River Avon Tidal Flood Risk Management Strategy

Strategic Environmental Assessment: Environmental Report

September 2017

Prepared for Bristol City Council

Limitations

AECOM Infrastructure & Environment UK Limited ("AECOM") has prepared this Report for the sole use of Bristol City Council ("Client") in accordance with the Agreement under which our services were performed River Avon Tidal Flood Risk Management Strategy RESP1007626 (23/10/15) and Response to Tender Submission Clarifications (03/11/15) (the "Agreement"). The report takes into account the particular instructions and requirements of the Client in accordance with the provisions of the Agreement. It is not intended for and cannot be relied upon by any third party. No liability is accepted by AECOM and no responsibility is undertaken to any third party.

Information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between April 2016 and September 2017 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Copyright

Assurance information

Document name	Ref	Prepared for	Prepared by	Reviewed by	Checked by	Date
River Avon Tidal Flood Risk Management Strategy Strategic Environmental Assessment: Interim SEA Environmental Report	'Options' Draft (pre-confirmation and finalisation of preferred option)	Bristol City Council	Hayley Siers Graduate Consultant Alex White Associate Director	Jason Drummond Principal Consultant	David Dales Director	August 2016
River Avon Tidal Flood Risk Management Strategy Strategic Environmental Assessment: SEA Environmental Report	Draft	Bristol City Council	Hayley Siers Graduate Consultant Alex White Associate Director	Jason Drummond Principal Consultant	David Dales Director	February 2017
Bristol City Council	Final Draft following incorporation of client comments	Bristol City Council	Hayley Siers Consultant Alex White Associate Director	Jason Drummond Principal Consultant	Nikki Smith Regional Director	April 2017
River Avon Tidal Flood Risk Management Strategy Strategic Environmental Assessment: SEA Environmental Report	Revised Final in response to Environment Agency comments (J Ager, 17 Aug 2017)	Bristol City Council	Jon Short Principal Consultant Graham McGrath Environmental Consultant	Steve Smith Technical Director	David Dales Technical Reviewer	September 2017

Table of Contents

Non-technical summary

The River Avon Tidal Flood Risk Management Strategy (TFRMS)

AECOM was commissioned to undertake a Strategic Environmental Assessment (SEA) to support the development of Bristol City Council's River Avon Tidal Flood Risk Management Strategy. This Environmental Report outlines the SEA process followed and presents the key findings of the environmental assessment of options. This report often references the SEA scoping report which sets out the environmental baseline and context for the assessment; this is found in Appendix A.

Strategic Environmental Assessment

SEA is required for certain plans and programs through European legislation known as the SEA Directive. SEA is undertaken to identify likely significant positive and negative effects that these plans and programs may have on the environment, and promote the consideration of environmental issues in the decision making process.

Whilst it is uncertain whether or not The Strategy requires SEA (no screening determination was undertaken) the Council decided to commission a voluntary SEA. The options assessed during the development of The Strategy, and the recommended preferred option, were subject to the SEA as detailed in this Environmental Report. This Environmental Report has been updated following stakeholder consultation and represents the final Environmental Report. Once The Strategy is adopted, an SEA Statement will be prepared by Bristol City Council.

Baseline and Context Review

The Study Area covered by The Strategy is located within Bristol. The Strategy is focused on the area which extends from the mouth of the River Avon in the west, at the point where it joins the Severn Estuary, through Bristol city centre, to Netham Weir in the east.

An earlier phase in the SEA process (referred to as 'scoping') defined the baseline, i.e. the current state of the environment in the Study Area and set the environmental objectives against which the performance of The Strategy would be assessed. The scope was presented in a 'Scoping Report' and was reviewed and confirmed by the statutory consultees (Historic England, Natural England and the Environment Agency). The Scoping Report is contained within Appendix A of this Environmental Report. All review comments, and details of how these have been accounted for in the SEA are included in Appendix B of the Environmental Report.

Summary of Significant Environmental Effects and Mitigation and Enhancement Opportunities

The SEA was undertaken as an integral part of The Strategy option appraisal phase in order that the potential strategic flood management options were comprehensively assessed against the environmental objectives established through scoping and to ascertain evaluate and compare the potential environmental impacts of different options.

This process, coupled with the multivariate appraisal contained within the 9B Report, Long List Report and Preferred Option Report has ensured that the environmental, technical, economic and social aspects and implications of the preferred option have been robustly assessed.

As will be highlighted throughout this SEA and its supporting documents, environmental mitigation will be promoted where unavoidable environmental impacts are expected to occur. This will ensure that the strategic management options are deliverable and legally compliant with international environmental

legislation. In addition, potential environmental enhancement opportunities have been identified for further exploration in subsequent stages of scheme design and development (subject to funding and deliverability).

The SEA has identified that the TFRMS preferred option has the potential to deliver the following significant positive effects on the environment:

- **Population/Health: people who are currently at risk from flooding in their homes or places of work will feel safer knowing that flood risk has been reduced by building flood defences;**
- **Material Assets: where defences are maintained or built, there will be a reduction in the number of properties, such as homes and businesses that are at risk of flooding. The defences will also protect land which is earmarked in the Local Plan for future development.**
- **Soil: there are sections of the alignment which may contain contaminated land. Flood defences will reduce the risk of flooding in these areas, and potentially reduce the risk of contaminated runoff;**
- **Cultural Heritage: there will be a reduction in the number of important historic buildings and structures at risk from flooding; and**
- **Climatic Factors: The defences will provide a high standard of protection from tidal flooding and therefore will provide protection from sea level rise due to climate change.**

In delivering these benefits, the construction of defences has the potential to bring about significant negative effects for biodiversity (if unmitigated/compensated) from loss of intertidal habitat. At this stage there are currently too many remaining uncertainties and unknowns, as well as a lack of supporting scheme impact modelling to enable firm or specific conclusions or recommendations with regard to compensation requirements.

Indicative scale of impacts for the Strategy delivery along with potential mitigation strategies, compensation requirements and monitoring work have been presented and signposted in this Environmental Report. However, the quantum and nature of biodiversity impacts and legislative compliance requirements will need to be further assessed and worked up in detail during the development and detailed design of individual schemes flowing from the Strategy. This further work will also need to include evaluation of any in combination effects with other relevant plans and programmes at the time.

It is likely that habitat losses could potentially be addressed through the Environment Agency's Regional Habitat Creation Programme, or through local creation as part of scheme delivery. The precise amount and type of compensatory habitat required will need to be determined and delivered through the design and scheme implementation phases. The need to engineer out or minimise habitat loss should be made a priority during detailed design of schemes flowing from the Strategy.

Potential minor (non-significant) negative environmental effects have also been identified in respect to landscape and heritage due to the introduction of a physical barrier on the urban realm. However opportunities to mitigate this impact have been identified (e.g. green resilience corridors and landscaped raised defences).

Monitoring

The SEA Directive requires that the significant environmental effects of The Strategy should be monitored once it has been adopted. A series of environmental indicators which could be monitored are outlined in this final Environmental Report.

Introduction

AECOM was commissioned to undertake a Strategic Environmental Assessment (SEA) in support of Bristol City Council's (BCC) emerging River Avon Tidal Flood Risk Management Strategy (The 'Strategy').

A tidal flood risk management strategy for Bristol is vitally important for the city, not just because of the threat to lives and property, but also because of the risk of long-term reputational damage to the city's attractiveness for investment and overall economic performance. Climate change has the potential to constrain the scale and form of development in central Bristol.

The Strategy recommends an adaptive programme of works, and identifies when flood risk management interventions are needed and how potential funding will be sought. The Strategy, once adopted by BCC's Cabinet following a Key Decision, will provide evidence to support the partial refresh of Bristol's Local Plan.

SEA explained

SEA is a mechanism for assessing and communicating the likely significant effects of an emerging plan, programme or strategy, and reasonable alternatives, in terms of key environmental issues. The aim of SEA is to inform and influence the decision-making process with a view to avoiding or mitigating negative effects and maximising positive effects.

SEA is undertaken in line with the procedures prescribed by the Environmental Assessment of Plans and Programmes Regulations 2004 (the SEA Regulations) which transpose into national law EU Directive 2001/42/EC 'on the assessment of the effects of certain plans and programmes on the environment' (the SEA Directive). The main aim of the SEA Directive is to *"provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development".*

As stated in paragraph 1.1, this SEA is being voluntarily undertaken by BCC; no screening exercise has been undertaken to determine whether The Strategy requires SEA under the SEA Regulations. However, BCC decided that although an SEA is not legally required (as The Strategy does not meet the statutory definition of a plan or programme potentially requiring SEA), as outputs of this project will inform the local plan refresh and constitute a recommendation for future action, a voluntary SEA would be endorsed by relevant parties. The reason for this is that this type of strategic approach would provide for a suitable assessment with regards to informing the decision making process; help to inform the choice of 'preferred option'; and provide a robust assessment of The Strategy on environmental grounds.

Two key procedural requirements of the SEA Regulations are:

1. **Regulation 12 (5): When deciding on 'the scope and level of detail of the information' which must be included in the 'Environmental Report' – a key output of the SEA process - there is a consultation with the 'consultation bodies'[1]; and**
2. **Regulation 13 (1): The Environmental Report is published for consultation alongside The Draft Strategy and presents an assessment of The Draft Strategy (i.e. discusses 'likely significant effects' that would result from Strategy implementation) and reasonable alternatives.**

The SEA process is covered in more detail in government guidance, 'A Practical Guide to the Strategic Environmental Assessment Directive'[2] (the 'Practical Guide'). This set's out a five stage process to SEA (see Figure 1 for more detail):

[1] In England, the Environment Agency, Historic England and Natural England

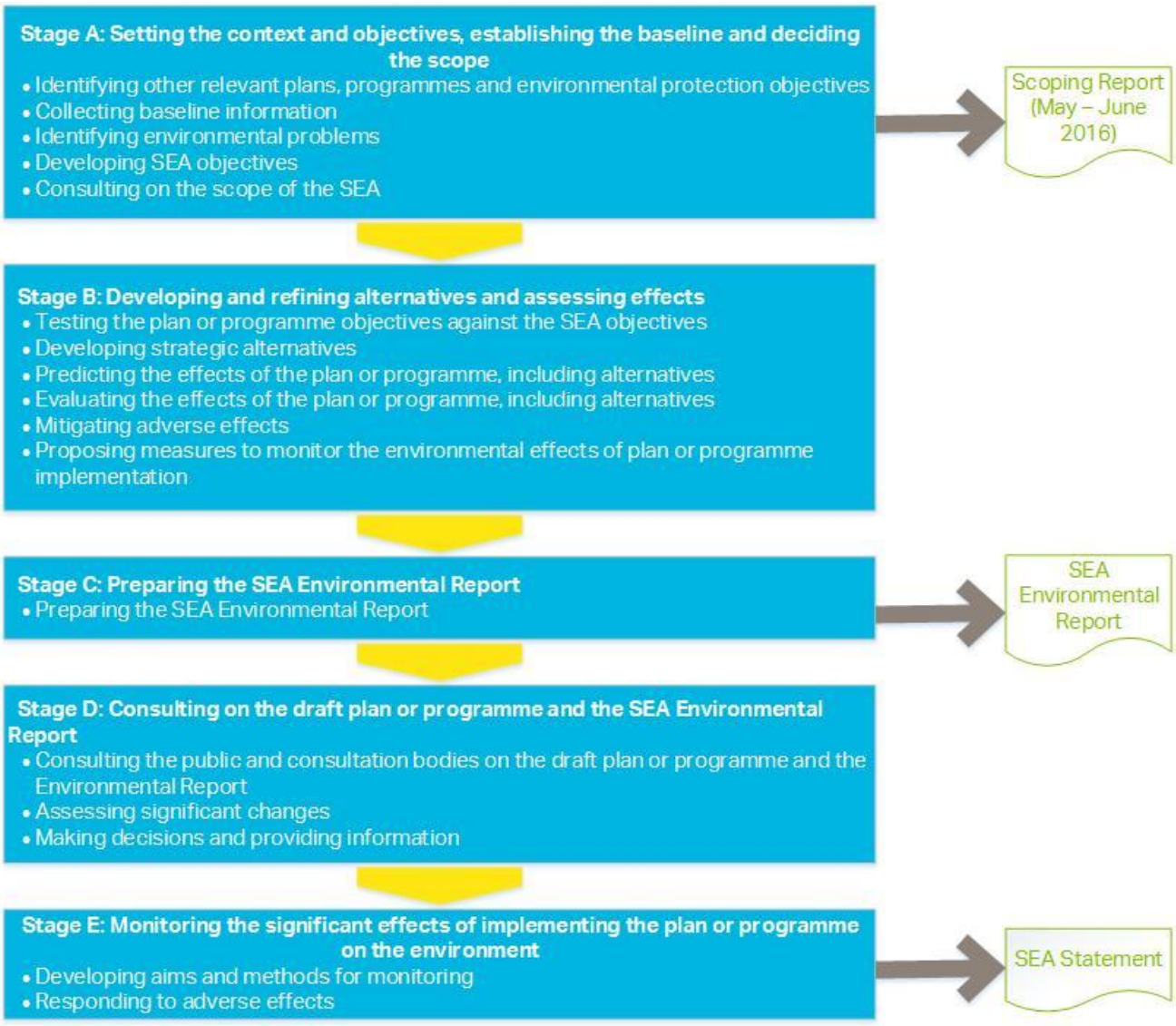


Figure 1: SEA stages and link to development of The Strategy

Compliance with the SEA Regulations

Whilst this SEA is being undertaken voluntarily, AECOM are adhering to the SEA Regulations. With this in mind, Table 1 below sets out the required content of the Environmental Report as defined in the SEA Regulations and details how these have been met.

Table 1: SEA regulatory requirements

Environmental Report requirements	Where these requirements have been met
(a) an outline of the contents, main objectives of the plan or programme and relationship with other relevant plans and programmes;	Appendix A of this Environmental Report
(b) the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme;	Appendix A of this Environmental Report
(c) the environmental characteristics of areas likely	Appendix A of this Environmental Report

[2] ODPM now DCLG (2006) A practical guide to the Strategic Environmental Assessment Directive [online] Available at: http://www.communities.gov.uk/publications/planningandbuilding/practicalguidesea (accessed 04/2016)

to be significantly affected;	
(d) any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 79/409/EEC (The Birds Directive) and 92/43/EEC (The Habitats Directive);	**Pages 38-54 of this Environmental Report**
(e) the environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation;	**Appendix A of this Environmental Report**
(f) the likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;	**Pages 38-54 of this Environmental Report**
(g) the measures envisaged to prevent, reduce and as fully as possible offset any significant negative effects on the environment of implementing the plan or programme;	**Pages 38-54 of this Environmental Report**
(h) an outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information;	**Pages 17 – 36 of this Environmental Report**
(i) a description of the measures envisaged concerning monitoring in accordance with Article 10;	**Pages 38-54 of this Environmental Report**
(j) a non-technical summary of the information provided under the above headings.	**Pages 5-6 of this Environmental Report**

Consultation

Scoping

Stage A: 'Scoping' was carried out (spring / summer 2016) in line with SEA Regulation 12 (5) to agree the scope of the assessment. The SEA consultation bodies[3] in addition to the Marine Management Organisation (given their role in spatial planning for the marine environment) were invited to comment on the scope of the assessment. The consultation period ran for five weeks from 26 May 2016 until 30 June 2016. Responses were received and evaluated from all organisations (Appendix B)

[3] Environment Agency, Historic England and Natural England

The next step was to assess the reasonable alternatives and document the SEA process and findings in this Environmental Report.

Environmental Report

The Environment Agency, in their capacity as members of the Project Board were consulted on the Interim Environmental Report which assessed all of the measures, as well as on the final Environmental Report which provided an update to the Interim Environmental Report and provided an assessment of the 'preferred option'.

Structure of this Environmental Report

In-line with the SEA Regulations, this Environmental Report must be published for consultation alongside The Draft Strategy. It must present certain information set out in Schedule 2 of the SEA Regulations. The report must then be taken into account, alongside consultation responses, when finalising The Strategy.

This Environmental Report is structured to answer the following four questions:

- **What's the scope of the SEA?**
    - **Setting out the agreed scope of the assessment**
- **What has strategy-making / SEA involved up to this point?**
    - **Including the consideration of reasonable alternatives**
- **What are the SEA findings at this stage?**
    - **Including an assessment of The Draft Strategy**
- **What are the next steps (including monitoring)?**
    - **What steps will be taken to finalise The Strategy?**
    - **What measures are proposed to monitor Strategy implementation?**

Overview of 'The Strategy'

The purpose of the River Avon Tidal Flood Risk Management Strategy ('The Strategy') is to provide a recommended strategic framework for the flood risk management work, to set out details of partnership working arrangements, and to provide a structure for a coordinated response to flood risk.

The key objectives of The Strategy, as specified by BCC, are:

1. **To develop an agreed understanding of flood risk from now until 2115 and to quantify the impact of this risk on existing development and infrastructure, and future proposals.**
2. **To confirm intervention options that form components of an adaptive strategic approach to maintaining an acceptable level of flood risk from now until 2115 (subject to review on the basis of the preferred intervention(s) timing and type).**
3. **To evaluate the justification for investment and recognise the different drivers and priorities of BCC and the Environment Agency.**

The process for the preparation of The Strategy is illustrated in Figure 2.

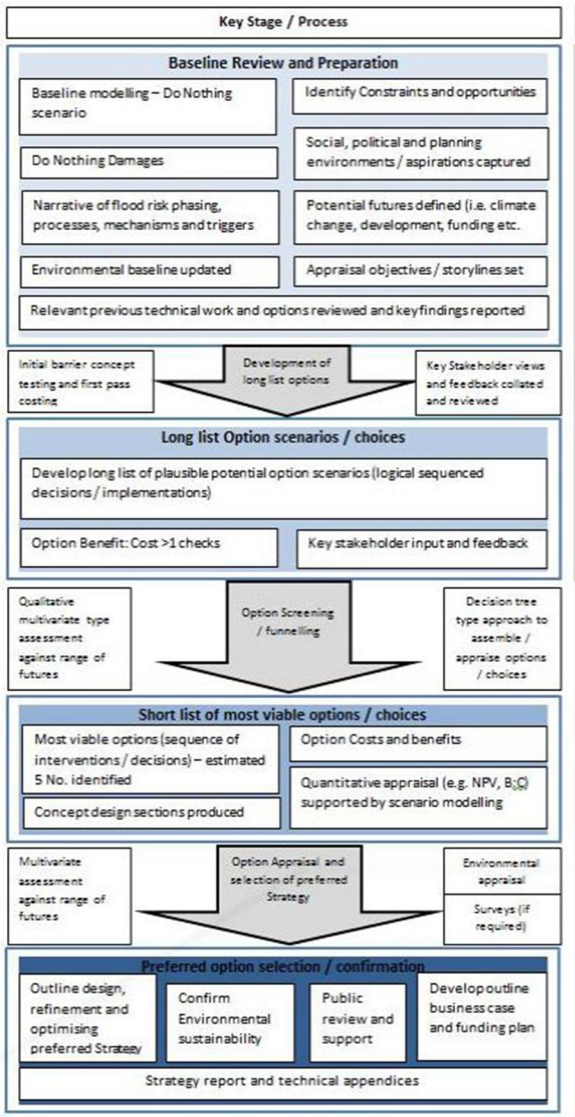


Figure 2: Flowchart of the process for preparing The Strategy

The area covered by The Strategy is located within Bristol. The area covered by The Strategy lies between Gloucestershire and North Somerset and extends from the mouth of the River Avon in the west, at the point where it joins the Severn Estuary, through Bristol city centre, to Netham Weir in the east. The Study Area has been divided into three reaches to assist in reporting and data interpretation, as illustrated in Figure 3:

- **Reach 1: Avonmouth (from the seaward end of the longest breakwaters at the mouth of the estuary) to the eastern boundary of the Severn Estuary Special Area of Conservation (SAC) boundary on the River Avon;**
- **Reach 2: The Severn Estuary SAC boundary to the western end of Cumberland Basin; and**
- **Reach 3: The western end of Cumberland Basin to Netham Weir.**

The Study Area boundary has been established based on the area of Bristol that is potentially at risk from tidal flooding by the end of The Strategy appraisal period (2115). The area at risk was determined using a modelling approach, whereby the land elevation within Bristol that falls beneath the 2115 1 in 200 year (0.5% annual exceedance probability) tidal water level i.e. Environment Agency Flood Zone 3 in the future, was defined and considered to be at risk. The extreme water level for 2115 was based upon the 'upper end' climate change emissions scenario to derive the maximum potential flood extent.

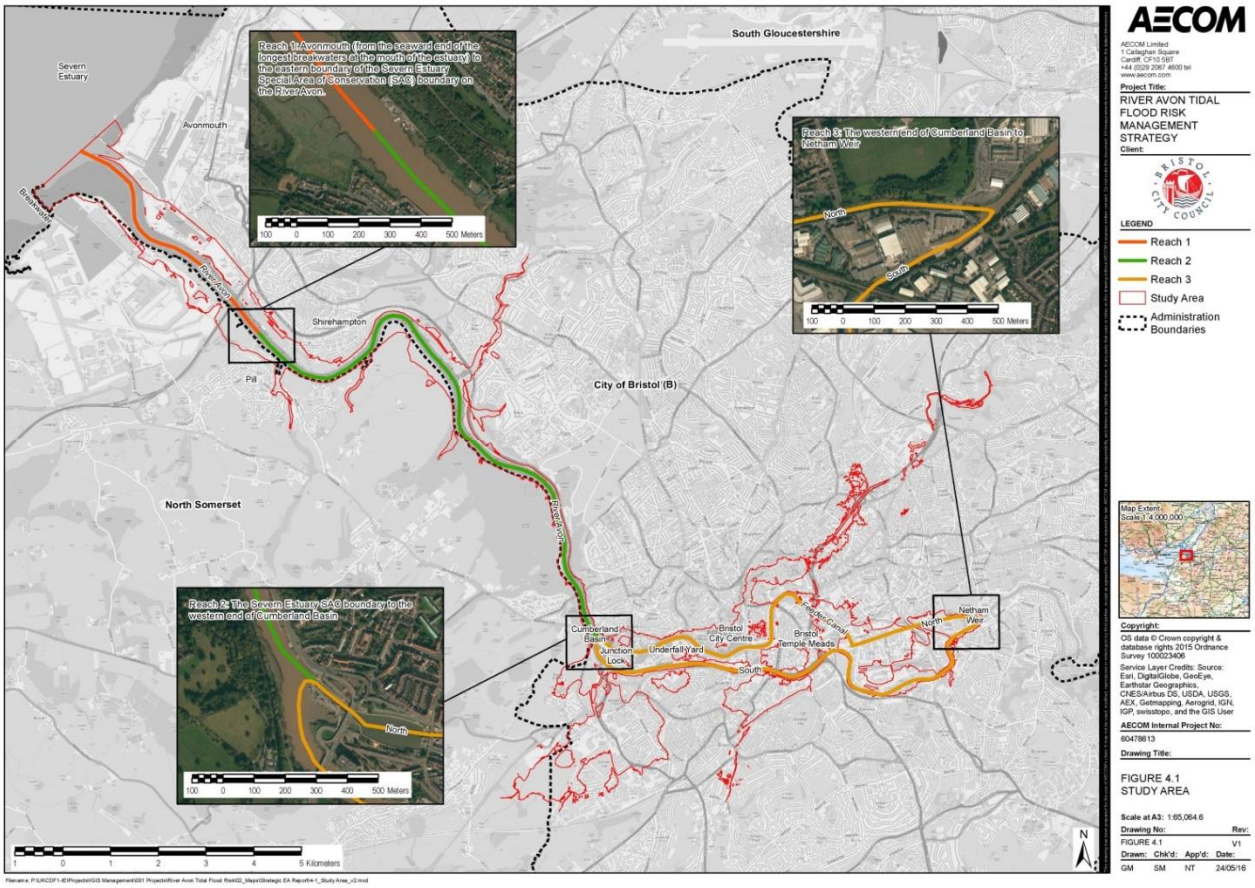


Figure 3: Study Area with the three reaches shown.

