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Scotland-National-Summary.pdf> (accessed 01/02/2019)

¹⁴² Scottish Government (2010) Consideration of Climatic Factors within Strategic Environmental Assessment (SEA) [online] Available at: <https://beta.gov.scot/binaries/content/documents/govscot/publications/publication/2010/03/consideration-climatic-factors-within-strategic-environmental-assessment-sea/documents/0096207-pdf/0096207-pdf/govscot.document/> (accessed 15/10/2018)

¹⁴³ Scottish Government (undated) Historic environment [online] Available at: <https://www.environment.gov.scot/our-environment/people-and-the-environment/historic-environment/> (accessed 10/08/2018)

Landscapes of the highest quality have been designated and include 40 National Scenic Areas (NSA) and two National Parks. Our landscapes have evolved over thousands of years as a consequence of natural and cultural forces, and they are still changing.

In general, landscape change has not resulted in any types of landscape character being lost or significantly changed. Nevertheless, important changes to some of the physical elements of landscapes are resulting in observable trends. For example, regional and local landscapes are becoming less distinct as a result of more similarity in building form, settlement patterns, and agricultural practices. Similarly, the distinctive landscape settings of urban areas is being lost as a result of settlement expansion and associated infrastructure such as roads and railways, while the development of renewable energy technology such as wind farms is affecting the extensive views and strong natural character of many of Scotland's rural landscapes.¹⁴⁴

Key landscape pressures include climate change, development, and changes in land use. Direct climate change impacts will result from changing temperatures, rainfall, extreme weather events (including drought and flood), and sea level change. It is likely that some land will be lost to the sea, that flooding will increase, and that the distribution patterns of natural and semi-natural habitats will change. Higher temperatures may also allow new crops to be grown and extend existing growing seasons.¹⁴⁵

Other, indirect effects from climate change, such as the spread of destructive pests and pathogens, could lead to more subtle landscape change through the loss of plant species from the landscape. The combined effects of climate change are likely to be most obvious in lowland and coastal areas, which coincides with such areas being more densely populated and hence resulting in a disproportionate impact on people. In the uplands, with the exception of developments such as wind farms, landscape change as a result of climate change may be less noticeable.¹⁴⁶

¹⁴⁴ Scottish Government (2014) Landscape [online] Available at: <https://www.environment.gov.scot/media/1196/land-landscape.pdf> (accessed 10/08/2018)

¹⁴⁵ ibid

¹⁴⁶ ibid

Appendix C Compilation of relevant findings from previous related SEA work

SEA Topic Area	Relevant findings from SEA Environmental Reports
Air and Climatic Factors	<ul style="list-style-type: none"> • The Adaptation Framework’s SEA identified limited impacts on air and climatic factors due to focus on adaptation. (Climate Change Adaptation Framework SEA) • Measures that support emissions reductions are likely to have positive effects on climatic factors. Positive secondary effects on air quality are likely from measures that support the decarbonisation of energy generation and transport. (Climate Change Bill SEA) • Achieving emissions reductions will both increase resilience to future climatic change and facilitate adaptation, particularly through changes in land use management and through storing carbon in the terrestrial and marine environments. (Climate Change Bill SEA).
Biodiversity	<ul style="list-style-type: none"> • The Adaptation Framework’s SEA identified potential for mixed impacts on biodiversity, and uncertainty around possible interactions. Actions seek to improve adaptive capacity. (Climate Change Adaptation Framework SEA) • Measures that support resilient habitats, tackle invasive species, and manage coastal habitats in particular are likely to result in positive effects on biodiversity. (Sector Action Plans SEA) • Natural environment measures will have largely positive effects on biodiversity, and potential negative effects from flood risk measures will depend on alleviation methods used. (SCCAP1 SEA) • Measures that result in changes to buildings have the potential to impact biodiversity (e.g. bats and birds) and should be considered at project level. (Climate Change Plan and Energy Strategy SEA)
Population and Human Health	<ul style="list-style-type: none"> • Findings from previous relevant SEA work suggest that different sectors of the population are likely to be impacted in different ways and further research is needed to determine where greater adaptation action is required. (Climate Change Adaptation Framework SEA) • Positive effects on population and human health are likely from flood management and risk avoidance measures as well as emergency responses to flooding, wildfire, and disease. (Sector Action Plans SEA) • In the long-term, there may be opportunities to address the positive (e.g. improved physical and mental wellbeing) as well as the potentially negative (e.g. greater exposure to ultraviolet light) impacts associated with increased outdoor access. (SCCAP1 SEA) • Positive secondary effects on population and human health are likely from measures that reduce greenhouse gas emissions and improve air quality (particularly through decarbonisation of energy generation and transport). (Climate Change Bill SEA) • Additional benefits to human health and wellbeing are likely from measures that facilitate improved energy security. (Climate Change Plan and Energy Strategy SEA)
Soil	<ul style="list-style-type: none"> • Findings from previous relevant SEA work suggests soil’s role as a carbon store is largely protected. However, there is a need to improve