What is the scope of the SEA?

This part of the Environmental Report sets out a summary of the scope of the SEA as agreed through consultation on the Scoping Report.

Appendix A includes an evidence base that has been amended in light of consultation responses. Appendix B presents summary comments from the consultation bodies and AECOM's response.

The SEA Framework

The 'SEA Framework' comprises a series of objectives and key issues that are used as a benchmark against which The Draft Strategy and reasonable alternatives are assessed. The SEA Framework 'embodies' the key issues drawn out through the analysis of the evidence base presented in Appendix A. Table 2 presents the SEA topics which are 'scoped in' and 'scoped out'. The areas struck through are proposed to be scoped out. The issues that are 'scoped in' represent the final SEA Framework post scoping stage.

Table 2: The SEA Framework

SEA topic	Key issues	SEA objective (proposed). Will the Strategy:
Biodiversity, flora and fauna	Reach 1 contains a SSSI and the Seven Estuary SPA / SAC	Protect and / or enhance biodiversity?
	Reach 2 contains Ham Green SSSI, a geodiversity SSSI in unfavourable condition. Reach 2 also contains a range of European protected species	
	Reach 3 contains no European sites or SSSIs. It does contain a range of European protected species	
	The Severn Estuary is an important nursery ground for fish which may be affected by the measures.	
Population / human health / material assets	~~Where appropriate, the Strategy should seek to support improvements to the built environment in the city, with a particular focus on those areas suffering from the highest levels of deprivation.~~	The Strategy is tightly focused both in terms of spatial extent and objectives. It is unlikely that the Strategy would be able to have any impact on deprivation or provision / capacity related to services, facilities and amenities.
	~~Aging population is likely to put pressure on services, facilities and amenities.~~	
	Flood risk issues exist in some parts of the areas proposed for future housing delivery in the city, including the city centre.	Minimise the risk of flooding to residential properties and community and economic assets?
	Flooding and erosion can result in effects	Improve the broad determinants of health

	on both physical and psychological health, which could exacerbate existing health issues. Repeated flooding can be a particular issue in relation to psychological health and well-being.	and encourage healthy lifestyles?
	The Strategy should ensure that material assets on the coast, such as walkways, residential/commercial areas in Avonmouth, Pill, Shirehampton and Bristol are not compromised as a result of flooding.	
Soil / water	There is the potential for contamination within the study area (e.g. the Avonmouth / Portbury Docks area of Reach 1) which may have adverse effects on water quality if this is released into the environment.	Protect and / or enhance soil and water quality?
	Reach 2: There is an area of Grade 2 (Very good) quality agricultural land to the east of Pill	
	Significant areas at risk of tidal and coastal flooding.	
	The implementation of The Strategy should ensure that the current situation is not exacerbated and should seek to improve the status of the water bodies where appropriate.	
	The Strategy should not affect abstraction sources.	
~~Air~~	~~Reach 3 is located within an AQMA. The Strategy should ensure that the current situation is not exacerbated.~~	Air quality is unlikely to be significantly affected by flood risk management options. Potential effects on air quality are likely to be limited to short term and temporary effects during the construction phase of engineered flood defences and more appropriately dealt with as part of an environmental impact assessment accompanying a planning application.
Climatic factors	In addition to flood risk management, the Strategy should facilitate the implementation of solutions which support further aspects of climate change adaptation, including linked to the urban heat effect, potential effects on biodiversity and water resources.	Adapt development to the impacts of climate change, ensuring that new development does not contribute to increased risk of flooding for existing property and people elsewhere? Encourage / enable low-carbon energy use / production?
	Where possible, low carbon solutions to flood risk issues should be considered to support climate change mitigation.	
	Given that much of the area is coastal, sea level rise is a serious concern as many identified assets are at risk of	

	flooding.	
Cultural heritage, including architectural and archaeological heritage	The preservation or enhancement of the existing character and setting of cultural heritage assets. The preservation or enhancement of the appearance of cultural heritage assets, conservation areas, and nationally and locally listed buildings. The conservation and enhancement of local archaeological remains. There are a number of Listed Buildings in Bristol which are located in close proximity to the River Avon are therefore vulnerable to flooding. They could also be impacted by the implementation of the Strategy if the defence is in close proximity to residential areas.	Protect and/or enhance the quality and character of the built environment and cultural heritage assets and their settings?
Landscape	Inappropriate design and layout may deteriorate the landscape or visual amenity, and also has the potential to prevent access to existing areas.	Protect and / or enhance landscape character and townscape quality?

In terms of the spatial scope, the assessment was undertaken for each Reach in turn and then amalgamated to consider the overall effect of The Strategy. The timeframe of the assessment is across the three Epochs identified in the baseline review:

- **Epoch 1: 2015 – 2030;**
- **Epoch 2: 2030 – 2065; and**
- **Epoch 3: 2065 – 2115.**

It is recognised that predicting effects across this timescale is inherently challenging and therefore uncertainty ratings have been built into the assessment framework.

Other Environmental Reporting

There have been a number of Environmental Reports produced to support the Strategy in addition to this SEA Environmental Report including: the 9B Report which provided a high level appraisal of 39 long list options, the 9B Addendum which provided an update of the 9B Report focusing on the selection of the preferred option, and the 9C Pre-Scoping Report. There are key differences between each of the Reports, and therefore the conclusions of these reports shouldn't be directly compared. For example, the 9B Report didn't consider Flood Risk as this was scored in the Preferred Option Report, however this topic is 'scoped in' to this Report.

Role of SEA in Strategy development

The SEA had an integral part in the development of The Strategy. Specifically, this part of the report explains the role of the SEA as part of a wider multivariate appraisal of long list options to reach a short list, and then further the SEA assessment of short list options to determine the preferred option.

Long List Measures

Forming the long list of strategic options was the first stage of the options appraisal process. Each of the 39 strategic options identified outlined a sequence of measures to be implemented in each Epoch of The Strategy (short, medium and long term). For example, a strategic option might be to implement property protection and temporary defence measures in the short term (2015-2030), construct low flood walls in the medium term (2030-2065) and, finally, construct a tidal barrier in the long term (2065-2115).

The objectives for the flood risk management options are as follows:

1. **To support the safe living, working and travelling of people in and around central Bristol by ensuring that the flood threat is reduced and that measures are in place to address residual risks.**
2. **To facilitate the sustainable growth of Bristol and the wider West of England economy by supporting development opportunities for employment and residential land, and associated infrastructure.**
3. **To maintain, and where possible enhance, natural, historic, visual and built environments.**
4. **To reduce whole life costs.**
5. **To ensure navigation of the River Avon and marine activities can continue.**
6. **Ensure The Strategy is technically feasible and deliverable over its duration.**

Before assembling the strategic options, a range of 'feasible' measures to manage tidal flood risk were identified. These included:

- **Low defences or crest raising;**
- **Narrow tidal barrier solution;**
- **Property protection and temporary defences;**
- **Do minimum;**
- **High defences or crest raising;**
- **Wide tidal barrier solution; and**
- **Secondary measures to manage the consequences/response to flooding (such as flood forecasting and warnings).**

A number of other measures were also considered, but were deemed 'unfeasible' solutions in the context of managing tidal flood risk in Bristol. The unfeasible measures included:

- **Fluvial flood storage areas;**
- **Pumping against the tide at the Floating Harbour;**
- **River Avon tidal barrage;**
- **Wholesale land raising in the floodplain;**

- **River Avon channel deepening/widening;**
- **Severn Estuary tidal barrage;**
- **Property/city relocation; and**
- **Fluvial flood diversion channels.**

Further details of the long list measures are provided in the Longlist Briefing Report.

Long List Options

Having identified the 'feasible' measures, the measures were then assembled into a range of different strategic options.

To ensure that this stage of the appraisal was robust and that each potential combination of measures was considered, an 'options tree' was created which mapped each potential sequence of measures for the long list strategic options, as shown in Figure 4.

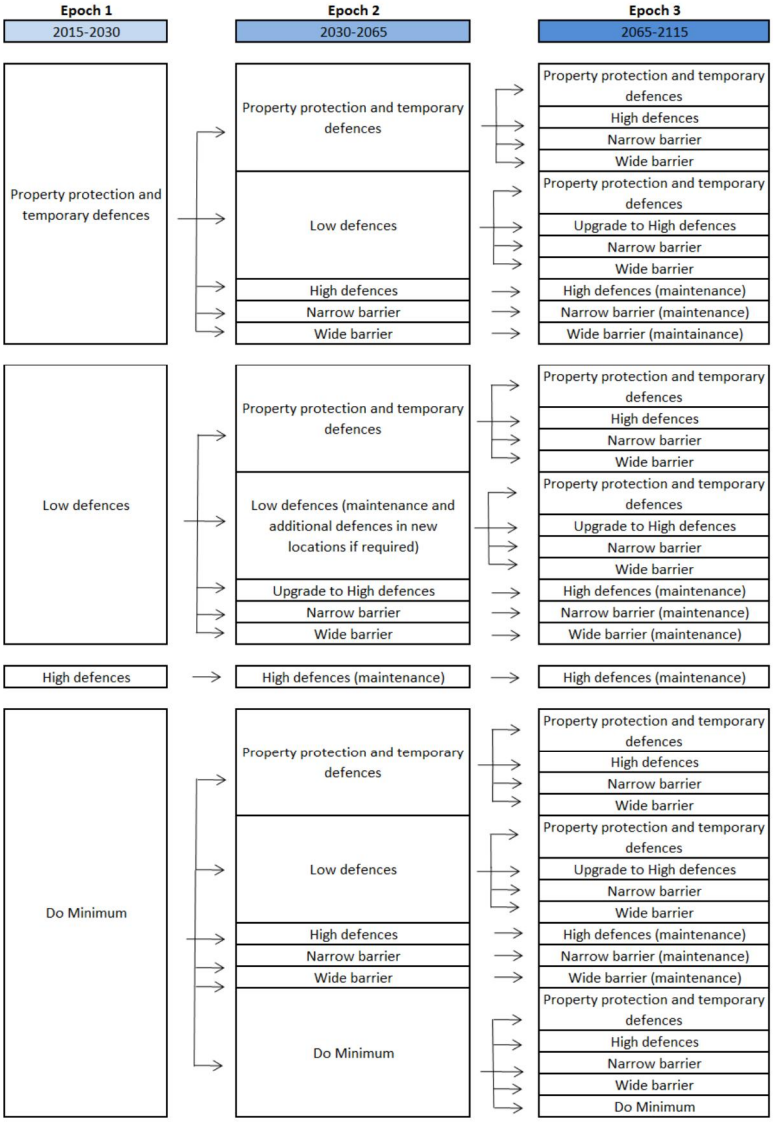


Figure 4: Options 'tree'

Impractical combinations were discounted from the tree and scoped out from further assessment. In total 39 long list options were developed; the long list of options is presented in Table 3.

Table 3: Long List of 39 options

Strategic Option	Epoch 1 measure	Epoch 2 measure	Epoch 3 measure
1	PLP	PLP	PLP
2	PLP	PLP	High defences
3	PLP	PLP	Narrow barrier
4	PLP	PLP	Wide barrier
5	PLP	Low defences	PLP
6	PLP	Low defences	High defences
7	PLP	Low defences	Narrow barrier
8	PLP	Low defences	Wide barrier
9	PLP	High defences	High defences
10	PLP	Narrow barrier	Narrow barrier
11	PLP	Wide barrier	Wide barrier
12	Low Defences	PLP	PLP
13	Low Defences	PLP	High defences
14	Low Defences	PLP	Narrow barrier
15	Low Defences	PLP	Wide barrier
16	Low Defences	Low defences	PLP
17	Low Defences	Low defences	High defences
18	Low Defences	Low defences	Narrow barrier
19	Low Defences	Low defences	Wide barrier
20	Low defences	High defences	High defences
21	Low defences	Narrow barrier	Narrow barrier
22	Low defences	Wide barrier	Wide barrier
23	High defences	High defences	High defences
24	Do minimum	PLP	PLP
25	Do minimum	PLP	High defences
26	Do minimum	PLP	Narrow barrier
27	Do minimum	PLP	Wide barrier
28	Do minimum	Low defences	PLP
29	Do minimum	Low defences	High defences

Strategic Option	Epoch 1 measure	Epoch 2 measure	Epoch 3 measure
30	Do minimum	Low defences	Narrow barrier
31	Do minimum	Low defences	Wide barrier
32	Do minimum	High defences	High defences
33	Do minimum	Narrow barrier	Narrow barrier
34	Do minimum	Wide barrier	Wide barrier
35	Do minimum	Do minimum	PLP
36	Do minimum	Do minimum	High defences
37	Do minimum	Do minimum	Narrow barrier
38	Do minimum	Do minimum	Wide barrier
39	Do minimum	Do minimum	Do minimum

Development of a short list of options

To develop a short list of options, multi-criteria analysis was used to assess each option against the project objective's, using a score to reflect the positive, neutral or negative impact of the option. The options were then ranked according to their total scores. The options listed in Table 4 were identified as the highest scoring. An environmental assessment category featured as part of this wider appraisal. Key environmental impacts (positive and negative) for each option were identified to support the 'whittling down' of long list options to a short list of options worthy of more detailed appraisal.

Table 4: Highest scoring options (note option designation for preferred option report in parentheses).

Option Number and title	Epoch 1 (2015-2030)	Epoch 2 (2030-2065)	Epoch 3 (2065-2115)
6 (A) – PLP – Low Defences – High Defences	Property level measures used to mitigate flood risk	Linear flood walls built to protect Bristol to a 1 in 200 year standard or higher in 2030	Linear flood walls built to protect Bristol to a 1 in 200 year standard or higher until 2115, with existing walls being raised or replaced as necessary
9 (B) - PLP – High defences – High defences	Property level measures used to mitigate flood risk	Linear flood walls built to protect Bristol to a 1 in 200 year standard or higher, for the next 100 years	Walls maintained, standard falls over time to 1 in 200 in 2115
10 (C) - PLP –Barrier – Barrier	Property level measures used to mitigate flood risk	Tidal flood barrier built to protect Bristol to a 1 in 200 year standard or higher, for the next 100 years	Barrier maintained, standard falls over time to 1 in 200 or higher
17 (D) - Low defences – Low	Linear flood walls built to protect Bristol to a 1 in	Walls maintained, standard falls over time	Additional linear flood walls built to protect

defences – High defences	**200 year standard or higher in 2030**		**Bristol to a 1 in 200 year standard or higher until 2115, with existing walls being raised or replaced as necessary**
21 (E) - Low defences –Barrier–Barrier	**Linear flood walls built to protect Bristol to a 1 in 200 year standard or higher, for the next 30 years**	**Tidal flood barrier built to protect Bristol to a 1 in 200 year standard or higher, for the next 100 years**	**Barrier maintained, standard falls over time to 1 in 200 or higher**
23 (F) - High defences – High defences – High defences	**Linear flood walls built to protect Bristol to a 1 in 200 year standard or higher, for the next 100 years**	**Walls maintained, standard falls over time but remains better than 1 in 200**	**Walls maintained, standard falls over time to 1 in 200 in 2115**
36 (G) - Do Min – Do Min – High defences	**Do Minimum approach, no new defences**	**Do Minimum approach, no new defences**	**Linear flood walls built to protect Bristol to a 1 in 200 year standard or higher until 2115**

These seven options were considered to be the reasonable and feasible alternatives from which the preferred option would be selected. They therefore formed the basis of the alternatives assessment for this SEA.

The likely evolution of the environment without The Strategy was also assessed; this is described as the 'Do Minimum' scenario. Do Minimum represents what would happen if the 'status quo' were maintained. This involves a continuation of maintenance to both the existing Floating Harbour water level control structures and raised defences throughout the duration of The Strategy period.

It is assumed that, under the Do Minimum scenario, the functioning of the Floating Harbour water level control structures would be sustained until 2115, and maintenance would incorporate improvements to the resilience of Mechanical, Electrical, Instrumentation, Controls Automation (MEICA) control and electrical systems to flooding (i.e. by raising the elevation of controls to reduce vulnerability to flooding). Do Minimum is considered a feasible approach to managing tidal flood risk.

Under the Do Minimum scenario, it is assumed that like-for-like replacement of mechanical infrastructure e.g. lock gates would be undertaken but with no improvements in performance to account for sea level rise. The raised defences within the city and those at Avonmouth (including at Pill and Shirehampton) would be maintained to ensure their flood defence function continued; however, the defences would not be raised and consequently the standard of flood protection would be expected fall over time in response to sea level rise.

Assessment of the shortlisted options

Method

As set out in the Scoping Report, the assessment will identify and evaluate the 'likely significant effects' of the preferred approach to The Strategy and any reasonable alternatives with respect to the baseline, i.e. the current state of the environment. This will draw on the topics and issues identified through scoping.

This Environmental Report aims to strike a balance between comprehensiveness and conciseness / accessibility for the benefit of the non-specialist reader. In some instances, given reasonable assumptions, it is not possible to predict 'significant effects', (particularly given some of the timescales concerned with this Strategy) but it is nevertheless possible to comment on the merits (or otherwise) of The Draft Strategy in more general terms.

The full assessment tables are presented in Appendix C; they have been designed to address the requirements of SEA Regulations Schedule 1. They also set out the assumptions for Do Minimum. Cumulative and synergistic effects have been considered in a discrete part of the chapter entitled 'What are the SEA findings at this stage?'

In terms of 'scoring' the outcomes of the assessment, it was decided not to use a 'summing' approach or weighted scoring. Guidance (for Water Resource Management Plans) sets out that "*SEA is a qualitative process. Its outputs are often based on qualitative judgements of the significance of varying types of impacts on different receptors. Such impacts are not readily convertible to numeric indicators and as such may not be directly integrated into the options appraisal process alongside other criteria such as cost or risk, which are more numeric. A system which attempts to aggregate qualitatively assessed impacts runs the risk of implying that two environmental impacts are necessarily greater than one, and that positive impacts on one receptor can compensate for negative effects on another. In reality this is not the case...*".[4]

The environmental effects and the relative impacts of the options were assessed against the SEA framework. The aim of this stage was to evaluate the likely environmental impacts of the options.

The assessment was a qualitative exercise based on professional judgement taking into account the detailed understanding of Reaches, engineering design detail of the options (as understood at the current time) and the information gathered in the Scoping Report as well as other available data and background information relevant to the issues raised in The Strategy.

The assessment is presented under the SEA topics refined through the scoping process, i.e.:

- **Biodiversity flora and fauna;**
- **Population / human health / material assets;**
- **Soil / water;**
- **Climatic factors;**
- **Cultural heritage, including architectural and archaeological heritage; and**
- **Landscape.**

Assumptions

In terms of potential impacts, the SEA team agreed the following assumptions and impacts with other colleagues involved in the project (see Table 5). These form the basis of the prediction of effects. See also Figure 5 for an arrangement plan for the tidal barrier.

[4] Cascade Consulting (2012) *Strategic Environmental Assessment and Habitats Regulations Assessment – Guidance for Water Resources Management Plans and Drought Plans.*

Table 5: A summary of the likely construction impacts for both the low and high defences and the barrier

Measure	Construction duration	Construction activities	Impact	Operation activities	Impact
Low and High defences	3 years (there would be about 7.2 km of barriers to be built. It has been assumed that 5 km would be constructed in a two year period. The remaining 2 km would take about 1 year in addition.)	Dredging Piling Excavation	· Sediment release · Disturbance to marine flora and fauna · Noise and dust · Entrainment of sediment · Possible generation of pollutant pathways	Occasional maintenance activities	· No Impact. Potential visual impacts on landscape and townscape. Potential impacts on heritage assets and their setting.
Barrier	3-5 years	Dredging Piling Excavation Cofferdam (estimated to take approximately 3 years) Access from the north via Nibley Road and the construction of a southern access road from Chapel Pill Lane River realignment	· Sediment release · Disturbance to marine flora and fauna · Noise and dust · Entrainment of sediment · Possible generation of pollutant pathways	Occasional maintenance Activities Closure of the barrier during high flood risk events.	· Potential visual impacts on landscape and townscape. · Potential impacts on heritage assets and their setting. · Possible negative impact on transient species when the barrier is closed as it will prevent species from moving up and down the river. · Acceleration of flows around piers.

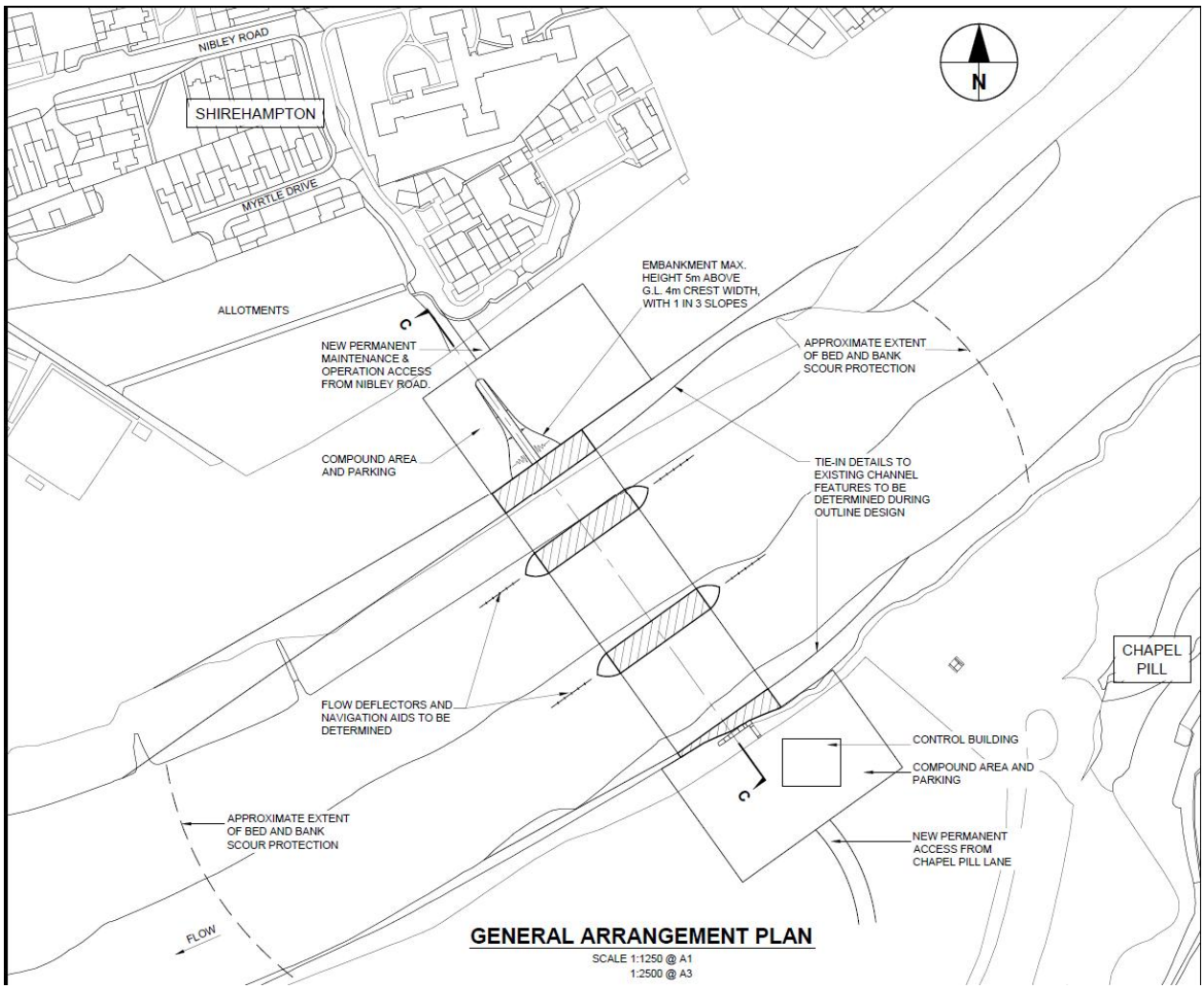


Figure 5: General arrangement plan for tidal barrier

Low and High defences option

It is assumed that a Low-to-High option would include a future proofing engineering solution to ensure that the most significant impacts (e.g. piling) only happen once. Ideally, flood defences should be modular and new; higher defences will comprise raising the existing Low defences. In the absence of detailed design information the defences have been assessed assuming a worst case scenario i.e. all defence options are 'front line' and not stepped back from the river side, and that they are all of a sheet-piled construction.

Biodiversity flora and fauna

Will The Strategy protect and / or enhance biodiversity?

Key issues for consideration:

- **Reach 1 contains a SSSI and the Seven Estuary SPA / SAC**
- **Reach 2 contains Ham Green SSSI, a geodiversity SSSI in unfavourable condition**
- **Reach 2 also contains a range of European protected species**
- **Reach 3 contains no European Sites or SSSIs**
- **It does contain a range of European protected species**
- **The Severn Estuary is an important nursery ground for fish which may be affected by the measures**

Construction

There are no defences proposed in Reach 1 under any options and therefore this is excluded from consideration for this objective.

Property Level Protection (PLP)

It is not considered that PLP would have any effects on this SEA topic.

Raised Defences

Within Reach 2, at Pill, the southern defence alignment borders the Severn Estuary SPA and SAC, SSSI and Ramsar Site. The remainder of the alignment (c. 800 m) extends along the foreshore; this section of the defence alignment is not located within an area designated for its biodiversity value. However, the southern extent of the alignment is located 150 m away from a strip of woodland and 400 m away from Leigh Wood which is ancient woodland. The Shirehampton alignment is situated partly in Lamplighters Local Nature Reserve and SNCI; it is also located in City and Port of Bristol Sports Ground both of which are wildlife corridors.

The proximity of the alignment to the European Site creates a relationship that could result in negative effects. Should 'defence' options be pursued, effects on European Sites would need to be determined through the Habitats Regulations Assessment process. At the moment, it is considered that significant negative effects from the construction of the Low and High defences in Reach 2 are likely given the nature of the activity, the proximity of the construction site and the importance of the designation.

Within Reach 3 there are a series of wildlife corridors that may be affected by construction impacts. It is considered that the level of importance of these corridors means that there could be a temporary negative effect but it is unlikely to be significant.

There are a range of standard practice mitigation measures, dependant on approaches to the construction of the defences e.g. bubble curtains, coffer dams and so on. It is recommended that The Strategy establishes a policy framework to ensure that any planning applications adhere to the highest standards of environmental performance (given the timescales of The Strategy, it will need to be flexible enough to adapt to changing technologies). This should include measures to both mitigate and enhance effects.

Barrier

The barrier is, indicatively, to be located in Reach 2, near Pill and Shirehampton. The preferred *location has not been identified* but for the purposes of the assessment we have used an approximation (see Figure 6).

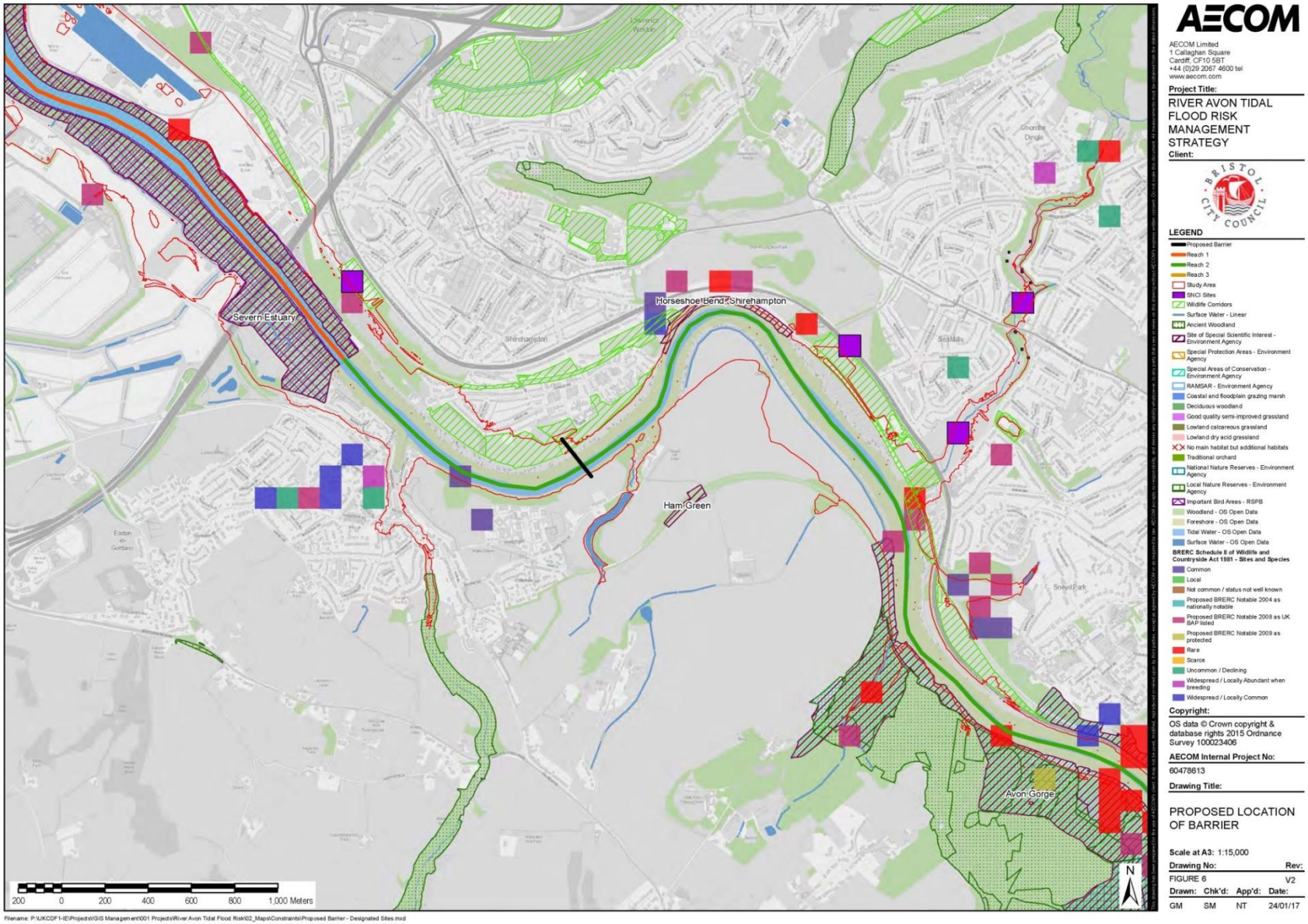


Figure 6: Proposed location of barrier

The northern extent of the tidal barrier is likely to lie in Nibley Road Open Space and just to the south of Myrtle Hall Allotments which are both wildlife corridors. The southern extent is not located in an area of biodiversity value, although there are several strips of woodland nearby (approx. 150 m).

There are a number of designated sites in proximity to the tidal barrier. The Severn Estuary SPA and SAC is located approximately 1 km west of the tidal barrier. Avon Gorge SSSI and Avon Gorge and Woodlands SAC are located approximately 1 km east of the barrier. There are a number of European protected species recorded within this Reach. Ham Green SSSI is located approximately 500 m south east of the barrier location. Horseshoe Bend SSSI is located approximately 500 m north east of the barrier.

The extent of the construction activities would be substantial. The access to the south of the site will require a southern access road, the alignment of which is currently unknown but it will likely run near the Ham Green SSSI. There will be significant disruption to the River Avon with roughly half the river blocked by cofferdams for around three years. This, in addition to the noise and other impacts associated with construction of major projects of this type. This has the potential to also affect fish populations through altering the velocity of water flow through the river and increasing sediment load (e.g. through dredging and river realignment).

The proximity of the barrier to the European Sites is clearly an issue but one that needs to be determined through the Habitats Regulations Assessment process should this alignment be proposed as a preferred option. It should be noted that moving the barrier up or down the River Avon will move it closer to one European Site as well as away from another. At the moment, it is considered that effects from construction are likely to be significant and negative (temporary) given the nature of the activity and the importance of the designation.

There are a range of standard practice mitigation measures, dependant on approaches to the construction of the defences e.g. bubble curtains, cofferdams and so on. It is recommended that The Strategy establishes a policy framework to ensure that any planning applications adhere to the highest standards of environmental performance (given the timescales of The Strategy, it will need to be flexible enough to adapt to changing technologies). This should include measures to both mitigate and deliver enhancement. Not withstanding this, at this stage it is predicted that there will be potential significant negative (temporary) effects on the Ham Green SSSI, the Severn Estuary SPA and SAC and possible the Avon Gorge SAC.

Operation

In the long run, from an operational perspective, all interventions to improve the Standard of Protection would result in a similar level of flood protection (although it is acknowledged that the barrier provides a higher standard of tidal flood protection and lowest residual risk). A key differentiator between options is the number of times a construction disturbance will be created. For example, Option C proposes just a tidal barrier in Epoch 2 but Option E proposes Low defences in Epoch 1 and a tidal barrier in Epoch 2. This would result in two sets of impacts relating to construction activities and both potentially on European Sites. With regard to biodiversity, those options with a minimum number of disturbances would be preferred (e.g. A, B, C, D, F and G) although the difference between the Low – High options would be negligible in this regard. With regard to the barrier options, it is recognised that there may by issues with regard to water velocity around the barrier piers and the effect on fish but the effect of this is unknown at this stage. Bearing this in mind, the preferred options for this topic would be (in no order or preference): A, B, D, F and G.

Population / human health / material assets

Will The Strategy:

Minimise the risk of flooding to residential properties and community and economic assets?

Improve the broad determinants of health and encourage healthy lifestyles?

Key issues for consideration:

- **Flood risk issues exist in some parts of the areas proposed for future housing delivery in the city, including the city centre**
- **Flooding and erosion can result in effects on both physical and psychological health, which could exacerbate existing health issues. Repeated flooding can be a particular issue in relation to psychological health and well-being**
- **The Strategy should ensure that material assets in the Study Arae, such as walkways, residential/commercial areas in Avonmouth, Pill, Shirehampton and Bristol are not compromised as a result of flooding**

Construction

There are no defences proposed in Reach 1 under any options and therefore this is excluded from consideration for this objective.

PLP

There is the potential for minor impacts from the installation of PLP measures for a modest number of dwellings in Reaches 2 and 3. There is the potential for temporary negative effects particularly for heritage assets but the effect will be minor.

Raised Defences

Construction impacts (e.g. dust, noise and traffic disruption) will generally be localised to those receptors close to the alignments. In the case of Reach 2, these should be confined to a number of residential properties in close proximity to the proposed alignment (the alignment runs near Pill, along Avon Road and Marine Parade and around Crockerne Pill). Within Reach 3, assuming a 'front-line' alignment, there are a number of major roads which run behind the Low/High defence alignment (e.g. Cumberland Road, Commercial Road, Clarence Road and Bath Road) which might be affected by increased traffic flows. A railway line also crosses the alignment near Whitby Road. Construction of the defences are likely to result in temporary negative effects.

Barrier

With regard to the tidal barrier there will be substantial construction impacts, for example noise and dust, vibration, construction traffic, disruption to river flows and sediment loads. Although construction impacts will generally be localised to those receptors relatively close to the barrier location, there is the potential for impacts to occur further afield. The northern extent of the tidal barrier is likely to lie in a Nibley Road Open Space. The southern extent of the Barrier is less than 100 m from Chapel Pill Lane. The tidal barrier is proposed to cross a tow path which runs along the bank of the River Avon. These impacts are likely to result in temporary negative effects. There will also be an effect on the navigability of the river during construction, certainly should coffer dams be used. This has the potential to result in temporary negative effects and should be managed in way that does not affect waterway navigability.

Operation

With regard to operation, all options will provide, ultimately, a very similar standard of flood defence and will have a permanent significant positive effect on this topic in terms of material assets, flood risk and health. There may be a permanent effect on navigability with the construction of the tidal barrier. However, it is expected that, initially, the tidal barrier will be closed once a year (and about twice a month for maintenance). However, it is accepted that this will increase in Epoch 2 and 3 and could result in a temporary minor negative effect on navigability.

Overall there is a trade-off between the construction impacts associated with an option, the timeliness of a high standard of protection and the long-term impacts of a higher flood defence standard. For this objective, those options that perform better are those that minimise the potential for construction impacts, implement a higher level standard of protection measure at an earlier Epoch (e.g. Low defences in Epoch 1 would be favourable to PLP in Epoch 1) and that maximise the overall standard of flood defence. Options A, B, C and G perform less well for this topic as they provide either PLP measures or Do Minimum for the first Epoch. Furthermore, whilst Option C provides a higher level or protection to Reach 3, it would provide a limited level of protection (PLP) for Shirehampton and Pill throughout The Strategy timescale; D, E and F are therefore preferred for this topic.

Soil / water

Will The Strategy:

Protect and / or enhance soil and water quality?

Key issues for consideration:

- **There is the potential for contamination within the Study Area (e.g. the Avonmouth / Portbury Docks area of Reach 1) which may have negative effects on water quality if this is released into the environment**
- **Reach 2: There is an area of Grade 2 (very good) quality agricultural land to the east of Pill**
- **Significant areas at risk of tidal and coastal flooding**
- **The implementation of The Strategy should ensure that the current situation is not exacerbated and should seek to improve the status of the water bodies where appropriate**
- **The Strategy should not affect abstraction sources**

Construction

There are no defences proposed in Reach 1 under any options and therefore this is excluded from consideration for this objective. A Preliminary Water Framework Directive (WFD) Assessment is contained within Appendix D.

PLP

It is not considered that PLP would have any effects on this SEA topic.

Defences

The most 'significant' negative effects resulting from the options will be produced through the activities related to the construction of the Low and High defences.

The construction activities for the Low and High defences are considered likely to have a temporary negative effect on water and soil through disturbance to the river bed and the release of sediment into the River Avon. It is considered that this can be mitigated through conventional measures.

Barrier

The construction impacts in most cases (e.g. noise and dust, vibration) will be localised to those receptors close to the alignments and the barrier location. The construction activities for the barrier are considered to have a likely temporary negative effect on water and soil through disturbance to the river bed and the release of sediment into the River Avon, to a greater extent and for a longer duration than defence construction. It is considered however, at this stage, that this effect could be mitigated through conventional measures after appropriate studies and investigations.

Operation

Overall there is a trade-off between the construction impacts of an option and the long-term impacts of a higher flood defence standard. For this objective, those options that perform better are those that minimise the potential for construction impacts and subsequent disturbance. There will be temporary negative effects during construction, but in the long term there is likely to be positive effects for all elements of this objective. Options with a minimum number of disturbances would be preferred (e.g. A, B, C, D, F and G) although the difference between the Low – High options would be negligible in this regard. With regard to the barrier options, it is recognised that there may by issues with regard to water velocity around the barrier

piers and sedimentation but the effect of this is unknown at this stage and requires further studies to predict the potential effects and identify suitable mitigation. Bearing this in mind, the preferred options for this topic would be (in no order or preference): A, B, D, F and G.

Climatic factors

Will The Strategy:

Adapt development to the impacts of climate change, ensuring that new development does not contribute to increased risk of flooding for existing property and people elsewhere?

Encourage / enable low-carbon energy use / production?

Key issues for consideration:

- **In addition to flood risk management, The Strategy should facilitate the implementation of solutions which support further aspects of climate change adaptation, including linked to the urban heat effect, potential effects on biodiversity and water resources**
- **Where possible, low carbon solutions to flood risk issues should be considered to support climate change mitigation**
- **Given that much of the area is coastal, sea level rise is a serious concern as many identified assets are at risk of flooding**

Construction

There are no defences proposed in Reach 1 under any options and therefore this is excluded from consideration for this objective.

PLP

There are no defences proposed in Reach 1 under any options and therefore this is excluded from consideration for this objective.

Defences

With regard to construction, it is assumed that the construction methods for both the Low and High defences are the same and that the only material difference is the height of the completed defence. The impacts of construction are likely to be limited to greenhouse gas emissions from the construction activities (HGV and operation of plant) and the embodied carbon in the defence measures themselves.

Barrier

At a simple level, it is likely that construction of the tidal barrier would result in the highest level of emissions given that it has a longer build period and a more substantial anticipated construction programme of works. With regard to embodied carbon and energy it is not possible assess this without estimates of material needs to construct the different schemes. This information is currently unavailable.

Operation

From an operational perspective, the measures that provide the highest standard of protection, including for sea level rise due to climate change, will perform better that others and result in significant positive effects in regard to providing protection from sea level rise. This is complicated by the area of coverage for the options; neither of the barrier options will provide the higher standard of protection for Pill and Shirehampton. For these areas, the barrier options provide either PLP in Epoch 1 (Option C) or Low defences (Option E). On balance, the options that propose High defences would likely perform better for this topic given that their assumed GHG emissions would be lower and the area covered with a high standard of protection would be greater (in no particular order: A, B, D, and F). Note that Option G is not considered preferred as there is a prolonged period of Do Minimum exposing receptors to sea-level rise related flood events.

Cultural heritage, including architectural and archaeological heritage

Will The Strategy:

- **Protect and/or enhance the quality and character of the built environment and cultural heritage assets and their settings?**

Key issues for consideration:

- **The preservation or enhancement of the existing character and setting of cultural heritage assets**
- **The preservation or enhancement of the appearance of cultural heritage assets, conservation areas, and nationally and locally listed buildings**
- **The conservation and enhancement of local archaeological remains**
- **There are a number of Listed Buildings in Bristol which are located in close proximity to the River Avon are therefore vulnerable to flooding. They could also be impacted by the implementation of The Strategy if the defence is in close proximity to residential areas**

Construction

In terms of spatial scope, only Reach 2 and 3 are considered under this objective. This is because there are no Strategy elements in Reach 1.

PLP

It is not considered that PLP would have any effects on this SEA topic.

Defences

Within Reach 2, the defence alignment in Pill extends in front of two Grade II Listed Buildings: Watch House, Retaining Walls to the River and Garage, and Mulberry Cottage Mulberry House. There is one Listed Building approximately 200 m from the Shirehampton alignment.

It is considered that construction of the Low and High defences will result in a temporary negative effect on the setting of the heritage assets in Reach 2. There are a range of mitigation solutions that can be considered (e.g. damping down dust, acoustic screening and so on) which should minimise the construction impacts to an insignificant level.

Within Reach 3 heritage assets that have the potential to be affected include:

- **Cumberland Road: Grade II* Listed Swing Bridge over North Entrance Lock, Grade II* Listed Swing Bridge over South Entrance Lock, Grade II* Listed Brunels South Entrance Lock, Grade II Listed B Bond Tobacco Warehouse, Grade II Listed Ashton Swing Bridge, Grade II Listed A Bond tobacco Warehouse, Grade II Vauxhall Bridge, Grade II Strand Buildings and 6 Grade II Listed buildings on Cumberland Road.**
- **Bathurst Basin the following heritage assets have been identified: Grade II Listed Bedminster Bridge and Grade II Listed Drinking Fountain 3 metres north-west of Bedminster Bridge. Underfall Yard which is a Scheduled Monument also has the potential to be impacted by this measure**
- **Low Defence at Temple Meads: Grade II Listed Temple Meads Station**
- **Totterdown: No Listed Buildings will be affected**
- **Clarence Road: Grade II Langton Street Bridge**
- **Netham Lock: Grade II Listed Netham Lock and Lock Keepers House**

The Conservation Areas which are likely to be affected by this measure are City Docks and Bedminster.

It is considered that construction of the Low and High defences will result in a temporary negative effect on the setting of the Heritage Assets in Reach 3. There are a range of mitigation solutions that can be considered (e.g. damping down dust, acoustic screening and so on) which should minimise the construction impacts to an insignificant level.

Barrier

With regard to the tidal barrier (Reach 2) there are three Grade II listed buildings within 500 m of the northern extent of the tidal barrier these are: Shirehampton Public Hall and Library, Powder Houses and Jetty and Myrtle Hall and Attached Wall. There are three further Grade II Listed Buildings within 500 m of the southern extent of the tidal barrier these are for: an Eighteenth Century Watergate, Gazebo and Flats to Ham Green Hospital.

It is considered that construction of the tidal barrier will result in a temporary negative effect on the setting of the Heritage Assets in Reach 2. There is also the potential to disturb archaeological sites during construction. There are a range of mitigation solutions that can be considered (e.g. damping down dust, acoustic screening and so on) which should minimise the construction impacts to an insignificant level.

It is recommended that The Strategy establishes a mitigation framework to ensure that any planning applications adhere to the highest standards of environmental performance.

Operation

In terms of operation of the Low and High defences, there is the potential for negative effects on the setting of heritage assets in both Reach 2 and 3. It is probable that the High defences would have the greatest potential for a significant effect given it is the scheme with the greatest height and therefore visibility from and to heritage assets. However, it may be possible to mitigate or reduce these effects with sensitive design of the defences (see Figure 7) that is sympathetic to the historic character of the city. It is considered there might be permanent effects on heritage assets with both the Low and High defences on both Reach 2 and 3 but it is not possible to determine the significance or direction at this stage i.e. without more details of design / appearance.

Figure 7: Example flood defence measures

From a perspective of protecting cultural heritage assets, clearly the protection from flooding of all the options would result in significant permanent positive effects as the setting and the fabric of the asset

would be protected from future flooding. PLP measures can help ensure that the asset itself is not flooded but will not protect the setting. The provision of a barrier would ensure that there were no construction impacts in Reach 3 and provide a higher standard of protection than the other options proposed. At this stage it has not been possible to identify a preferred option from an SEA perspective. All options have the potential for significant effects but in the absence of design details it is not possible to differentiate between them.

Landscape

Will The Strategy:

- **Protect and / or enhance landscape character and townscape quality?**

Key issues for consideration:

- **Inappropriate design and layout may deteriorate the landscape or visual amenity, and also has the potential to prevent access to existing areas**

Construction

In terms of spatial scope, only Reach 2 and 3 are considered under this objective. This is because there are no Strategy elements in Reach 1.

PLP

It is not considered that PLP would have any effects on this SEA topic.

Defences

Within Reach 2, Pill is located within Avon Valley Rolling Farmland Landscape Character Area (LCA). The Shirehampton alignment is not located within an LCA.

It is considered that construction of the Low and High defences will result in a temporary negative effect on the setting of the LCA in Reach 2. There are a range of mitigation solutions that can be considered which should minimise the construction impacts to an insignificant level.

It is considered that construction of the Low and High defences will result in a temporary negative effect on the townscape in Reach 3. There are a range of mitigation solutions that can be considered (e.g. damping down dust, visual screening and so on) which should minimise the construction impacts to an insignificant level. There is also the opportunity for positive effects, for example through the inclusion of green infrastructure as part of the proposals which would improve the public realm, and enhance the landscape character and townscape quality.