SEA Topic Area	Relevant findings from SEA Environmental Reports
	<p>integration of soil management across topic areas and enhance our understanding of soil's vulnerability to climate change. (Climate Change Adaptation Framework SEA)</p> <ul style="list-style-type: none"> • Previous SEA work on Sector Action Plans did not identify adverse effects on soil based on assumptions around agricultural and forestry sector protection of soil quality and biodiversity. (Sector Action Plans SEA) • Adaptation measures that support buildings and infrastructure networks including potential excavation works linked to transport infrastructure resilience could result in mixed effects on soils. (SCCAP1 SEA)
Water	<ul style="list-style-type: none"> • The Adaptation Framework's SEA considered the impacts of climate change on the water environment and recognised scope to improve understanding of competing demands on the water environment. (Climate Change Adaptation Framework SEA) • Certain measures in the SEA of the Sector Action Plans were identified as supporting water quality and flood management. (Sector Action Plans SEA) • Natural environment measures could have medium and long-term benefits for water and further measures addressing impacts on water quality and quantity could be beneficial. (SCCAP1 SEA)
Material Assets	<ul style="list-style-type: none"> • There will be mixed effects on material assets resulting from climate change adaptation measures across different policy sectors. (Climate Change Adaptation Framework SEA) • Sector responses to the need to protect forestry and agriculture and increase the sustainability of transport and infrastructure could have positive effects on material assets. (Sector Action Plans SEA) • Adaptation measures that support the natural environment and buildings and infrastructure networks could have positive effects on material assets in the medium/long-term. (SCCAP1 SEA) • Further work to identify impacts on energy generation arising from changes in water supply, temperature, and storm damage as a direct result of climate change could be beneficial. (SCCAP1 SEA) • New infrastructure required to reduce emissions will be the primary source of any negative secondary effects on other receptors. Effects can be reduced through reuse wherever possible and project level mitigation. (Climate Change Bill SEA)
Cultural Heritage	<ul style="list-style-type: none"> • Conflict between protection of cultural heritage and adaptation actions is likely and direct and indirect adaptation responses are likely to result in mixed impacts. (Climate Change Adaptation Framework SEA) • Some positive effects may be likely through protective measures. (Sector Action Plans SEA) • Measures that result in changes to buildings have the potential to impact cultural heritage and should be considered at project level. Measures taken to increase the resilience of some forms of transport infrastructure could also have an effect on cultural heritage. (SCCAP1 SEA)

SEA Topic Area	Relevant findings from SEA Environmental Reports
Landscape	<ul style="list-style-type: none"> • Adaptation measures are likely to result in landscape change and this could result in positive or negative impacts. (Climate Change Adaptation Framework SEA) • Policy protection for landscapes outside protected areas is more limited and so such landscapes are more vulnerable to change. (Climate Change Adaptation Framework SEA) • Potential negative effects on landscapes from flood risk measures will depend on the alleviation methods used. (SCCAP1 SEA)



Appendix D Respondent information form

Draft Second Scottish Climate Change Adaptation Programme

Respondent information form

Please Note this form **must** be completed and returned with your response.

To find out how we handle your personal data, please see our privacy policy: <https://beta.gov.scot/privacy/>

Are you responding as an individual or an organisation?

- Individual
 Organisation

Full name or organisation's name

Phone number

Address

Postcode

Email

The Scottish Government would like your permission to publish your consultation response. Please indicate your publishing preference:

- Publish response with name
 Publish response only (without name)
 Do not publish response

Information for organisations:

The option 'Publish response only (without name)' is available for individual respondents only. If this option is selected, the organisation name will still be published.

If you choose the option 'Do not publish response', your organisation name may still be listed as having responded to the consultation in, for example, the analysis report.

We will share your response internally with other Scottish Government policy teams who may be addressing the issues you discuss. They may wish to contact you again in the future, but we require your permission to do so. Are you content for Scottish Government to contact you again in relation to this consultation exercise?

- Yes
 No



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