Barrier

It is considered that construction of the tidal barrier will result in a temporary negative effect on the setting of the LCA in Reach 2. There are a range of mitigation solutions that can be considered (e.g. damping down dust, visual screening and so on) which should minimise the construction impacts to an insignificant level.

Operation

In terms of operation of the Low and High defences, there may be negative effects on the Landscape and Townscape in both Reach 2 and 3. It is probable that the High defences would have the greatest potential for a significant effect given it is the scheme with the greatest height and therefore visibility. However, it may be possible to mitigate these effects with sensitive design of the defences (see Figure 5). Therefore is it is considered is potential for a permanent negative effect on landscape with both the Low and High Barriers on both Reach 2 and 3.

With regard to the tidal barrier (Reach 2), it is likely that the barrier would be prominent and have a significant impact on local key viewpoints and the landscape character of the area, although it will be relatively localised. Whether this is negative or positive is subjective; this impact would be subject to a more detailed Landscape Assessment as part of the planning application. For example, if it is an iconic structure

(such as the Thames Barrier) then the effect could be significantly positive. Also, the effects (if negative) may reduce over time as receptors 'get used' to the new landscape and it becomes part of the accepted landscape character (see 'Cornish Alps'). At this stage it has not been possible to identify a preferred option from an SEA perspective. All options have the potential for significant effects but in the absence of design details it is not possible to differentiate between them.

It is recommended that The Strategy establishes a framework to ensure that any planning applications adhere to the highest standards of environmental performance and where possible seeks to enhance the environment.

Summary of the options assessment

'Option D' has been recommended as the preferred option in AECOM's Preferred Option Report. Option D involves the construction of linear Low defences in Epoch 1, the construction of additional linear Low defences in Epoch 2 and the raising of existing Low defences to High defences in Epoch 3.

In terms of assessing the options, and the recommended option, it should be remembered that the SEA assessed the options against the current and future baseline and against each other. In the SEA as with the 9B Environmental Report, all environmental aspects were given equal weight. The SEA has two fundamental assumptions underpinning the assessment. First, unlike the 9B Environmental Report, the SEA takes into account flood risk. Second, the cost of the options was not factored into the SEA. It should be remembered that SEA is a decision informing tool and that it, amongst many other studies, will need to be considered when the Council decides on the preferred option.

It should be noted that predicting effects on the environment over a 100 year timescale is made complex by at least three factors. First, the baseline itself will change during this period; under a do minimum scenario flood risk will increase. Second, the change in available technology over this timescale can be significant thus affecting mitigation / enhancement solutions. Third, over time, the sensitivity of receptors may change as the acceptability of interventions increases. The SEA needs to weigh up these factors and determine how the options perform relative to each other.

The spatial extent of the construction effects for the tidal barrier are likely to be in many cases confined, approximately, to the 'immediate area' around the proposed location in Reach 2, whilst recognising that sedimentation (and water quality) effects may diffuse over a wider area in the estuary. Furthermore if any vegetation removal was required for access and setting up the compound this would have the potential to result in impacts to the landscape character of the area, as well as key views to and from the river. The activities likely to be required to build the tidal barrier include the use of cofferdams, the construction of an access road to the north and south of the site, dredging, piling and excavation which is expected to last for about three years. The construction effects of the Low defences are likely to take place over two years, and the subsequent lengthening (i.e. from low to high), would probably take place over a year. These activities will be spread over Reach 2 (Shirehampton and Pill) and Reach 3 exposing a higher number and type of receptors to the effects of construction. From an operational perspective, the effects of the barrier would again likely be constrained to the 'immediate area' with landscape and visual effects to the fore. There may be ongoing negative effects on navigation caused by sedimentation. For the Low / High defences there are likely to be long-term visual effects on landscape and townscape in Reach 2 and 3 and potential effects on heritage assets in Reach 3.

In light of the above, there is a fine balance in terms of a 'best' option from an SEA perspective. The construction effects of the barrier would take place on a smaller spatial scale but are likely to be more focused. The construction effects of the Low/High defences might be more diffuse but will affect a greater number of receptors. Operationally, the barrier options would provide a higher standard of protection and but may have navigation / benthic effects. The Low/High defences would provide a lower (but still suitable) standard of protection but there are potential effects on landscape / townscape through Reach 2 and 3.

Some options do have a clear issue in terms of timescale of implementation. For example, a failure to implement any measure until Epoch 3 (Option G) would clearly be an issue given the increased flood risk predicted in the future do-minimum baseline. Similarly, PLP first options, whilst better than the do-minimum, would perform worse than those options that include Low/High defences in Epoch 1.

In summary, Options A, B, C and G perform the least well from an SEA perspective as they offer a lower standard of protection in the earlier Epochs (do-minimum and PLP). Options D, E and F perform the best from an SEA perspective due to the provision of a higher standard of protection at an earlier Epoch (protecting more, for longer). This can be further refined through consideration of the extent of flood

protection. Option E would provide a higher standard of protection east of Pill and Shirehampton but a lower standard of protection in those villages relative to Options D and F which will both provide High defences ultimately and protect Pill and Shirehampton at a higher standard of protection. Taking into account the economic and socio-economic factors, this narrows the preferred SEA option down to D or F. In terms of the preferred option, the final decision remains with BCC to consider the recommended preferred option, and determine which one they take forward based on cost, viability and other considerations.

What are the SEA findings of The Draft Strategy?

This part of the Environmental Report presents the assessment findings in relation to the River Avon TFRMS at the time of publication for consultation, i.e. The Draft Strategy. A detailed assessment is presented in Appendix C.

The section is structured according to the SEA topics agreed through scoping:

- **Biodiversity, flora and fauna;**
- **Population, human health and material assets;**
- **Soil and water;**
- **Climatic factors;**
- **Cultural heritage; and**
- **Landscape.**

Each section sets out the assessment findings for each Epoch as set out in 'What is the scope of the SEA?'.

Plan development subsequent to the options stage

'Option D' was recommended as the preferred option in AECOM's Preferred Option Report. In this latest phase of work Option D has been refined to create Preferred Option D1 with further details of defence alignments, design, cost estimates, and phasing being developed.

There are no defences proposed in Reach 1 or Reach 2 as part of the preferred option and therefore these areas have been excluded from consideration in this assessment. For further information on how the preferred option has been refined see the Preferred Option Development Report.

To deliver the preferred option (Option D1), approximately 5 km of new raised defences will be required in Reach 3. Within central Bristol, new raised defences will be required in core areas, comprising: Cumberland Road; Commercial Road; Clarence Road; Cattle Market Road; Totterdown; and St. Phillips. Defences in these locations should prevent local flooding to the properties and assets situated behind the defences. In addition, new defences at additional core areas including Entrance Lock, Netham, Bathurst Dam, and Cumberland Road underpass will also be required. These defences will prevent water from flowing into the Floating Harbour and flooding properties in central Bristol once the harbour capacity is exceeded. Part of the new defences at Entrance Lock and Netham will be the installation of new tidal stop gates and operating infrastructure. The proposed defence alignment for each Epoch is shown in Figures 8, 9 and 11.

The preferred strategic option requires new raised defences across Reach 3 from Epoch 1 onwards. The defences will be constructed in two separate phases; Low defences during Epochs 1 and 2 and then High defences during Epoch 3. The exact time within Epoch 3 when the defences are upgraded is unknown at this time and the upgrade will involve raising the height of the Low defences rather than starting the construction of High defences from scratch.

The Low defences will be constructed to a 1:200 year standard of protection for 2030. The upgraded High defences will provide a 1:200 year standard of protection for 2115.

In addition to the construction of Low and High defences in the core areas considered as part of the preferred option, the refined option also includes the provision of 'Detriment Mitigation Measures' within Reach 3.

Freeboard Allowance

The maximum height of the defences includes a 'freeboard allowance' of 200 mm. This is the height of the defence above the design water level, which can be seen as a safety margin that makes allowance for uncertainties in modelling.

Defence Finish

In some, isolated locations the high defences will be up to 3.9[5] m in height relative to existing ground levels (typically much less high). This has the potential to negatively impact the landscape and visual character of the area. To limit this impact, new defences up to 1.2 m in height (relative to existing ground levels) will be finished with masonry cladding or an alternative finish that is suitable for the local landscape. For defences greater than 1.2 m in height (relative to existing ground levels) several approaches will be developed, and specific locations will be identified for each treatment. One of the options is to install reinforced glass on top of the masonry clad defences instead of a solid structure. A photograph example showing installed glass walls is shown in Figure 7.

Low Defences

Low defences are proposed to be constructed in Epochs 1 and 2. Low defences in Epoch 1 will be constructed at Entrance Lock, Netham, Bathurst Basin and Totterdown, as shown in Figure 8. In Epoch 2 the Low defences will be constructed at Clarence Road, Cumberland Road, Commercial Road and Cattle Market Road, as shown in Figure 8.

Epoch 1

In Epoch 1 (immediately-2030) Low defences will be constructed to a height of approximately 9.65 m – 9.8 m Above Ordnance Datum (AOD) including 200 m of freeboard allowance (i.e. 0.1 - 3.0 m above existing ground levels). The Low defences will provide 1:200 year standard of protection and will be constructed in the following locations:

- **Entrance Lock;**
- **Netham;**
- **Bathurst Dam; and**
- **Totterdown.**

In addition Entrance Lock Gate and Netham Lock Gate will be replaced during this Epoch:

- **Entrance Lock Gate – the Gate will be increased to 10.3 m AOD in height including 200 mm of freeboard allowance.**
- **Netham Lock Gate – the Gate will be increased 10.4 m AOD in height including 200 mm freeboard allowance.**

[5] There is uncertainty in the LiDAR data at this location

Figure 8: Epoch 1

Epoch 2

In Epoch 2 (2030-2065) Low defences will be constructed to a height of approximately 9.65 m – 9.8 m AOD including 200 mm of free board allowance (i.e. 0.1 - 1.9 m above existing ground levels). The Low defences will provide a 1:200 year standard of protection and are proposed to be constructed in the following locations:

- **Cumberland Road;**
- **Cumberland Road East;**
- **Commercial Road;**
- **Clarence Road; and**
- **Cattle Market Road.**

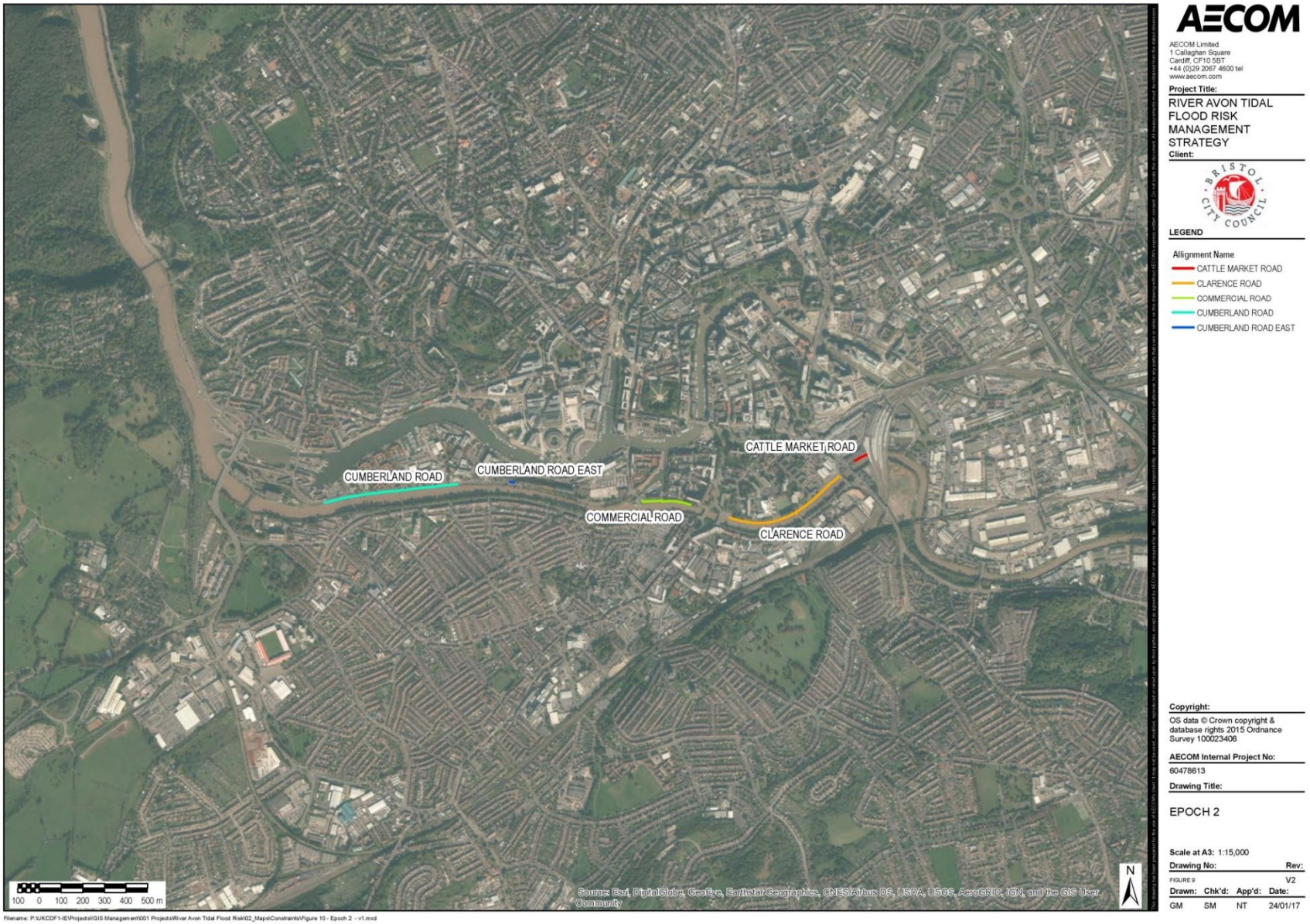


Figure 9: Epoch 2

High Defences

In Epoch 3 (2065-2115) all of the low defences constructed in Epoch 1 and 2 will be raised to high defences, as shown in Figure 11. The height of the defences is expected to be approximately 10.3 – 10.4 m AOD (including 200 m of freeboard allowance (0.1 m - 3.9[6]) m above existing ground levels) and will provide a 1:200 year standard of protection. Where appropriate the defence will be masonry clad concrete wall, except where the height exceeds 1.2 m and reinforced glass will be used. An illustration of a typical high defence is presented below.

[6] Uncertainty in the LiDAR data at this location

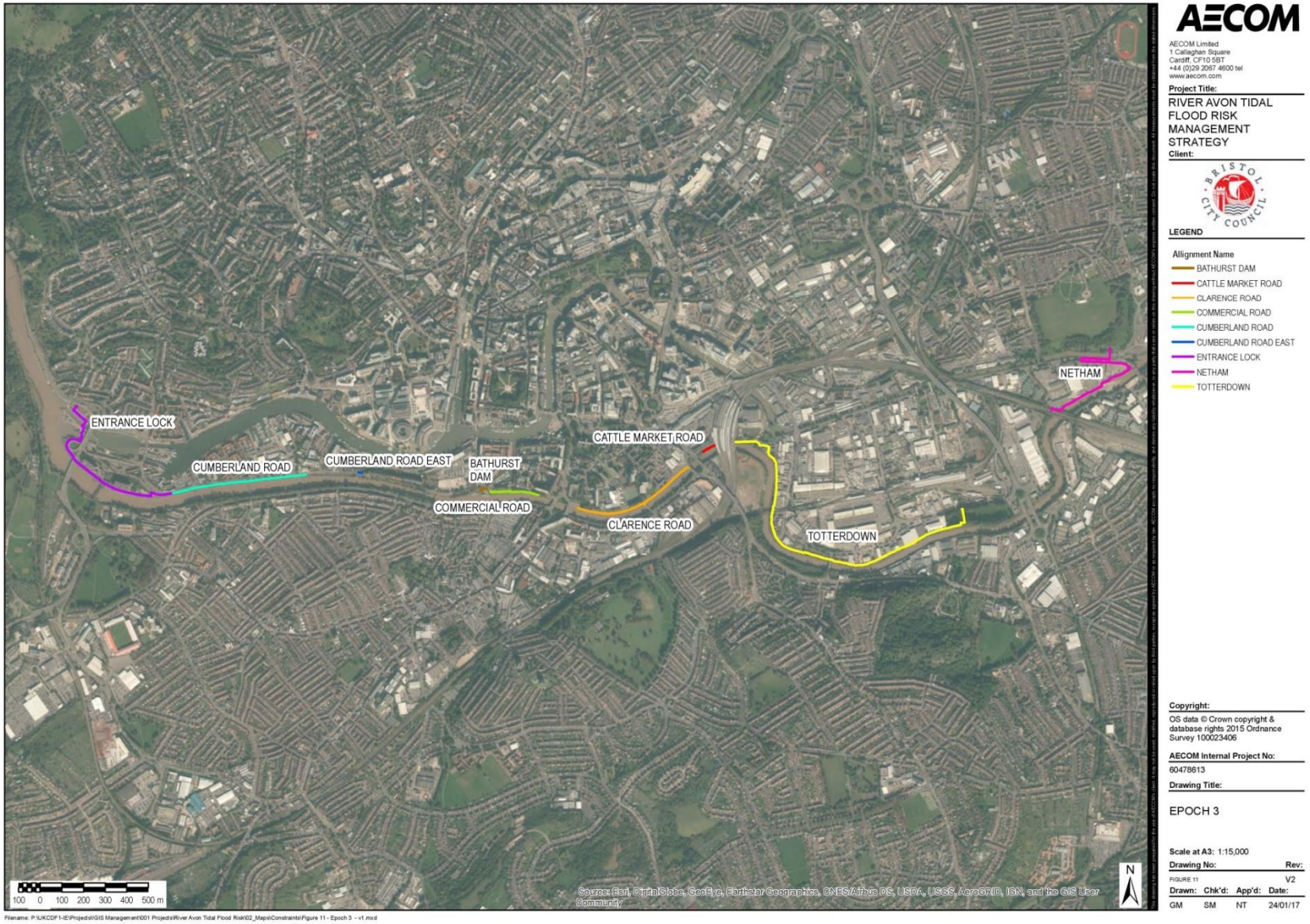


Figure 11: Epoch 3

Detriment Mitigation

Numerical modelling has found that implementation of the Strategy's main defences would lead to an increased risk of flooding (detriment) in four areas – Totterdown, Netham, Bower Ashton and Bedminster, and therefore detriment mitigation works have been included in The Strategy to resolve the issue. It is important to note that proposals in these areas are at an early stage of development, and further investigations and design development on a local level will be required to confirm and refine proposals.

Bower Ashton

At Bower Ashton the proposals involve the raising of the existing bank to a height of 10.3 m. This bank will be approximately 480 m long (as shown in Figure 12), with an average height increase of 1.4 m, and a maximum height increase of 2.4 m. The difference in height between high tide level and the proposed embankment is circa 5 m compared to present day Mean High Water (MHW).

Totterdown

This involves the raising of private flood defences by up to 1.3 m.

Netham

At Netham several measures are proposed:

- **Raise the existing sheet piled defence to prevent overtopping to a height of 10.4 m. The maximum length of defence required is 950m (as shown in Figure 12), with an average raising of approximately 800mm;**
- **Flap the Brislington Brook outfall;**
- **Culvert the open section of Brislington Brook or raise defences around it;**
- **Provide overpumping when Brislington Brook cannot discharge under gravity;**
- **PLP measures will be installed to a small number of properties; and**
- **Upstream storage upstream of Netham to capture fluvial water. As this measure is at a very early design stage it has not been possible to assess this measure due limited information associated with the location, and the nature and scale of the proposals; however, this will be considered at a later design stage.**

Bedminster

Detriment Mitigation in the form of Property Level Protection is proposed to be installed into approximately seven properties. The specific properties where this measure will be installed will be confirmed at a later stage of project development

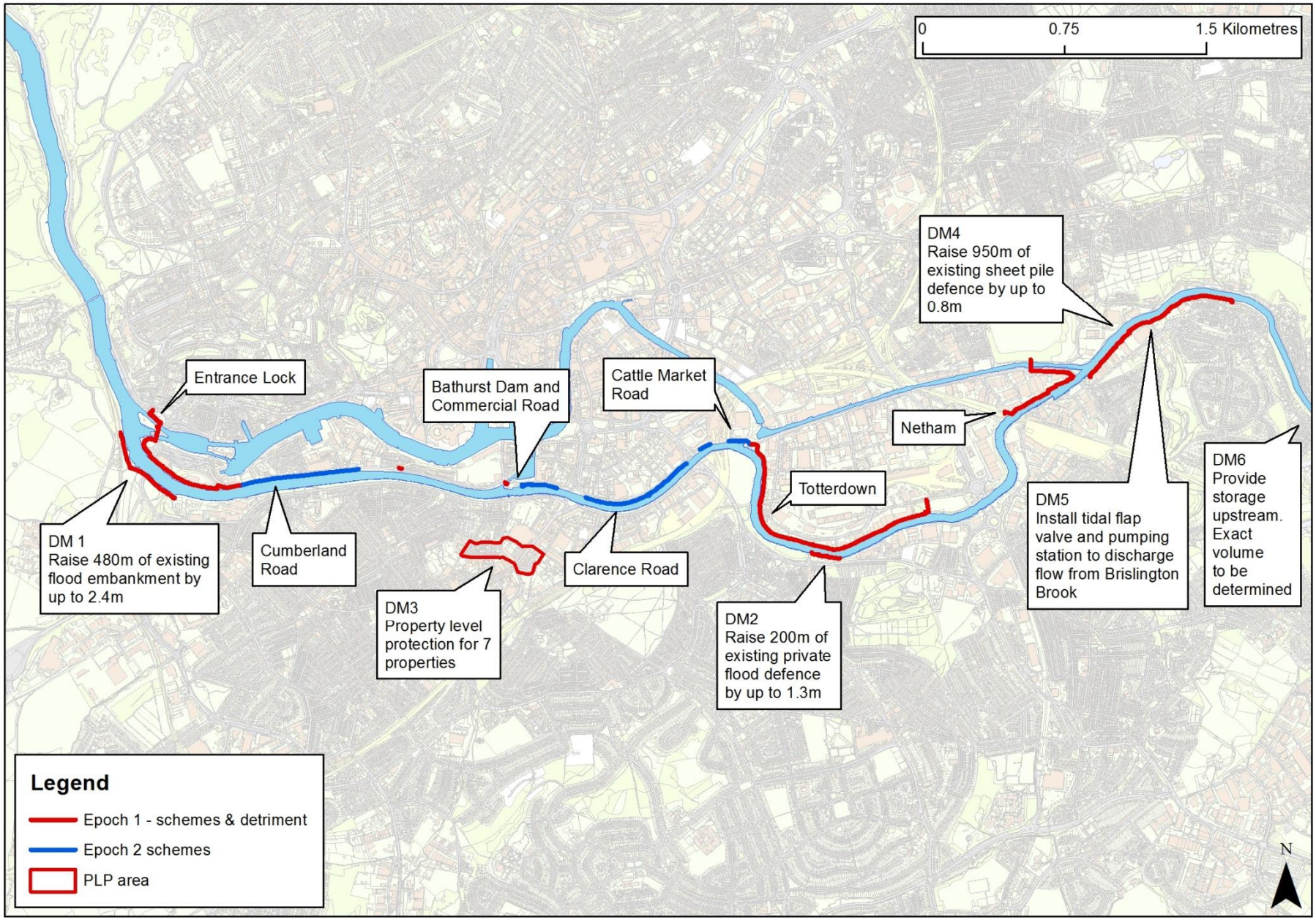


Figure 12: Detriment Mitigation

Assessment of Environmental Impacts of the Strategy

BCC selected Option D as the Preferred Option based on AECOM's recommendation outlined in the Preferred Option Report. The Preferred Option Report draws on a number of other supporting reports and technical studies – including the interim SEA during the options appraisal process to arrive at this Option.

A summary of AECOM's justification for selecting Option D (as per the Preferred Option Report) is provided below:

- **The barrier options (C and E) were discounted based on substantially higher costs compared to any of the options involving walls (A, B, D and F).**
- **Option G (Do min-Do Min-High Def) was discounted as this option was found to lead to a significant deterioration in standards of protection over the next 50 years which would mean large numbers of properties would remain at risk of flooding, and therefore did not meet the Strategy objectives.**
- **Options A and B were also discounted as these measures would not provide a measure of protection to homes and businesses over the lifetime of the Strategy – only until 2030.**
- **Options D and F were considered as they would provide an immediate improvement in standards of protection allowing development to be facilitated.**

Overall, it was found that Option D has a lower cost, lesser or equal environmental impact and is more adaptable to future sea level rise compared to Option F, and therefore Option D was selected as the preferred option.

Whilst environmental factors and the findings of the SEA contributed towards the selection of the preferred option by the Council, it should be recognised that other factors such as economic, social and technical factors also formed key drivers. Therefore, the preferred option in The Strategy is not necessarily the option that has the least environmental impact, but the preferred option demonstrated to be environmentally acceptable, if not preferred.

An assessment of the likely environmental impacts in each SEA category is presented within Appendix C of this Environmental Report for the preferred option. The following chapters outline this assessment for the preferred option on a category by category basis

Biodiversity, flora and fauna

The aim of this section is to present an assessment of The Strategy in terms of the 'biodiversity' related issues established through scoping. In summary these issues are:

- **Reach 3 contains no European Sites or SSSI's, however it does contain a range of European protected species.**
- **There are a number of wildlife corridors in Reach 3.**
- **The Severn Estuary is an important nursery ground for fish which may be affected by the measures.**

Assessment Findings

The assessment findings below are presented in terms of Construction effects and Operation Effects. A discussion of Detriment Mitigation is presented under each of these headings.

Construction

Defences

Designated sites

The HRA (contained within Appendix D) concluded that there are likely to be no 'Likely Significant Effects' in relation to disturbance of European Sites i.e. the Seven Estuary SPA, SAC and Ramsar.

There are also unlikely to be significant effects on the Seven Estuary SSSI and BAP mudflats during the construction of the defences as construction will be taking place approximately 8 km upstream of these designated sites. In addition given that disturbance will take place only during construction, such effects will be temporary with the majority of construction activity occurring during Epoch 1 (present – 2030) and Epoch 2 (2030 -2065).

There are no sites designated for their ecological value within Reach 3; however, there are a series of wildlife corridors that may be affected by construction impacts. It is considered that given the level of importance of these corridors against the magnitude and duration of the construction impacts there is potential for a temporary negative effect but it is unlikely to be significant.

Intertidal Habitat Loss

As the Strategy is refined further, and detailed defence design takes place, every opportunity should be taken to minimise net loss of intertidal mudflat and reduce the potential losses identified in this analysis. Ultimately, measures will be devised and presented as part of the detail to support a planning application to ensure no net loss of intertidal habitat. This will take account of any increased coastal squeeze that may result from new defences and also from any increased coastal defence footprint.

Estuarine Ecology

There may be a temporary negative effect on estuarine ecology during the construction period particularly in locations where frontline alignments are proposed (i.e at Netham, Bathurst Dam, Commerical Road, Clarence Road and Cattle Market Road) due to the disturbance of sediment as well as noise impacts, although it is expected that the majority of these impacts can be adequately mitigated in a CEMP.

Detriment Mitigation

The embankment raising at Bower Ashton may have a minor temporary negative effect due to impacts associated with construction activity. Designated sites within the vicinity of the proposed embankment include Ashton Court SSSI (approximately 100 m from the proposed embankment), Bower Ashton Site of

Nature Conservation Interest (approximately 250 m from the proposed embankment), and Avon Gorge and Woodlands SSSI (approximately 300 m from the proposed embankment). Given the magnitude and duration of the construction impacts there is potential for a temporary negative effect but it is unlikely to be significant.

The raising of the sheet piled defence at Netham, and culverting the Brislington Brook may have a temporary negative impact on estuarine ecology during construction due to disturbance of sediment as well as noise impacts.

It is not considered that PLP would have any effects on this SEA topic.

Operation

Defences

From an operational perspective, the low and high defences would provide a high level of protection from flooding. Once the defences have been built, no significant impact on biodiversity, flora and fauna is expected.

A substantial length of the frontage proposed to be defended already has existing flood defences, with built-up areas behind them which would prevent any landward retreat of intertidal habitats even without this Strategy. Any loss of intertidal habitat along most of the frontage would not therefore be the result of this scheme.

During the winter period the Somerset Levels & Moors may be subject to freezing conditions which can mean that birds move out to coastal areas such as the extensive mudflats and associated high-tide roosts of the Severn Estuary SPA/Ramsar site. While passage and wintering birds associated with this SPA/Ramsar site may sometimes then use the mudflats in the tidal River Avon around Bristol, the amount of intertidal mudflat available (generally a maximum 20m wide strip and often much less) inherently limits the value of these mudflats compared to those within the Severn Estuary SPA/Ramsar site itself and only a small proportion of the total SPA/Ramsar population is likely to utilise these mudflats at any time. However, compensatory and mitigation measures will be devised and presented as part of the detail to support a planning application to ensure no net loss of intertidal habitat (once compensatory measures have been carried out.

Detriment Mitigation

At Bower Ashton there is the potential for a negative impact on estuarine geomorphology as a result of the Strategy constructing a new flood defence and causing coastal squeeze. At this location there is an undeveloped area of grassland behind the proposed embankment; although this is not an entirely naturalised area due to the presence of the channelised River Avon and water infrastructure (e.g. culverted watercourses), theoretically, without the embankment the river banks could erode over time, allowing the intertidal mudflat in this location to retreat inland and thus be preserved in extent notwithstanding sea level rise.

The Severn Estuary Shoreline Management Plan (SMP) Review (2010) provides an assessment of the risks associated with coastal processes and presents a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner. The SMP policy for the area (policy unit BRIS5) is Hold the Line (HTL) which is "to provide some level of coastal defence, keeping the position of the defence approximately where it is at the moment". In terms of coastal squeeze, it is considered the Strategy is in conformity with the Severn Estuary SMP, despite the construction of the earth embankment at Bower Ashton. The adopted SMP and its policies have been accepted by key consultees (Bristol City Council, Environment Agency and Natural England). Despite the SMP stating that HTL for this policy unit is the best environmental option, it is acknowledged that this does not mean that there are no

environmental effects at all and therefore any habitat loss as a result of coastal squeeze will be mitigated/compensated before this embankment is constructed. The Bower Ashton embankment's alignment would also be setback at a level above high tide. This means it would not directly encroach into the intertidal zone at the time of construction in the first epoch, and the landward transgression of intertidal habitats, assuming the gradient of the river bank permits transgression, would not be impeded until sometime later on in the Strategy. It is anticipated that the intertidal habitats would be monitored at regular intervals following the implementation of the scheme to verify the conclusions of the Environmental Statement (or identify the need for additional mitigation). The method and frequency of this monitoring will be determined at EIA stage.

In total, the direct footprint loss for estuarine habitats associated with the Strategy (as currently proposed by the outline design) is estimated to be 2218 m^2. This is based on 2218 m length of defences and a maximum 1 m encroachment out from current defences. This estimate includes the Netham detriment works and at this stage there is uncertainty as to whether these works will lead to encroachment in order to raise defence heights; should the footprint not be increased at Netham the maximum estuarine land take will reduce to an estimated 1268m^2 (0.127 ha). Such losses would require compensation in order to maintain habitat balances. It would be the responsibility of any projects which result in loss of habitats to ensure compensatory habitat has been provided (on behalf of BCC), and agreed with the Environment Agency and Natural England, prior to any losses occurring. Whilst recognising the need to potentially compensate as a result of the Strategy, suitable sites for habitat creation should be identified at a later stage of scheme development once the total area of habitat loss, both direct loss via encroachment and indirect losses by altering tidal water levels and impedance of habitat "rollback" has been predicted using hydraulic modelling, habitat characterisation and geomorphological appraisal.

The further work for scheme development and implementation should include identifying the type of habitat that could be lost as a result of coastal squeeze. At this early stage of design we have assumed a worst case scenario that encroachment will be in the intertidal zone. A targeted, Phase 1 Habitat Survey should be completed at EIA stage to characterise habitats and confirm the type and quality of habitat which has the potential to be impacted directly and indirectly. Alongside ecological work, a geomorphological appraisal would be necessary to confirm whether the estuary's form and adjacent hinterland would permit the rollback of intertidal habitats under rising sea levels i.e. steep river bank gradients may limit the likelihood of rollback.

It would be prudent to ascertain when the habitat losses are likely to occur. A separate modelling exercise is recommended for scheme implementation during the EIA phase in order to estimate the projected coastal squeeze under the future baseline and with development scenarios. It is not considered possible or appropriate to estimate the potential habitat losses at this stage of the project because more detailed baseline information and design is required than is currently available at the time of writing.

It is acknowledged that the River Avon intertidal mud in the Strategy area is outside any European site, but could be used by larval lamprey (ammocoetes) associated with the Severn Estuary SAC, or by non-breeding birds associated with the Severn Estuary SPA (at least occasionally in small numbers). However, given the small amount of intertidal mudflat in this area, it is unlikely that creating the embankment at Bower Ashton will radically affect the ability of the Bristol Avon to support ammocoetes. The Preliminary HRA Report provides further information on this issue.

It is not considered that any of the other proposed detriment mitigation measures would have any effects on this SEA topic.

Habitat Regulations Assessment

The UK is bound by the terms of the Habitats Directive (92/43/EEC). Under Article 6(3) of the Habitats Directive, an appropriate assessment is required, where a plan or project is likely to have a significant effect

upon a European Site, either individually or in combination with other projects. The Directive is implemented in the UK by the Conservation of Habitats and Species Regulations 2010 (as amended) (the "Habitats Regulations").

A preliminary HRA report has been carried out which presents an analysis of the Likely Significant Effects of The Strategy on the only European Sites for which a risk of effect is present: the Severn Estuary SAC and Severn Estuary Ramsar site, with specific reference to their migratory fish qualifying interests. The Report contained within Appendix D concluded that The Strategy would result in 'no likely significant effects' on any European Sites either alone or in combination with other projects and plans, providing a number of precautionary measures were followed such as using low noise and vibration piling techniques and carrying out works outside of the sensitive season for fish migration. This conclusion will be reviewed in the scheme HRA which will be developed, once the precautionary measures have been further developed and incorporated into the design or construction methodologies, in order to confirm the conclusion of no likely significant effects.

Proposed Mitigation

There are a range of standard practice mitigation measures, dependant on approaches to construction of the defences. It is recommended that The Strategy establishes a policy framework to ensure that any planning applications adhere to the highest standards of environmental performance (given the timescales of The Strategy, it will need to be flexible enough to adapt to changing technologies). This should include measures to both mitigate and enhance effects.

As mentioned above, in order to reduce the potential significant effect identified in the preliminary HRA with regard to European Sites, and specifically to their migratory fish qualifying interests the following mitigation is recommended:

- **Piling construction work should use low noise and vibration techniques such as pressing or vibro-piling rather than impact/percussive piling;**
- **The lowest power levels of impact piling equipment that can undertake the task should be selected;**
- **No percussive piling should be permitted at dusk and dawn and no piling of any kind will occur between the hours of 6pm and 8am;**
- **The piling programme should be carefully scheduled to minimise impact piling during the most sensitive time periods;**
- **Piling should be permitted on the ebb tide only during migration upstream and during the flood tide only for migration downstream;**
- **Scheduling impact piling to restrict percussive piling to a maximum of *N* hours per day/ per week during the sensitive season (N to be determined on the basis of local site conditions, particularly water depth at piling position and confirmed details of the piling equipment to be used).**
- **Where necessary low tide working (where percussive piling is only permitted at low tide ± *X* hours (*X* to be determined based on tidal cycles and local site conditions) can also be adopted during the migration season (though this can be very time restrictive in the winter months),**
- **It is recommended that such works should take place outside of the sensitive season for migration. For Atlantic salmon and sea trout this is generally April to June, although the Atlantic salmon migration period for the Bristol Avon can be later in the season (July to October). European eel start migrating upstream into the catchment from mid-February, with juvenile eels migrating when water temperatures are between 13 and 14°C. If it is not possible to avoid conducting works during the sensitive season, underwater noise modelling and measurement can be used to determine the**

precise nature of any noise barrier created during piling and if necessary enable mitigation to be devised.

- **As a general precaution, any 'in river' impact piling works should cease if there is evidence of dolphin or porpoise being present at the time of piling.**

- **Eel mitigation is required to ensure eel passage is maintained during works to Brislington Brook outfall, culverting and the proposed over pumping. Works to Netham sluice gates could also provide an opportunity to improve eel passage at this structure.**

As planning application(s) are developed, the mitigation measures listed above will need to be developed further, with particular regard to the noise generated by the actual construction methods. These further developed measures will need to be included in an HRA to accompany the planning application. They will then need to be conditioned as part of any planning permission.

Intertidal Habitat Loss

As detailed defence design takes place, every opportunity should be taken to minimise net loss of intertidal mudflat to reduce the losses identified in this analysis. Ultimately, measures will be devised and presented as part of the detail to support a planning application to ensure no net loss of intertidal habitat. This will take account of any increased coastal squeeze that may result from new defences (such as the embankment at Bower Ashton) and also from any increased coastal defence footprint.

Fish Passage

Measures will need to be included in the detailed design of the flap on the Brislington Brook outfall, a culvert on the open section of the Brislington Brook (if this is necessary) and the over-pumping when the Brislington Brook cannot discharge under gravity to ensure that fish passage generally and eel/lamprey passage in particular is preserved. There are several standard guides and methodologies for designing such features that will need to be followed during detailed design[7].

Works to Netham Weir sluice gates could also provide opportunity to improve eel passage at this structure, but net positive measures (i.e. those that are not strictly required to avoid a likely significant effect or adverse effect on integrity) more properly belong in the SEA report or other supporting documentation, rather than in the HRA.

Potential enhancement opportunities

Japanese knotweed, Giant Hogweed and Himalayan Balsam have all been recorded within the wider study area. These are all plant species that are often associated with riverine environments due to the ease of spread via flowing water. It is probable that stands of all these species are present in various locations along the riverbank, although no specific survey has been undertaken at this stage. Opportunities to eradicate these species while delivering the strategy should be investigated (via a detailed invasive species survey and associated management plan) and included in delivery of the strategy.

Proposed Monitoring

The following indicators are proposed to monitor the significant effects of The Strategy:

- **It is anticipated that the intertidal habitats would be monitored at regular intervals to inform key decisions as to when the proposed embankment will be constructed .The method and frequency of this monitoring will be determined at EIA stage.**
- **Changes in condition to designated sites**

[7] http://www.ecrr.org/Publications/tabid/2624/mod/11083/articleType/ArticleView/articleId/3317/Default.aspx
http://www.southampton.ac.uk/engineering/research/projects/fish_passage_upstream_over_gauging_structures.page
http://www.sciencedirect.com/science/article/pii/S092585741630129X

- **Achievement of biodiversity targets**
- **Chemical and ecological condition of rivers**
- **Requirements for habitat enhancement and/or compensation arising out of the River Avon TFRMS**

Population, human health and material assets

The aim of this section is to present an assessment of The Strategy in terms of the 'population, human health and material assets' related issues established through scoping. In summary these issues are:

- **Flood risk issues exist in some parts of the areas proposed for future housing delivery in the city, including the city centre.**
- **Flooding and erosion can result in effects on both physical and psychological health, which could exacerbate existing health issues. Repeated flooding can be a particular issue in relation to psychological health and well-being.**
- **The Strategy should ensure that material assets on the coast, such as walkways, residential/commercial areas in Avonmouth, Pill, Shirehampton and Bristol are not compromised as a result of flooding.**

Assessment Findings

The assessment findings below are presented in terms of Construction effects and Operation Effects. A discussion of Detriment Mitigation is presented under each of these headings.

Construction

Defences

Construction impacts (e.g. dust, noise and traffic disruption) will generally be localised to those receptors in vicinity of the defences (i.e. at Cumberland Road etc.). As the alignments are spread over a three Epochs (over 100 years), the receptors will not be the same at the end as when the works start. There are a number of major roads which run behind the Low/High defence alignments (e.g. Cumberland Road, Commercial Road, Clarence Road and Feeder Road) which might be affected by increased traffic flows. Constructions of the defences are likely to result in temporary negative effects on this SEA topic.

Detriment Mitigation

There is the potential for minor impacts from the installation/construction of detriment mitigation measures for a modest number of dwellings in Reaches 2 and 3. There is the potential for temporary negative effects should PLP be installed into any Listed Buildings but the effect will be minor and can be mitigated.

Operation

Defences

Over time, there will be a permanent significant positive effect in terms of flood risk protection for material assets, food risk and health afforded to the level of flood protection provided by the defences compared to the Do Minimum measure and PLP.

In terms of health, during Epoch 1 and Epoch 2 (present-2060), construction of low defences will reduce the flood risk which may have a minor benefit to the physical and psychological health of the local population through a reduction of injuries during flooding events. During Epoch 3 (2060-2115) when the low defences are raised to high defences this is likely to have a significant positive impact on physical and psychological health due to the reduction in flood risk.

When considering material assets, in Epoch 1 and Epoch 2 (present-2060) where low defences are proposed, this is likely to have a significant positive impact on material assets due to the reduction in flood risk. In Epoch 3 (2060-2115) the widespread raising of the defences from low to high across throughout the alignment is likely to provide significant benefits to the material assets at risk of flooding.

Detriment Mitigation

Once operational there will be a positive effect in terms of flood protection for the houses which the detriment mitigation measures protect. However, for the properties which are offered protection by PLP, the success of the flood defence depends on if the flood gates are able to be installed prior to periods of high rainfall.

Proposed Mitigation

None proposed as part of The Strategy.

Potential enhancement opportunities

The Strategy has the potential to support improvements to the built environment in the city, with a particular focus on those areas suffering from the highest levels of deprivation. In instances where low and high level defences are to be deployed within the urban area there are opportunities to enhance the character of the surroundings and make use of community spaces. These could be investigated as part of the scheme appraisal and design stage, for instance, through working with the council to provide spaces for street art and other community led projects. Bristol is well known for its street art and it has been shown to contribute positively to the city. For instance the Upfest Street Art and Graffiti Festival, which is held in Bristol is the largest festival of its kind in Europe.

Proposed Monitoring

The following indicators are proposed to monitor the effects of The Strategy:

- **Number of properties/businesses at risk of flooding**
- **Number of recreational and amenity facilities affected by flooding incidents**
- **Number and severity of incidents leading to disruption or damage to transport infrastructure and other critical assets.**
- **Number of days lost by industry due to access problems**
- **Number and severity of incidents leading to disruption or damage to service provision.**

Soil and water

The aim of this section is to present an assessment of The Strategy in terms of the 'Soil and water' related issues established through scoping. In summary these issues are:

- **Significant areas at risk of tidal and coastal flooding.**
- **The implementation of The Strategy should ensure that the current situation is not exacerbated and should seek to improve the status of water bodies where appropriate.**
- **The Strategy should not affect abstraction sources.**

Assessment Findings

The assessment findings below are presented in terms of Construction effects and Operation Effects. A discussion of Detriment Mitigation is presented under each of these headings.

Construction

Defences

The most 'significant' negative effects resulting from the options will be produced through activities relating to the construction of Low defences. The foundations of Low defences will be 'future proofed' to support the increased height required to build up low defences to form high defences. As such piling will not be required in Epoch 3 when the low defences are proposed to be raised.

The construction activities for the Low and High defences may have a temporary negative effect on water and soil through disturbance to the river bed and the release of sediment into the River Avon, particularly at locations where the alignment is frontline such as Netham, Bathurst Dam, Commercial Road, Clarence Road and Cattle Market Road. It is considered that this can be mitigated through conventional measures.

Detriment Mitigation

The construction activities associated with raising the sheet piled wall at Netham may have a temporary negative effect on water and soil, particularly if the wall will have to be re-piled as this will cause disturbance to the river bed and the release of sediment into the River Avon. It is considered that this can be mitigated through conventional measures such as silt curtains or containment strategies. Similar effects are expected associated with culverting the Brislington Brook due to the disturbance of the river bed.

It is not considered that the proposed embankment at Bower Ashton, PLP or installing a flap on the Brislington Brook outfall would have any effects on this SEA topic.

Operation

Defences

In terms of soil, over the lifetime of The Strategy (present -2115), construction of the defences along the alignment will provide increased flood and erosion protection and significantly reduce the chance of contaminated land exposure therefore providing a permanent positive effect.

For the most part the frontage to be defended already has existing flood defences, with built-up areas behind them which would prevent any changes to geomorphology even without this scheme. Any changes in geomorphology along most of the frontage would not therefore be the result of this scheme.

Detriment Mitigation

At Bower Ashton there is the potential for a negative impact on estuarine geomorphology as a result of the Strategy constructing a new flood defence and causing coastal squeeze. At this location there is an undeveloped area of grassland behind the proposed embankment; although this is not an entirely naturalised area due to the presence of the channelised River Avon and water infrastructure (e.g. culverted watercourses), theoretically, without the embankment the river banks could erode over time, allowing the intertidal mudflat in this location to retreat inland and thus be preserved in extent notwithstanding sea level rise.

The Severn Estuary Shoreline Management Plan (SMP) Review (2010) provides an assessment of the risks associated with coastal processes and presents a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner. The SMP policy for the area (policy unit BRIS5) is Hold the Line (HTL) which is "to provide some level of coastal defence, keeping the position of the defence approximately where it is at the moment". In terms of coastal squeeze, it is considered the Strategy is in conformity with the Severn Estuary SMP, despite the construction of the earth embankment at Bower Ashton. The adopted SMP and its policies have been accepted by key consultees (Bristol City Council, Environment Agency and Natural England). Despite the SMP stating that HTL for this policy unit is the best environmental option, it is acknowledged that this does not mean that there are no environmental effects at all and therefore any habitat loss as a result of coastal squeeze will be mitigated/compensated before this embankment is constructed.

The Bower Ashton embankment's alignment would also be setback at a level above high tide. This means it would not directly encroach into the intertidal zone at the time of construction in the first epoch, and the landward transgression of intertidal habitats, assuming the gradient of the river bank permits transgression, would not be impeded until sometime later on in the Strategy. It is anticipated that the intertidal habitats would be monitored at regular intervals following the implementation of the scheme to verify the conclusions of the Environmental Statement (or identify the need for additional mitigation). The method and frequency of this monitoring will be determined at EIA stage.

In total, the direct footprint loss for estuarine habitats associated with the Strategy is estimated to be 2218 m^2. This is based on 2218 m length of defences and a maximum 1 m encroachment out from current defences. This estimate includes the Netham detriment works and at this stage there is uncertainty as to whether these works will lead to encroachment in order to raise defence heights; should the footprint not be increased at Netham the maximum estuarine land take will reduce to an estimated 1268m^2 (0.127 ha). Such losses would require compensation in order to maintain habitat balances. It would be the responsibility of BCC to ensure compensatory habitat has been provided, and agreed with the Environment Agency and Natural England, prior to any losses occurring. Whilst recognising the need to potentially compensate as a result of the Strategy, suitable sites for habitat creation should be identified at a later stage of scheme development once the total area of habitat loss, both direct loss via encroachment and indirect losses by altering tidal water levels and impedance of habitat "rollback" has been predicted using hydraulic modelling, habitat characterisation and geomorphological appraisal.

The further work for scheme implementation should include identifying the type of habitat that could be lost as a result of coastal squeeze. At this early stage of design we have assumed a worst case scenario that encroachment will be in the intertidal zone. A targeted, Phase 1 Habitat Survey should be completed at EIA stage to characterise habitats and confirm the type and quality of habitat which has the potential to be impacted directly and indirectly. Alongside ecological work, a geomorphological appraisal would be necessary to confirm whether the estuary's form and adjacent hinterland would permit the rollback of intertidal habitats under rising sea levels i.e. steep river bank gradients may limit the likelihood of rollback.

It would be prudent to ascertain when the habitat losses are likely to occur. A separate modelling exercise is recommended for scheme implementation during the EIA phase in order to estimate the projected coastal squeeze under the future baseline and with development scenarios. It is not considered possible or appropriate to estimate the potential habitat losses at this stage of the project because more detailed baseline information and design is required than is currently available at the time of writing.

Outline Preliminary WFD Assessment

An Outline Preliminary WFD Assessment has been produced which includes an assessment of all water bodies that could be affected by the implementation of The Strategy, including their current water quality status. This can be found within Appendix E of this SEA Environmental Report.

The Outline Preliminary WFD Assessment concluded that the piling involved for any defences has the potential to intercept groundwater levels, however there are currently no groundwater SPZ in the scheme area, and no groundwater abstractions close to the River Avon that would be likely to be affected and as such impact to groundwater is scoped out of this WFD assessment. This statement should be reassessed in the future as new groundwater abstraction licences could be granted near the River Avon, within the Triassic Groundwater body that could potentially be impacted by piling.

If the proposed raised or new defence is set back from river water body, then it will not alter the morphological regime or the water quality, and therefore would not require WFD assessment. The replacement or raising of existing lock gates would be unlikely to cause any change or deterioration to WFD objectives as the works will be undertaken within the existing footprint of the defence or landwards and would not impact the waterbody.

However, the Outline Preliminary WFD Assessment found that there is potential for impacts on the Bristol Avon waterbody as the construction of defences in currently undefended areas has the potential to impact the ecological status of the waterbody, as this will likely involve a reduction of aquatic habitat areas, as well as have a negative effect on the hydromorphology of the waterbody. The Outline Preliminary WFD Assessment therefore recommends that a WFD assessment will be required to evaluate the total combined length and percentage of the water body affected to assess the overall significance of the impact. As whilst an individual scheme may have an insignificant impact on WFD quality elements within a reach, the combined effect of several small-scale schemes within a waterbody may cause deterioration. It is intended that a full WFD Assessment will be carried out and submitted as part of a future Environmental Impact Assessment (EIA).

Proposed Mitigation

The schemes flowing from the Strategy should seek to improve the status of the water bodies. The following mitigation is recommended:

- **Potential for localised water quality impacts as a result construction works and the potential to expose soils that are contaminated could be further reduced with sensitive construction techniques. All mitigation measures should be contained within a Construction Environmental Management Plan (CEMP).**
- **The Environment Agency have identified a list of mitigation measures for the River Avon waterbody that will be required to meet WFD objectives at 2027 and beyond, although the Environment Agency suggest that at this time none of the mitigation measures have been implemented. The measures include:**
    - **Realign flood defence**
    - **Fish passes**
    - **Enhance ecology**
    - **Remove obsolete structure**
    - **Changes to locks etc**
    - **Avoid the need to dredge**
    - **Dredging disposal strategy**
    - **Reduce impact of dredging**
    - **Reduce sediment suspension**
    - **Retime dredging or disposal**
    - **Sediment management**
    - **Dredge disposal site selection**

- **Manage disturbance**
- **Retain habitats**
- **Remove or soften hard bank**
- **Indirect mitigation**
- **Preserve or restore habitats**
- **In-channel morph diversity**
- **Bank rehabilitation**

- **Any future WFD assessment should take into account the existing mitigation measures identified for the achievement of Good Ecological Potential and seek opportunities to help deliver the objectives of the current River Basin Management Plan at the time of assessment.**

Potential enhancement opportunities

Due to the urban nature of the Study Area there is the potential for contamination which may have adverse effects on water quality if pollutants are released into the environment. There is significant potential for the Strategy to remediate such contaminated areas. Likewise a number of the mitigation measures listed above can be considered as enhancement opportunities when planning schemes (e.g. restoring habitats, introducing bank rehabilitation etc.)

Proposed Monitoring

The following indicators are proposed to monitor the effects of The Strategy:

- **Number of properties/businesses at risk of flooding**
- **Number of flood defences developed and condition of existing flood defence**
- **Condition of water bodies (Water Framework Directive)**
- **Monitoring of in-channel habitat losses at currently undefended locations**

Climatic factors

The aim of this section is to present an assessment of The Strategy in terms of the 'Climatic factors' related issues established through scoping. In summary these issues are:

- **In addition to flood risk management, The Strategy should facilitate the implementation of solutions which support further aspects of climate change adaption, including linked to the urban heat effect, potential effects on biodiversity and water resources.**
- **Where possible, low carbon solutions to flood risk issues should be considered to support climate change mitigation.**
- **Given that much of the area is coastal sea level rise is a serious concern as many identified assets are at risk of flooding.**

Assessment Findings

The assessment findings below are presented in terms of Construction effects and Operation Effects. A discussion of Detriment Mitigation is presented under each of these headings.

Construction

Defences

With regard to construction the impacts of construction are likely to be limited to greenhouse gas emissions from the construction activities (HGV and operation of plant) and the embodied carbon in the defence measures themselves, the effect of this is not likely to be significant. As the defences will be 'future proofed' the defences will only need to be piled once reducing the amount of greenhouse gases produced during the construction phase.

Detriment Mitigation

The impacts associated with detriment mitigation measures are likely to be associated with greenhouse gas emission from construction activities and the embodied carbon in the measures themselves, the effect of this is not likely to be significant.

Operation

Defences

From an operational perspective, the low and high defences provide a high standard of protection from tidal flooding and therefore will provide adequate protection from sea level rise due to climate change. In the operational phase there will be GHG emissions and therefore a positive effect is expected for this topic.

Detriment Mitigation

It is not considered that any of the detriment mitigation measures would have any effects on this SEA topic.

Potential enhancement opportunities

None proposed as part of The Strategy

Proposed Mitigation

None proposed as part of The Strategy

Proposed Monitoring

None proposed as part of The Strategy

Cultural heritage

The aim of this section is to present an assessment of The Strategy in terms of the 'Cultural heritage' related issues established through scoping. In summary these issues are:

- **The preservation or enhancement of the existing character and setting of cultural heritage assets**
- **The preservation or enhancement of the appearance of cultural heritage assets, conservation areas, and nationally and locally listed buildings.**
- **The conservation and enhancement of local archaeological remains.**
- **There are a number of Listed Buildings in Bristol which are located in close proximity to the River Avon and are therefore vulnerable to flooding. They could also be impacted by the implementation of The Strategy if the defence is in close proximity to residential areas.**

Assessment Findings

The assessment findings below are presented in terms of Construction effects and Operation Effects. A discussion of Detriment Mitigation is presented under each of these headings.

Construction

Defences

The heritage assets that have the potential to be affected include:

- **Entrance Lock - Grade II* Swing Bridge over North Entrance Lock and South Entrance Lock; Grade II* Brunel's South Entrance Lock; Grade II B Bond Tobacco Warehouse; Grade II A Bond Tobacco Warehouse; Grade II Ashton Swing Bridge; Grade II buildings on Avon Crescent; Grade II buildings within Underfall Yard; and Underfall Yard Scheduled Ancient Monument. There are also a number of non-statutory designated assets in close proximity to the proposed alignment.**
- **Cumberland Road - Grade II Vauxhall Bridge; there are also a number of non-statutory designated assets in close proximity to the proposed alignment.**
- **Clarence Road - Grade II Langton Street Bridge.**
- **Totterdown - There are no listed buildings in close proximity to this alignment; however there are a number of non-statutory designated assets.**
- **Netham - Grade I Avon Bridge; and Grade II Netham Locks Bridge. There are also a number of non-statutory designated assets in close proximity to the proposed alignment.**

The Conservation Areas which are likely to be affected by this measure are City Docks and Bedminster.

It is considered that construction of the Low and High defences will result in a temporary negative effect due to the potential impact on the setting of the Heritage Assets described above. Due to the historic nature of the Study Area, there is also the potential for archaeological remains which should be a consideration during the construction process, with mitigation included within a CEMP.

Detriment Mitigation

It is not considered that any of the detriment mitigation measures would have any effects on this SEA topic, providing that the PLP measures are not installed into any Listed Buildings.

Operation

Defences

In terms of operation of the Low and High defences, there may be negative effects on the setting of heritage assets in Reach 3. It is probable that the High defences would have the greatest potential for a significant effect given it is the scheme with the greatest height and therefore visibility from and to heritage assets. However, it may be possible to mitigate these effects with sensitive design of the defences (see Figure 5) that is sympathetic to the historic character of the city. It is considered there might be permanent effects on heritage assets with both the Low and High defences on both Reach 2 and 3 but it is not possible to determine the significance or direction at this stage i.e. without more details of design / appearance.

From a perspective of protecting and preserving cultural heritage assets, clearly the improved protection from flooding from all the options would result in significant permanent positive effects as the setting and the fabric of the asset would be protected from future flooding.

Detriment Mitigation

It is not considered that PLP any of the detriment mitigation measures would have any effects on this SEA topic.

Proposed Mitigation

The character and setting of nearby designated sites and structures need to be considered when undertaking the construction works. This is to ensure that the character and setting of important historic buildings and structures is not compromised by any structures which have the potential to alter the overall character and setting of the area.

During the construction phase there are a range of mitigation solutions that can be considered (e.g. damping down dust, acoustic screening and so on) which should minimise the construction impacts to an insignificant level.

Potential enhancement opportunities

There may be opportunities for the strategy to contribute to the enhancement of the existing character, setting and appearance of cultural heritage assets and Conservation Areas. Reference should be made to the specific Conservation Area's Enhancement Objectives (contained in appendix B of the Scoping Report) when determining design of specific flood risk interventions present in, or in proximity to these areas. The effect considered in the context of the intervention being considered as part of the Strategy.

Proposed Monitoring

The following indicators are proposed to monitor the effects of The Strategy:

- **Number of listed buildings at risk of flooding events**
- **Number of flood defences/strategies implemented to protect listed buildings since the Strategy was published**
- **Number and condition of conservation areas, historic parks and gardens**

Landscape

The aim of this section is to present an assessment of The Strategy in terms of the 'Landscape' related issues established through scoping. In summary these issues are:

- **Inappropriate design and layout may deteriorate the landscape or visual amenity, and also has the potential to prevent access to existing areas**

Assessment Findings

The assessment findings below are presented in terms of Construction effects and Operation Effects. A discussion of Detriment Mitigation is presented under each of these headings.

Construction

Defences

It is considered that construction of the Low and High defences may result in a temporary negative effect on Townscape as in some locations the alignment is already partially defended (i.e. at Cumberland Road) and is of an urban nature.

Detriment Mitigation

The only measures which are may result in a temporary negative effect on Townscape are those involving the raising of the embankment at Bower Ashton, and the raising of the sheet piled wall at Netham.

It is not considered that culverting the Brislington Brook, installing a flap on the Brislington Brook outfall, or PLP measures would have any effects on this SEA topic.

Operation

Defences

In terms of operation of the Low and High defences, there is potential for negative effects on the landscape and townscape. It is probable that the High defences would have the greatest potential for a significant effect given it is the scheme with the greatest height and therefore visibility. However, it may be possible to mitigate these effects with sensitive design of the defences. There is also the opportunity for positive effects, for example through the inclusion of green infrastructure as part of the proposals which would improve the public realm, and enhance the landscape character and townscape quality.

Detriment Mitigation

It is not considered that raising the existing embankment at Bower Ashton or raising the existing wall at Netham would have any effects on this SEA topic, as the proposals only involve an average raising of 1.4 m and 800 mm respectively which is a small increase considering the both structures are in the range of 9-10 m in height currently.

It is recommended that The Strategy establishes a framework to ensure that any planning applications adhere to the highest standards of environmental performance and where possible seeks to enhance the environment.

Potential enhancement opportunities

There is opportunities to provide urban realm enhancements through the inclusion of green infrastructure as part of the scheme proposals which would improve the public realm, and enhance the landscape

character and townscape quality. Such opportunities have currently been identified un the Strategy and ongoing development of these will be carried out through subsequent stages of scheme development.

Proposed Mitigation

Any flood risk or erosion management measures employed should be sensitive to the location in which they are being undertaken and the sensitivity of any landscape resources. In particular, the townscape of Entrance Lock where there are a number of heritage assets should be protected.

During the construction phase there are a range of mitigation solutions that can be considered (e.g. damping down dust, visual screening and so on) which should minimise the construction impacts to an insignificant level.

Proposed Monitoring

The following indicators are proposed to monitor the effects of The Strategy:

- **Number of proposed and actual flood mitigation developments to be located within landscapes with a high sensitivity.**

Cumulative Effects

In assessing the effects of The Strategy on the environment, it is important to consider how implementation of The Strategy might *interact* with other initiatives (e.g. other policies, plans, programmes and projects) and generate possible *cumulative* effects on the environment. As the Government's guidance on SEA states, "*Many environmental problems result from the accumulation of multiple small and often indirect effects, rather than a few large and obvious ones*".[8] The guidance advises that cumulative effects arise, for instance, where several developments each have insignificant effects but together have a significant effect; or where several individual effects of a plan (e.g. noise, dust and visual) have a combined effect.

The Strategy has the potential to combine with other planned or on-going activities in the vicinity of the proposed measures to result in cumulative effects; see Table 6. Currently the 'in combination effects' of the Strategy with two main plans have been identified and assessed; however it is recognised that more comprehensive assessment of in combination effects of schemes should be carried out at the time of scheme development and design to ensure all aspects and relevant plans and programmes at the time are considered.

Table 6: In-combination effects

Other plans and programmes	Likely in combination effects with The Strategy
The Severn Estuary Shoreline Management Plan[9]	The Strategy is in-keeping with the Hold the Line Policy set out in the SMP2 for the study area. The environmental effects of this policy have been assessed as part of the SMP SEA and environmental compliance assessments. The Strategy could lead to some minor advancement of the line in the delivery of new raised defences, and this effect has not currently been accounted for the SMP2. There is potential that other schemes delivering SMP policies in other parts of the estuary could lead also lead to additional adverse impacts; these scheme impacts should be assessed and quantified 'in combination' at the time to ensure to in that the additional compensation or mitigation is provided either regionally, or within the waterbody (where WFD compliance is an issue).
The Severn Estuary Strategy [10]	Likely to work in combination with The Severn Estuary Strategy to reduce the level of flood risk and coastal erosion across the wider region. There is likely to be positive effects for biodiversity, population, health and material assets, soil and water through the delivery of these strategies, however the specific details of schemes required to implement the Estuary Strategy are not currently known. However, there are also potential adverse impacts in the delivery of these two Strategies, such as coastal squeeze and encroachment impacts on key habitats; the quantum and scale of such impacts should be assessed in combination across the region. When the schemes come forward to deliver the Strategy further assessment of in combination effects should be assessed at the time to ensure effects remain sustainable, and where possible further synergistic benefit opportunities with other strategy plans and programmes should be identified delivered.
Bristol City Council Local Plan[11]	The River Avon TFRMS complements and supports Bristol City's Local Plan, as there are flood risk issues which exist in some parts of the city which are proposed for future housing delivery, including the city centre. The provision of the Strategy will facilitate greater enablement of

[8] Office of the Deputy Prime Minister, Scottish Executive, Welsh Assembly Government and Department of the Environment (2005). A Practical Guide to the Strategic Environmental Assessment Directive [online] available at: www.gov.uk/government/uploads/system/uploads/attachment_data/file/7657/practicalguidesea.pdf (accessed 11 July 2017).
[9] http://sites.cardiff.ac.uk/secg/files/2016/03/SE-SMP2-planning-leaflet_N-Somerset_draft_v1.pdf
[10] http://www.severnestuarypartnership.org.uk/files/2016/01/Consultation-Draft-2016-Severn-Estuary-Strategy.pdf
[11] Bristol City Council (2011) Local Plan. Available online at: https://www.bristol.gov.uk/planning-and-building-regulations/local-plan Accessed on: July 2017

	development in these areas in the future. Over time, there will be a permanent significant positive effect in terms of flood risk protection for cultural heritage and material assets afforded to the level of flood protection provided by the defences. **Furthermore, flooding and erosion can result in effects on both physical and psychological health, which could exacerbate existing health issues. Repeated flooding can be a particular issue in relation to psychological health and well-being. By reducing the flood risk in the city centre this has the potential to improve physical and psychological health. This should have positive effects for human health for those currently at risk of flooding.** **The Strategy is aimed at reducing the risk of flooding which will minimise the impact of potential flood incidents on material assets and critical infrastructure within the centre of Bristol. Therefore the Strategy will support any of the BCC plans or policies which relate to the protection of critical infrastructure and material assets. This will have further positive effects for population, human health, material assets and cultural heritage.** **The Strategy is aimed at reducing the risk of flooding which will minimise the impact of potential flood incidents on heritage assets within the centre of Bristol. Therefore the Strategy will support any of the BCC plans or policies which relate to the protection of cultural heritage within the area. This will have further significant positive impacts on cultural heritage with interlinkages between other topics including population, human health and material assets.** **The Strategy has the potential to provide a high degree of synergy with adopted Plans within the centre of Bristol whose primary focus is to enhance the landscape of the area.** **When the schemes come forward to deliver the Strategy further assessment of in combination effects with the Local Plan should be assessed at the time to ensure effects remain sustainable, and where possible further synergist benefit opportunities should be identified delivered.**
Bristol Central Area Plan[12]	**The Bristol Central Area Plan was Adopted in March 2015 and this sets out the vision for Bristol to 2026. The Tidal Strategy is supportive of the aspiration for a vibrant thriving economy, attractive and interesting public realm with iconic cultural stimuli. The Strategy effects will work in combination with the delivery of this plan, and there are opportunities to support the delivery of objectives. Potential opportunities to incorporate a green resilience corridor into the defences for example would provide synergistic landscape benefits, as well as population, health and social benefits from better flood protection. Further work should be carried out to ensure that any adverse impacts of the delivery of the Strategy are mitigated so that the objectives of the Central area plan are not compromised. Likewise, any wider schemes or initiatives being implemented within the area from the Plan should consider the Tidal Strategy scheme plans to ensure joined up thinking, delivery of beneficial opportunities and robust mitigation strategies to address potential adverse impacts.**

[12] https://www.bristol.gov.uk/documents/20182/34540/BCAP%20Adopted%20March%202015%20-%20Main%20Document%20&%20Annex%20-%20Web%20PDF.pdf/d05a0c22-ab91-4530-926a-f26160ab72a5

Conclusions and Recommendations

Conclusions

In the assessment, The Strategy was found to have likely significant positive effects on the following topics:

- **Health/Population/Material Assets; and**
- **Cultural Heritage.**

Without suitable mitigation and compensation there is the potential for the Strategy to have significant negative effects on the following topics:

- **Biodiversity.**

Indicative scale of impacts for the Strategy delivery along with potential mitigation strategies, compensation requirements and monitoring work have been presented and signposted in this Environmental Report. However, the quantum and nature of biodiversity impacts and legislative compliance requirements will need to be further assessed and worked up in detail during the development and detailed design of individual schemes flowing from the Strategy. This further work will also need to include evaluation of any in combination effects with other relevant plans and programmes at the time.

Similarly, minor effects (not significant) were identified for the following topics:

- **Landscape;**
- **Soil/Water; and**
- **Climatic Factors.**

The most sensitive location in terms of receptors is Entrance Lock due to the number of heritage receptors in close proximity to the proposed alignment. Here there are several positive effects predicted for:

- **Health/ Population/Material Assets;**
- **Soil/Water;**
- **Cultural Heritage; and**
- **Climatic Factors.**

Recommendations

The following are recommended to mitigate negative effects:

- **Where possible local labour should be used in order to support the local economy;**
- **A Transport Management Plan (TMP) should be prepared in order to mitigate any negative effects associated with transport as a result of The Strategy;**
- **To mitigate negative effects on riverine ecology measures such as bubble netting should be explored;**
- **A Landscape Character Assessment (LCA) would ensure that there is some focus on the protection and enhancement of townscape and landscape character.**
- **A Landscape Visual Impact Assessment (LVIA) is recommended to minimise any impacts on the landscape and key views to and from the river;**

- **A Heritage Assessment should be carried out to allow the impacts of The Strategy on the significance of any heritage assets to be understood further;**
- **A CEMP should be prepared to mitigate any impacts associated with the construction phase;**
- **The Environment Agency have identified a list of mitigation measures for the River Avon waterbody that will be required to meet WFD objectives at 2027 and beyond, although the Environment Agency suggest that at this time none of the mitigation measures have been implemented. The measures include:**
    - **Realign flood defence**
    - **Fish passes**
    - **Enhance ecology**
    - **Remove obsolete structure**
    - **Changes to locks etc**
    - **Avoid the need to dredge**
    - **Dredging disposal strategy**
    - **Reduce impact of dredging**
    - **Reduce sediment suspension**
    - **Retime dredging or disposal**
    - **Sediment management**
    - **Dredge disposal site selection**
    - **Manage disturbance**
    - **Retain habitats**
    - **Remove or soften hard bank**
    - **Indirect mitigation**
    - **Preserve or restore habitats**
    - **In-channel morph diversity**
    - **Bank rehabilitation**
- **Any future WFD assessment should take into account the existing mitigation measures identified for the achievement of Good Ecological Potential and seek opportunities to help deliver the objectives of the current River Basin Management Plan at the time of assessment.**
- **Piling construction work should use low noise and vibration techniques such as pressing or vibro-piling rather than impact/percussive piling;**
- **The lowest power levels of impact piling equipment that can undertake the task should be selected;**
- **No percussive piling should be permitted at dusk and dawn and no piling of any kind should occur between the hours of 6pm and 8am;**
- **The piling programme should be carefully scheduled to minimise impact piling during the most sensitive time periods;**
- **Piling should be permitted on the ebb tide only during migration upstream and during the flood tide only for migration downstream;**
- **Scheduling impact piling to restrict percussive piling to a maximum of N hours per day/ per week during the sensitive season (N to be determined on the basis of local site conditions, particularly water depth at piling position and confirmed details of the piling equipment to be used);**
- **Where necessary low tide working (where percussive piling should only be permitted at low tide ± X hours (X to be determined based on tidal cycles and local site conditions) can also be adopted during the migration season (though this can be very time restrictive in the winter months); and**
- **It is recommended that such works should take place outside of the sensitive season for migration. For Atlantic salmon and sea trout this is April to October. European eel start migrating upstream in**

mid to late February while juvenile eels migrate when water temperatures are between 13 and 14°C. If it is not possible to avoid conducting works during the sensitive season, underwater noise modelling and measurement should be used to determine the precise nature of any noise barrier created during piling and if necessary enable mitigation to be devised.

- **Eel mitigation is required to ensure eel passage is maintained during works to Brislington Brook outfall, culverting and the proposed over pumping. Works to Netham sluice gates could also provide an opportunity to improve eel passage at this structure.**

Environmental Enhancement opportunities

A number of potential enhancement opportunities have been identified for the Strategy; these should be further explored with a requirement for schemes to deliver appropriate additional benefits (in addition to required mitigation and compensation.

Key areas of opportunity lie with public realm and landscape enhancement, where potential measures such as green infrastructure resilience corridor initiatives should be further assessed during scheme development to provide betterment.

In addition biodiversity enhancement through removal of invasive species (e.g. Japanese Knotweed), re-planting of native species, regrading and riverbank restoration should be sought.

Where hard defences are required in the watercourse, measures such as vertipools could be considered to improve the biodiversity potential of otherwise largely sterile sheet piling / walls.

What are the next steps (including monitoring)?

This section of the Report explains the next steps that will be taken as part of plan-making/SEA.

Strategy finalisation and adoption

Subsequent to consultation on The Strategy it will be finalised with the intention that it will be formally 'adopted' by the Council. At the time of adoption, a 'SEA Statement' will published that sets out (amongst other things) 'the measures decided concerning monitoring'.

Future Action

Currently it has been identified that the Strategy is likely to produce a negative impact on intertidal (and potentially subtidal) habitats within the River Avon through direct footprint encroachment but also potentially influencing the tidal frame. The extent of habitat affected as well as the scale of impact is not able to be accurately estimated at present, as until a design freeze for the scheme is produced containing further detail of alignments and construction, it is not possible to measure this effect. In addition, this assessment will require the support of hydraulic modelling to establish the impacts of the scheme on low and high tide levels within the study area against the current situation. This will then be used to ascertain the scale of potential impacts to habitats and areas of loss and will inform the requirements for compensatory habitat area. This should also be evaluated in the wider context of likely impacts due to sea level rise. It may also be prudent to consider a potential IROPI case if necessary.

Suitable mitigation and/or compensation may be required within the water body to satisfy WFD and HRA compliance and this should be discussed and planned in close consultation with Natural England, the Environment Agency and other key stakeholders.

Monitoring

Monitoring in Strategic Environmental Assessment

The SEA Directive states that *'member states shall monitor the significant environmental effects of the implementation of plans and programmes.....in order, inter alia, to identify at an early stage unforeseen adverse effects, and to be able to undertake appropriate remedial action'* (Article 10.1). In addition, the Environmental Report should provide information on a 'description of the measures envisaged concerning monitoring' (Annex I (i)). To limit the potential burdens related to monitoring associated with the SEA process, monitoring should be undertaken smartly. For this reason, the proposed monitoring framework should focus on those aspects of the environment that are likely to be negatively impacted upon, where the impact is uncertain or where particular opportunities for improvement might arise.

Proposed monitoring programme

The purpose of monitoring is to measure the significant sustainability effects of a plan, as well as to measure success against the plan's objectives. It is therefore beneficial if the monitoring strategy builds on monitoring systems which are already in place. To this end, many of the indicators of progress chosen for the SEA require data that is already being routinely collected at a local level by Bristol City Council. It should also be noted that monitoring can provide useful information for future plans and programmes.

Table 7 outlines suggestions for a monitoring programme for measuring the Strategy's implementation in relation to the areas where the SEA has identified significant opportunities for an improvement in

sustainability performance to arise. It also seeks to monitor where uncertainties relating to the assessment findings arose and suggests where monitoring is required to help ensure that the benefits of The Strategy are achieved through the planning process.

Table 7: Proposed monitoring

SEA Theme	Proposed Monitoring
Biodiversity, Flora and Fauna	· It is anticipated that the intertidal habitats would be monitored at regular intervals to inform key decisions as to when the proposed embankment will be constructed .The method and frequency of this monitoring will be determined at EIA stage. · Changes in condition to designated sites. · Achievement of biodiversity targets. · Chemical and ecological condition of rivers. · Requirements for habitat enhancement and/or compensation arising out of the River Avon TFRMS.
Population, Human Health and Material Assets	· Number of properties/businesses at risk of flooding. · Number of recreational and amenity facilities affected by flooding incidents. · Change in number/area/quality of public open spaces. · Number of flood related injuries/health issues. · Number and severity of incidents leading to disruption or damage to transport infrastructure and other critical assets. · Number of days lost by industry due to access problems. · Number and severity of incidents leading to disruption or damage to service provision.
Soil and Water	· Number of properties/businesses at risk of flooding. · Number of flood defences developed and condition of existing flood defence. · Condition of water bodies (Water Framework Directive). · Monitoring of in-channel habitat losses at currently undefended locations.
Cultural Heritage	· Number of listed buildings at risk of flooding events. · Number of flood defences/strategies implemented to protect listed buildings since the Strategy was published. · Number and condition of conservation areas. · Number and condition of registered historic parks and gardens.
Landscape	· Number of proposed and actual flood mitigation developments to be located within landscapes with a high sensitivity.

Appendix A: SEA Scoping Report

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Strategic Environmental Assessment: Scoping Report

May 2016

Prepared for Bristol City Council

Issue	Date	Details	Prepared by	Checked by	Approved by
1	29 April 2016	Draft for client review	**Hayley Siers** Graduate Environmental Consultant **Alex White** Associate Director, Policy and Appraisal	**Neil Titley** Associate, Environment **Steve Smith** Technical Director, Policy and Appraisal	**Jason Drummond*** *in absence of David Dales (on leave 29/04/16) Principal Flood and Coastal Specialist
2	16 May 2016	BCC Project Team comments actioned	**Hayley Siers** Graduate Environmental Consultant **Alex White** Associate Director, Policy and Appraisal	**Neil Titley** Associate, Environment **Steve Smith** Technical Director, Policy and Appraisal	**Jason Drummond*** *in absence of David Dales Principal Flood and Coastal Specialist
3	25 May 2016	Final for statutory consultation	**Hayley Siers** Graduate Environmental Consultant **Alex White** Associate Director, Policy and Appraisal	**Neil Titley** Associate, Environment **Steve Smith** Technical Director, Policy and Appraisal	**Neil Titley** Associate, Environment **Steve Smith** Technical Director, Policy and Appraisal

Limitations

AECOM Infrastructure & Environment UK Limited ("AECOM") has prepared this Report for the sole use of **Bristol City Council** in accordance with the Agreement under which our services were performed **[River Avon Tidal Flood Risk Management Strategy RESP1007626 (23/10/15) and Response to Tender Submission Clarifications (03/11/15)]**. No other warranty, expressed or implied, is made as to the professional advice included in this Report or any other services provided by AECOM. The report takes into account the particular instructions and requirements of Bristol City Council. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

The conclusions and recommendations contained in this Report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between **14 April 2016** and **25 May 2016** and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

AECOM disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to AECOM's attention after the date of the Report.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ

materially from the results predicted. AECOM specifically does not guarantee or warrant any estimate or projections contained in this Report, but does take into account the particular instructions and requirements of Bristol City Council.

Acronyms

AQMA	Air Quality Management Area
AMIE	Archives and Monuments Information England
BAP	Biodiversity Action Plan
EA	Environment Agency
EU	European Union
GHG	Greenhouse Gases
JLTP	Joint Local Transport Plan
LQMA	Local Air Quality Management Area
LCA	Landscape Character Area
NO_2	Nitrogen oxides
NERC	Natural Environment and Rural Communities
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
PM	Particulate Matter
PRoW	Public Rights of Way
SAC	Special Area of Conservation
SEA	Strategic Environmental Assessment
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
WFD	Water Framework Directive

TABLE OF CONTENTS

1. INTRODUCTION

AECOM has been commissioned to undertake a voluntary strategic environmental assessment (SEA) in support of Bristol City Council's (BCC) emerging River Avon Tidal Flood Risk Management Strategy (the 'Strategy').

A tidal risk management strategy for Bristol is vitally important for the city, not just because of the threat to lives and property, but also because of the risk of long-term reputational damage to the city's attractiveness for investment and overall economic performance. Climate change as predicted has the potential to constrain the scale and form of development in central Bristol

The Strategy will recommend an adaptive programme; identify when flood risk management interventions are needed and how they will be funded. The Strategy, once adopted by BCC's Cabinet following a Key Decision, will provide evidence to support the partial refresh of Bristol's Local Plan. The Strategy may conclude that no strategic intervention is justified for some time if, for instance, another possible form of intervention(s) can achieve the Strategy's objectives.

No screening exercise has been undertaken to determine whether the Strategy requires SEA under the Environmental Assessment of Plans and Programmes Regulations 2004 (the SEA Regulations) as the assessment is being undertaken voluntarily by BCC.

1.1 Background to SEA

SEA is a mechanism for assessing and communicating the likely significant effects of an emerging plan or strategy, and reasonable alternatives, in terms of key environmental and sustainability issues. The aim of SEA is to inform and influence the strategy-making process with a view to avoiding and mitigating negative effects and maximising positive effects. Through this approach, the SEA for the Strategy seeks to maximise the environmental and sustainability performance of the emerging Strategy.

SEA is undertaken in line with the procedures prescribed by the Environmental Assessment of Plans and Programmes Regulations 2004 (the SEA Regulations) which transpose into national law EU Directive 2001/42/EC 'on the assessment of the effects of certain plans and programmes on the environment' (the SEA Directive). The main aim of the SEA Directive is to *"provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development".*

Two key procedural requirements of the SEA Regulations are that:

1. Regulation 12 (5): When deciding on 'the scope and level of detail of the information' which must be included in the 'environmental report' – a key output of the SEA process - there is a consultation with the 'consultation bodies'[1]; and
2. Regulation 13 (1): The environmental report is published for consultation alongside the Draft Strategy that presents an **assessment** of the Draft Strategy (i.e. discusses 'likely significant effects' that would result from Strategy implementation) and reasonable alternatives**.**

The SEA process is covered in more detail in 'A Practical Guide to the Strategic Environmental Assessment Directive'[2] (the 'Practical Guide'). This set's out a five stage process to SEA (see also **Figure 2-1**):

- **Stage A**: Setting the context and objectives, establishing the baseline and deciding on the scope;
- **Stage B**: Developing and refining alternatives and assessing effects;
- **Stage C**: Preparing the environmental report;
- **Stage D**: Consulting on the draft plan or programme and the environmental report; and

[1] In England, the Environment Agency, Historic England and Natural England

[2] ODPM now DCLG (2006) A practical guide to the Strategic Environmental Assessment Directive [online] @ http://www.communities.gov.uk/publications/planningandbuilding/practicalguidesea. Accessed 04/2016

- **Stage E**: Monitoring the significant effects of implementing the plan or programme on the environment.

To aid the consultation process, this scoping report contains two further sections covering:

- **SEA methodology**: this section sets out an indicative methodology for assessing the effects of the Strategy, and reasonable alternatives.
- **Environmental report**: this sections sets out a proposed structure for the environmental report.

1.2 Scoping Report

This scoping report sets out the information described in guidance for Stage A (scoping) and will be consulted on in line with SEA Regulation 12 (5) i.e. with the consultation bodies for five weeks. This report sets out the results of four tasks:

- Task A1: Identifies other relevant plans, programmes and environmental protection objectives;
- Task A2: Provides baseline information;
- Task A3: Identifies environmental problems; and
- Task A4: Provides a draft set of SEA objectives (the SEA Framework; these provide the benchmark or yardstick for gauging the Strategy's environment and sustainability performance).

2. THE RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

The area covered by the Strategy is located within Bristol in the South West of England. The area covered by the Strategy lies between Gloucestershire and North Somerset and extends from the mouth of the River Avon in the west, at the point where it joins the Severn Estuary, through Bristol city centre, to Netham Weir in the east. The Study Area has been divided into three reaches to assist in reporting and data interpretation, as illustrated in **Figure 4-1**:

- Reach 1: Avonmouth (from the seaward end of the longest breakwaters at the mouth of the estuary) to the eastern boundary of the Severn Estuary Special Area of Conservation (SAC) boundary on the River Avon;
- Reach 2: The Severn Estuary SAC boundary to the western end of Cumberland Basin; and
- Reach 3: The western end of Cumberland Basin to Netham Weir.

The Study Area boundary has been established based on the area of Bristol that is potentially at risk from tidal flooding by the end of the Strategy appraisal period (2115). The area at risk in the future was determined using a modelling approach, whereby the land elevation within Bristol that falls beneath the 2115 1 in 200 year (0.5% annual exceedance probability) tidal water level i.e. Environment Agency Flood Zone 3, was defined and considered to be at risk. The extreme water level for 2115 was based upon the 'Upper end' climate change emissions scenario to derive the maximum potential flood extent.

The objectives of the Strategy are:

- To support the safe living, working and travelling of people in and around central Bristol by ensuring that the flood threat is reduced and that measures are in place to address residual risks;
- To facilitate the sustainable growth of Bristol and the wider West of England economy by supporting development opportunities for employment and residential land, and associated infrastructure;
- To maintain, and where possible enhance, natural, historic, visual and built environments;
- To reduce whole life costs, with consideration of reactive emergency response, and to ensure the Strategy is fundable;
- To ensure navigation of the River Avon and marine activities can continue; and to

- Ensure the Strategy is technically feasible and deliverable over its duration.

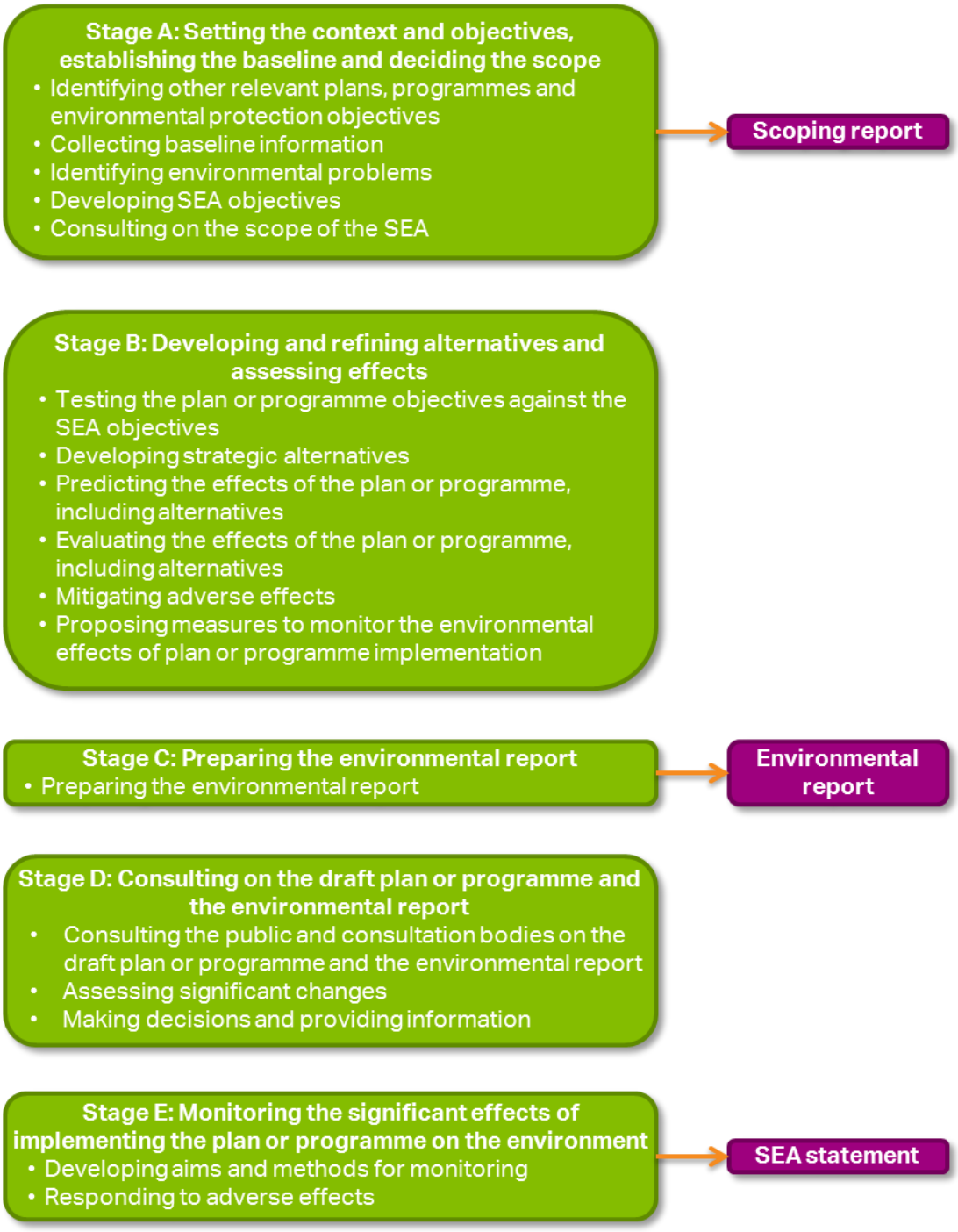


Figure 2-1: SEA stages and link to development of the Strategy

3. MEETING THE REQUIREMENTS OF THE SEA REGULATIONS

The next output of the SEA process will be the environmental report. The environmental report will need to contain all the relevant information to meet the requirements of Regulation 12(3) of the SEA Regulations (i.e. the requirements set out in Schedule 2 of the SEA Regulations). A reference table will be provided in the environmental report setting out how each regulatory requirement has been met (see **Table 3-1**).

Table 3-1: SEA Regulations requirements for the environmental report as outlined in the SEA Regulations

Environmental report must include:	Where in the environmental report has this been addressed?
(a) an outline of the contents, main objectives of the plan or programme and relationship with other relevant plans and programmes;	Text to be included in the environmental report
(b) the relevant aspects of the current state of the environment and the likely evolution thereof without implementation of the plan or programme;	Text to be included in the environmental report
(c) the environmental characteristics of areas likely to be significantly affected;	Text to be included in the environmental report
(d) any existing environmental problems which are relevant to the plan or programme including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 79/409/EEC (The Birds Directive) and 92/43/EEC (The Habitats Directive);	Text to be included in the environmental report
(e) the environmental protection objectives, established at international, Community or Member State level, which are relevant to the plan or programme and the way those objectives and any environmental considerations have been taken into account during its preparation;	Text to be included in the environmental report
(f) the likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors;	Text to be included in the environmental report
(g) the measures envisaged to prevent, reduce and as fully as possible offset any significant adverse effects on the environment of implementing the plan or programme;	Text to be included in the environmental report
(h) an outline of the reasons for selecting the alternatives dealt with, and a description of how the assessment was undertaken including any difficulties (such as technical deficiencies or lack of know-how) encountered in compiling the required information;	Text to be included in the environmental report
(i) a description of the measures envisaged concerning monitoring in accordance with Article 10;	Text to be included in the environmental report

Environmental report must include:	Where in the environmental report has this been addressed?
(j) a non-technical summary of the information provided under the above headings.	Text to be included in the environmental report

4. SCOPE OF THE SEA

The SEA Regulations require the assessment of the likely significant environmental effects of the plan or programme, and reasonable alternatives, to focus on issues such as:

- Air;
- Biodiversity (including flora and fauna);
- Climatic factors;
- Cultural heritage;
- Human health;
- Landscape;
- Material assets;
- Population;
- Soil;
- Water;
- and the interrelationship between the above factors.

Note that the wording of the SEA Regulations is not prescriptive. This allows for the scope to be tailored to the plan or strategy being assessed. This scoping report includes a chapter on each of the relevant topics. Each topic chapter presents the information referred to in Section 1.2 in order to determine which matters are in or out of the SEA scope. The conclusions with regard to what topics are 'in' or 'out' of scope is set out in **Table 15-1**.

Severn Estuary
Avonmouth
Breakwater
River Avon
Shirehampton
Pill
South Gloucestershire
City of Bristol (B)
North Somerset
River Avon
Cumberland Basin
Junction Lock
Underfall Yard
Bristol City Centre
Bristol Temple Meads
Feeder Canal
South
North
Netham Weir
North

Reach 1: Avonmouth (from the seaward end of the longest breakwaters at the mouth of the estuary) to the eastern boundary of the Severn Estuary Special Area of Conservation (SAC) boundary on the River Avon.

100 0 100 200 300 400 500 Meters

Reach 2: The Severn Estuary SAC boundary to the western end of Cumberland Basin

100 0 100 200 300 400 500 Meters

Reach 3: The western end of Cumberland Basin to Netham Weir

100 0 100 200 300 400 500 Meters

1 0 1 2 3 4 5 Kilometers

N

AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Administration Boundaries

Map Extent
Scale 1:4,000,000

AECOM Internal Project No:

60478613

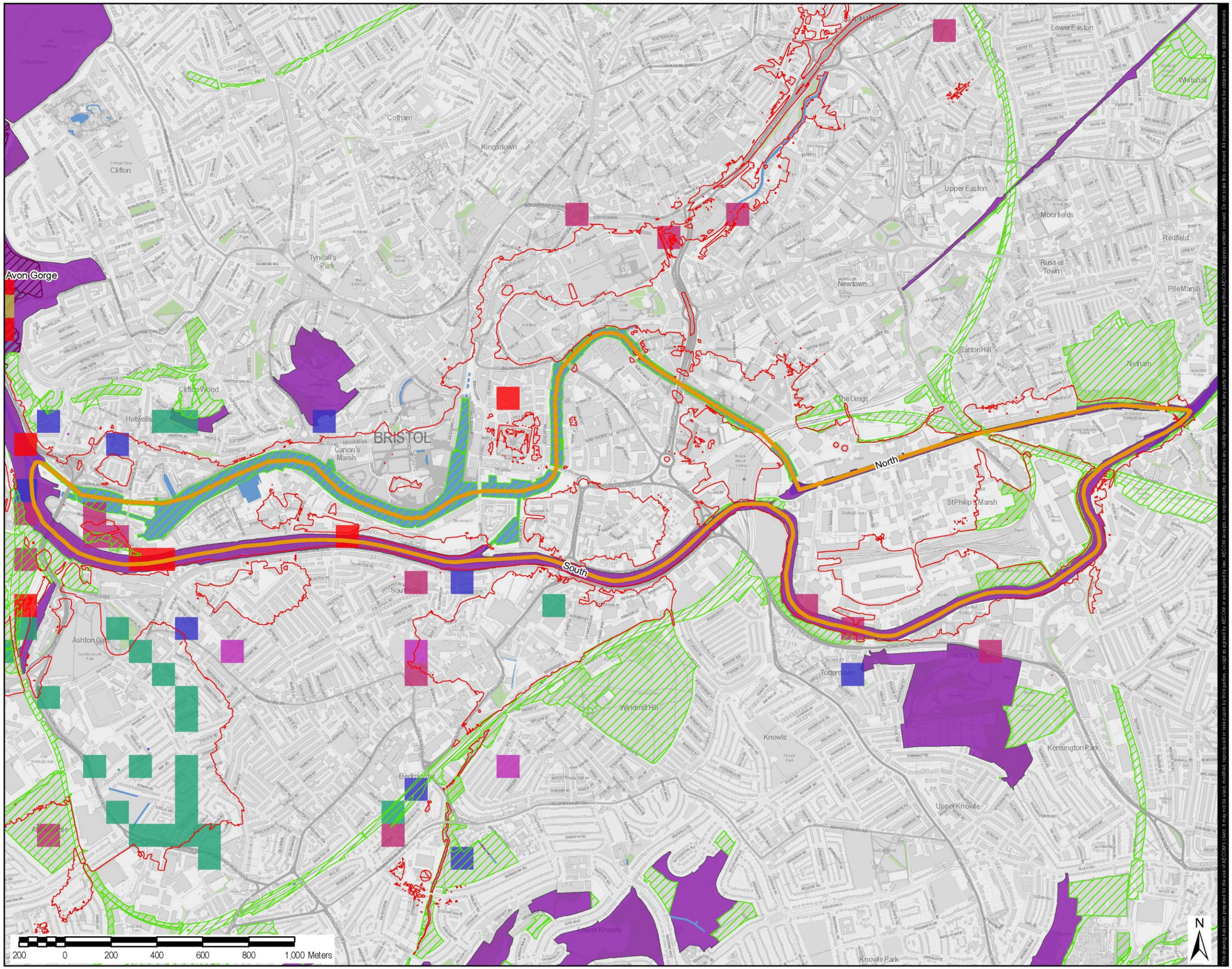
Drawing Title:

FIGURE 4.1
STUDY AREA

Scale at A3: 1:65,064.6

Drawing No:			Rev:
FIGURE 4.1			V1
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	24/05/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\4-1_Study Area_v2.mxd



Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\5-1_Biodiversity_Pages_v2.mxd

AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Wildlife Corridors

BRERC Schedule 8 of Wildlife and Countryside Act 1981 - Sites and Species

- Common
- Local
- Not common / status not well known
- Proposed BRERC Notable 2004 as nationally notable
- Proposed BRERC Notable 2008 as UK BAP listed
- Proposed BRERC Notable 2009 as protected
- Rare
- Scarce
- Uncommon / Declining
- Widespread / Locally Abundant when breeding
- Widespread / Locally Common
- Surface Water - Linear
- Ancient Woodland
- Site of Special Scientific Interest - Environment Agency
- Special Protection Areas - Environment Agency
- Special Areas of Conservation - Environment Agency
- RAMSAR - Environment Agency
- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland calcareous grassland
- Lowland dry acid grassland
- No main habitat but additional habitats
- Traditional orchard
- National Nature Reserves - Environment Agency
- Local Nature Reserves - Environment Agency
- Important Bird Areas - RSPB
- SNCI Sites
- Woodland - OS Open Data
- Foreshore - OS Open Data
- Tidal Water - OS Open Data
- Surface Water - OS Open Data

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 5.1C BIODIVERSITY FLORA AND FAUNA

Scale at A3: 1:15,000

Drawing No:			Rev:
FIGURE 5.1C			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	16/05/16

5. BIODIVERSITY, FLORA AND FAUNA

5.1 Policy context

European context

Given the location of the study area and its international importance for biodiversity, the primary policies relevant to the area are Directive 2009/147/EC 'on the conservation of wild birds' (the Birds Directive and Directive 92/43/EEC 'on the conservation of natural habitats and of wild fauna and flora' (the Habitats Directive). These Directives seek to conserve habitats and species of European importance and require Member States to take measures to maintain or restore natural habitats and species at a favourable conservation status.

National context

At the national level there is both legislation and guidance in relation to the conservation of biodiversity. The Wildlife & Countryside Act (1981)[3] provides for the protection of Sites of Special Scientific Interest (SSSI) and protects listed species while the Natural Environment and Rural Communities Act (NERC) 2006[4] outlines that the conservation of biodiversity encompasses the restoration and enhancement of species populations and habitats, in addition to protection.

The National Planning Policy Framework (NPPF)[5] provides guidance that designated areas should not be compromised and impacts on biodiversity should be minimised.

The Governments Natural Environment White Paper: 'The Natural Choice: securing the value of nature' (2011) [6] evokes a new approach to nature and outlines four key ambitions:

- Protecting and improving our natural environment;
- Growing a green economy;
- Reconnecting people and nature; and
- International and EU leadership.

The NEWP sets out the importance of a healthy, functioning natural environment to sustained economic growth, prospering communities and personal well-being. It was in part a response to the UK's failure to halt and reverse the decline in biodiversity by 2010 and it signalled a move away from the traditional approach of protecting biodiversity in nature reserves to adopting a landscape approach to protecting and enhancing biodiversity. The NEWP also aims to create a green economy in which economic growth and the health of our natural resources sustain each other and markets, business and Government better reflect the value of nature. It includes commitments to:

- Halt biodiversity loss, support functioning ecosystems and establish coherent ecological networks by 2020;
- Establish a new voluntary approach to biodiversity offsetting to be tested in pilot areas;
- Enable partnerships of local authorities, local communities and landowners, the private sector and conservation organisations to establish new Nature Improvement Areas; and
- Address barriers to using green infrastructure to promote sustainable growth.

The NEWP recognises that green infrastructure is 'one of the most effective tools available' to manage 'environmental risks such as flooding and heat waves'. With respect to trees and woodlands, an ambition is to create more opportunities for planting woodlands; for more trees in our towns, cities and villages; and a greater proportion of existing woodlands to be in active management in order to 'enhance the wide range of benefits that woodlands provide' including

[3] See: http://www.legislation.gov.uk/ukpga/1981/69
[4] See: http://www.legislation.gov.uk/ukpga/2006/16/contents
[5] DCLG (2012) National Planning Policy Framework [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf. Accessed 20 May 2016
[6] Defra (2012) The Natural Choice: securing the value of nature (Natural Environment White Paper) [online] @ http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf. Accessed May 2016.

'new wildlife habitats and green space for people to use and enjoy' and to help 'mitigate and adapt to the future changing climate.'

The Government has also published '**Biodiversity 2020**'[7], which builds on the Natural Environment White Paper and sets out the strategic direction for biodiversity policy for the next decade. In relation to planning, it states that the objective should be to: *'guide development to the best locations, encourage greener design and enable development to enhance natural networks'.*

The proposals set out in the NEWP are directly linked to the ground breaking research in the National Ecosystem Assessment (NEA)[8], a major project that was able to draw conclusions on the 'substantial' benefits that ecosystems provide to society directly and through supporting economic prosperity. The NEA identified development as a key driver of loss and biodiversity offsets as a possible means of increasing 'private sector involvement in conservation and habitat creation'.

The Biodiversity Offsetting Green Paper[9] was released in September 2013. Biodiversity offsets are conservation activities that are designed to give biodiversity gain to compensate for residual losses. They are different from other types of ecological compensation as they need to show measurable outcomes that are sustained over time. The Green Paper sets out options for an offsetting scheme tailored for England and its habitats and species. It also highlights the Government's preference for giving developers the choice to use offsetting.

Regional context

Severn Estuary Flood Risk Management Plan[10]

Flood Risk Management Plans (FRMPs) are produced every 6 years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how risk management authorities (RMAs) plan to work together with communities and businesses to manage and reduce flood risk. The Severn Estuary Flood Risk Management Plan (SEFRMP) sets out a 13 objectives that set out the key factors that the measures in the plan should tackle. Relevant objectives are:

- Manage flood and coastal erosion risks, taking account of the needs of communities businesses and the environment and working with natural solutions wherever possible
- Ensure that wherever possible investment in flood and coastal risk management provides environmental, social and economic benefits, protects and enhances the natural, built and historic environment and supports the achievement of WFD objectives.
- Reduce the risk of flooding from reservoirs to people, property, infrastructure and the environment.

Severn Estuary Shoreline Management Plan Review[11]

The Severn Estuary Shoreline Management Plan Review (SMP2) provides a policy approach over 100 years. The Theme area 'Severnside, Bristol and Avon' covers the study area and identifies the Severn Estuary SAC, SPA and Ramsar site as well as the Avon Gorge

[7] Defra (2011) Biodiversity 2020: A strategy for England's wildlife and ecosystem services [online] @ http://www.defra.gov.uk/publications/files/pb13583-biodiversity-strategy-2020-111111.pdf. Accessed May 2016
[8] 12 UNEP-WCMC (2011) UK National Ecosystem Assessment [online] @ http://uknea.unepwcmc.org/Resources/tabid/82/Default.aspx. Accessed May 2016
[9] Defra (2013) Biodiversity Offsetting in England Green Paper [online] @https://www.gov.uk/government/consultations/biodiversity-offsetting-in-england (accessed 11/2013)
[10] Environment Agency and Natural Resources Wales (2016) Severn River Basin District Flood Risk Management Plan 2015-2021 [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507832/LIT_10213_SEVERN_FRMP_PART_A.pdf. Accessed 18 May 2016
[11] Environment Agency (2011) Severn Estuary Draft Flood Risk Management Strategy Strategic Environmental Assessment Report [online] @ http://www.severnestuary.net/frms/docs/2013/info/SEA_FRMS_Draft_Report_DG029_complete_ver_2%5B1%5D.pdf. Accessed May 2016.

Woodlands SAC as key policy drivers. It identifies a 'hold the line' policy for all Policy Units and epochs.

Local context

Bristol City Core Strategy[12]

It is an objective of the Bristol Core Strategy to ensure a 'High Quality Natural Environment where valued open spaces and biodiversity are enhanced'. The Bristol Biodiversity Action Plan is in place to protect and enhance biodiversity.

Bristol Temple Quarter Spatial Framework[13]

The Bristol Temple Quarter Spatial Framework (TQSF) is a non-statutory planning document that sets out how the Temple Quarter Enterprise Zone could become a thriving new city quarter over 25 years. The TQSF will guide and shape new development in the area, seeking to deliver quality places for people through good planning and design that reflect our distinctiveness, entrepreneurship, culture and Green Capital status. The draft TQSF sets out eight objectives to guide development:

- Temple Meads transformed into a city gateway befitting a Green Capital City; and
- A rediscovered green heart to the Quarter at Totterdown Basin.

North Somerset Core Strategy[14]

At the local level the North Somerset Core Strategy contains relevant policies including CS1 Addressing Climate Change and Carbon Reduction and CS4 Nature Conservation.

5.2 Baseline review

The baseline information presented below was provided by Bristol Regional Environmental Records Centre (BRERC)[15] (2016). The data received extended to the entire area covered by BCC's jurisdiction. Based on the advice of an AECOM ecologist the data was spatially 'clipped' to include records within 500 m from the Severn Estuary and 100 m from the Study Area (shown in **Figure 4.1**) elsewhere in Reach 2 and 3..

Special Protection Area (SPA), Special Area of Conservation (SAC), European Protected Species data and Site of Special Scientific Interest (SSSI) data was downloaded from Environment Agency geostore[16] (2015). The data was spatially clipped to a 1 km buffer of the study area. Special Nature Conservation Interest (SNCI) data was provided by Bristol City Council; data was clipped to 1 km buffer of the study area.

.

5.2.1 *Reach 1*

Designated sites within Reach 1 are included in **Figure 5.1A**.

Designated Sites

There are several designated sites within Reach 1 that could be affected by The Strategy. **Table 5.1** below lists the designated sites considered to be most relevant to the implementation of the Strategy, the reasons for their designation and their existing condition.

[12] Bristol Core Strategy (2012) - https://www2.bristol.gov.uk/committee/2011/ta/ta000/0621_7b_appendixa.pdf
[13] BCC (2015) Bristol Temple Quarter Spatial Framework [online] @ http://www.bristoltemplequarter.com/spatialframework. Accessed 18 May 2016
[14] North Somerset Core Strategy (2012) [online] @ https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf
[15] Bristol Regional Environmental Records Centre (nd) [online] @http://www.brerc.org.uk/. Accessed May 2016.
[16] Environment Agency, (nd) Geostore [online] @http://www.geostore.com/environment-agency/survey.html#/survey. Accessed May 2016.

Table 5.1: Designated sites in Reach 1

Site	Condition / Status	Designated for:
Severn Estuary Site of Special Scientific Interest (SSSI)	Favourable	Biological and Geological Importance.
Severn Estuary Special Protection Area (SPA)[17]	N/A	This site is designated for supporting Bewick's Swan (*Cygnus columbianus)* which is an Annex 1 bird species. This site is designated for supporting a number of rare Annex II bird species including Gadwall (*Anas strepa*), White-fronted Goose (*Anser albifrons),* Dunlin (*Calidris alpina*), Shelduck *(Tadorna tadorna)* and Redshank (*Tringa totanus*). The site is also designated for supporting waterfowl assemblages and migratory species including: Wigeon (*Anas Penelope*) Teal (*Anas crecca)* Pintail (*Anas acuta)* Pochard (Aythya ferina) Tufted duck (*Aythya fuligula*) Ringed plover (*Charadrius hiaticula)* Grey plover (*Pluvialis squatarola*) Curlew (*Numenius arquata*) Whimbrel (*Numenius phaeopu*) Spotted redshank (*Tringa erythropus*)
Severn Estuary Special Area of Conservation (SAC)[18]	N/A	The primary reasons for designation of this site are for: Annex I habitats including estuaries, mudflats and sandflats not covered by seawater at low tide, and Atlantic salt meadows. supporting Annex II species including Sea lamprey (*Petromyzon marinus*), River lamprey (*Lampetra fluviatilis*) and Twaite shad (*Alosa fallax*).
Severn Estuary Ramsar	N/A	This site is designated for its unique habitat which is an important run of migratory fish between sea and river. It is also of particular importance for migratory birds during spring and autumn.
Lamplighters Marsh Site of Nature Conservation Interest	N/A	This site is designated for its biological importance.

Fauna

European Protected Species

No records of European protected species were returned from the data search within the Reach 1 Study Area or the immediate surrounding area.

[17] JNCC (2015) Severn Estuary Special Protection Area (SPA) [online] @http://jncc.defra.gov.uk/pdf/SPA/UK9015022.pdf. Accessed 18 May 2016

[18] JNCC, Severn Estuary Special Area of Conservation. [online] @http://jncc.defra.gov.uk/ProtectedSites/SACselection/sac.asp?EUCode=UK0013030. Accessed May 2016

Birds

Within the Reach 1 Study Area 36 bird species which are all Schedule 1, Red or Amber listed were recorded. The data search also returned 21 additional records of birds outside of the Reach 1 Study Area but within close proximity. A complete list of species is contained within Appendix A.

Badgers

One badger (*Meles meles*) record was returned from the data search within the Study Area adjacent to Reach 1.

Invasive species

Canada goose (*Branta Canadensis*) were recorded outside the Reach 1 Study Area but in close proximity.

Fish

There are over 110 species of fish recorded in the Severn Estuary making it one of the most diverse in Britain[19]. The Severn Estuary is used as a key migration route for Salmon (Salmo salar), sea trout (*S. trutta*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), allis shad (*Alosa alosa*), twaite shad (*A. fallax*), and eel (*Anguilla anguilla*).

The Severn Estuary Partnership[20] reports that fishing activity in the Severn Estuary and Inner Bristol Channel is generally much lower than on fishing grounds to the west and in comparison to the rest of the UK inshore fisheries due to strong tides and low density of fish. The Partnership goes on to say that *"The Estuary acts as an important nursery ground for many commercially valuable species including sole and bass and as a result, the majority of the fish found within the Estuary are juveniles."* There is a gap in data as to the baseline further up the river.

The Marine Management Organisation (MMO) recently consulted on a Sustainability Appraisal Scoping Report.[21] The MMO stated that that the Severn Estuary is important as a feeding and nursery ground specifically for spawning cod and whiting.

Flora

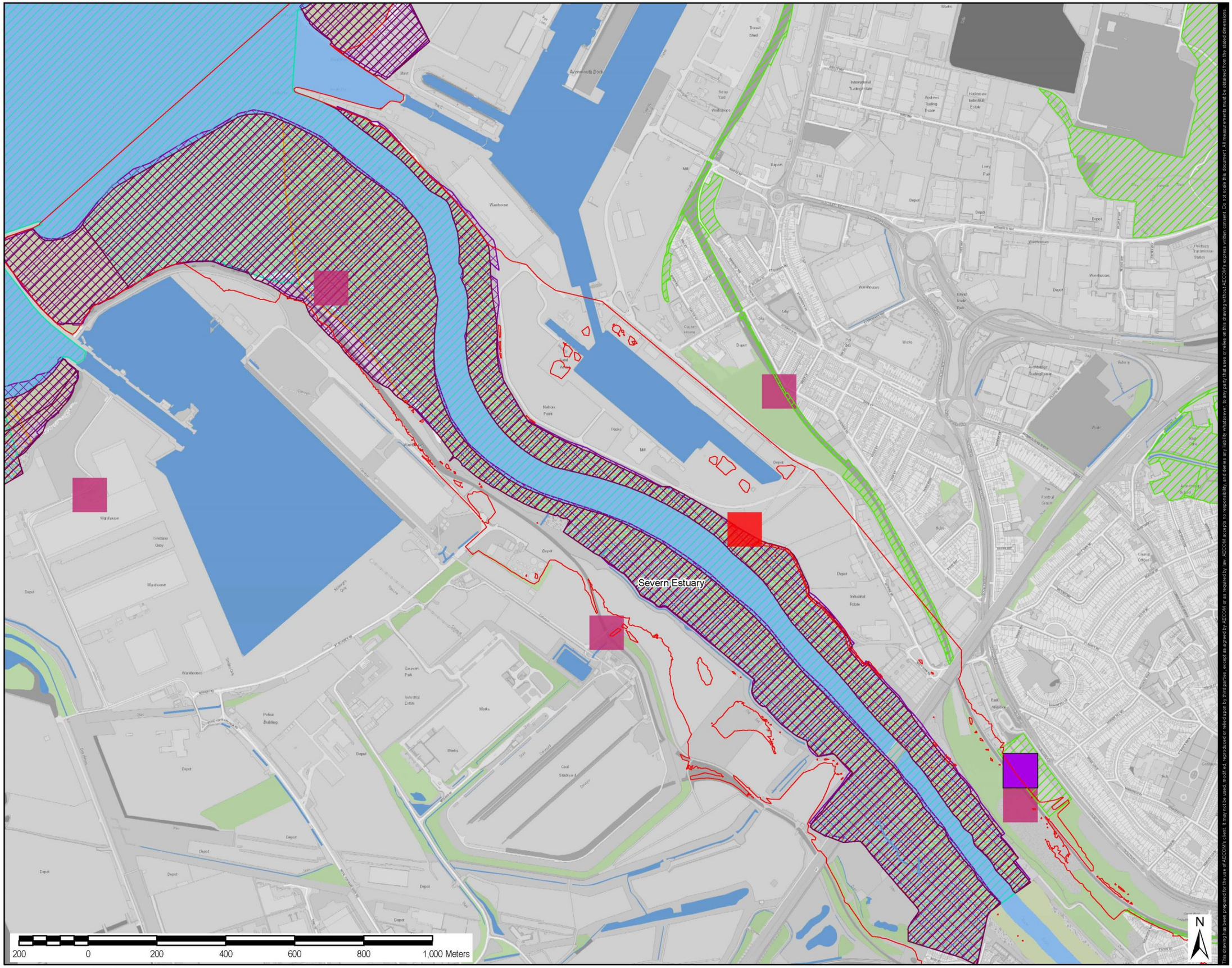
Invasive species

A record of Japanese knotweed (Fallopia japonica), New Zealand pigmyweed (*Crassula helmsii*), Virginia creeper (*Parthenocissus quinquefolia*) and Himalayan cotoneaster (*Cotoneaster simonsii*) were recorded within or in close proximity to the Reach 1 Study Area.

[19] JNCC Severn Estuary Ramsar Site (1995). [online] @http://jncc.defra.gov.uk/pdf/RIS/UK11081.pdf. Accessed May 2016

[20] Severn Estuary Partnership (2011) The Use of the Severn [online] @http://www.severnestuary.net/sep/estuary/fisheries.html. Accessed May 2016.

[21] Marine Management Organisation (2016) Sustainability Appraisal Scoping Consultation. Scoping Report Cards [online] @https://www.connect.marinemanagement.org.uk/uploads/upload61.pdf. Accessed May 2016.



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- SNCI Sites
- Wildlife Corridors
- Surface Water - Linear
- Ancient Woodland
- Site of Special Scientific Interest - Environment Agency
- Special Protection Areas - Environment Agency
- Special Areas of Conservation - Environment Agency
- RAMSAR - Environment Agency
- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland calcareous grassland
- Lowland dry acid grassland
- No main habitat but additional habitats
- Traditional orchard
- National Nature Reserves - Environment Agency
- Local Nature Reserves - Environment Agency
- Important Bird Areas - RSPB
- Woodland - OS Open Data
- Foreshore - OS Open Data
- Tidal Water - OS Open Data
- Surface Water - OS Open Data

BRERC Schedule 8 of Wildlife and Countryside Act 1981 - Sites and Species

- Common
- Local
- Not common / status not well known
- Proposed BRERC Notable 2004 as nationally notable
- Proposed BRERC Notable 2008 as UK BAP listed
- Proposed BRERC Notable 2009 as protected
- Rare
- Scarce
- Uncommon / Declining
- Widespread / Locally Abundant when breeding
- Widespread / Locally Common

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 5.1A BIODIVERSITY FLORA AND FAUNA

Scale at A3: 1:10,000

Drawing No:			Rev:
FIGURE 5.1A			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\5-1_Biodiversity_Pages_v2.mxd

5.2.2 *Reach 2*

Designated Sites

The table below lists the designated sites considered to be most relevant to the implementation of The Strategy, the reasons for their designation and their existing condition. Designated sites are included in **Table 5.2** and **Figure 5.1B**. Biodiversity Action Plan species recorded within Reach 2 are included in **Figure 5.2B**.

Table 5.2: Designated sites in Reach 2

Site	Condition/Status	Designated for:
Ham Green SSSI[22]	Unfavorable - no change	Geological importance
Horseshoe Bend SSSI[23]	Favourable	Biological importance
Avon Gorge SSSI[24]	Favourable/Unfavourable-Recovering	Biological and Geological Importance
Ashton Court SSSI[25]	Favourable	Biological importance
Avon Gorge Woodlands Special Area of Conservation (SAC)	N/A	Biological importance.
Three Acre Covert and Portway Gardens SNCI	N/A	Biological importance.
Trym Valley SNCI	N/A	Biological importance.

Fauna

Protected Species

European Protected Species

Otter (*Lutra lutra*) has been recorded south of Shirehampton golf course within the Reach 2 Study Area.

Other European protected species records returned from the data search within the Reach 2 Study Area include: two records of lesser horseshoe bat (*Rhinolophus hipposideros*); four records of noctule bat (*Nyctalus noctula*); one record of Daubenton's bat (*Myotis daubentonii*) and one record of common pipistrelle (*Pipistrellus pipistrellus*).

Additional European protected species records returned from the data search but outside the Reach 2 Study Area include records of: brown long-eared bat (*Plecotus auritus*); soprano pipistrelle (*Pipistrellus pygmaeus)*; serotine (*Eptesicus serotinus*); Natterer's bat (*Myotis nattereri*); Myotis bat sp; and greater horseshoe bat (*Rhinolophus ferrumequinum*).

Birds

Within the Reach 2 Study Area 58 birds were recoded which are Schedule 1, Red or Amber listed. A complete list of species can be found in Appendix A.

---

[22] Natural England (1990) Ham Green SSSI Information. [online] @https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1001500&SiteName=ham%20green&countyCode=&responsiblePerson=. Accessed May 2016

[23] Natural England (1999) Horseshoe Bend SSSI Information. [online] @https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S2000327&SiteName=horseshoe%20bend&countyCode=&responsiblePerson=. Accessed May 2016

[24] Natural England (1974) Avon Gorge SSSI Information. [online] @ https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S1003073&SiteName=&countyCode=8&responsiblePerson=. Accessed May 2016

[25] Natural England (1998) Ashton Court SSSI Information. [online] @ https://designatedsites.naturalengland.org.uk/SiteDetail.aspx?SiteCode=S2000331&SiteName=&countyCode=8&responsiblePerson=. Accessed May 2016

Badgers (confidential)

The data search returned 11 records of badger within the Reach 2 Study Area and 19 records just outside of the Reach 2 Study Area.

Invasive Species

The following invasive non-native species have been recorded within the Reach 2 Study Area: grey squirrel (*Sciurus carolinensis*); and mandarin duck (*Aix galericulata*).

Additional invasive non-native species were returned from the data search but are not within the Study Area and budgerigar (Melopsittacus undulates).

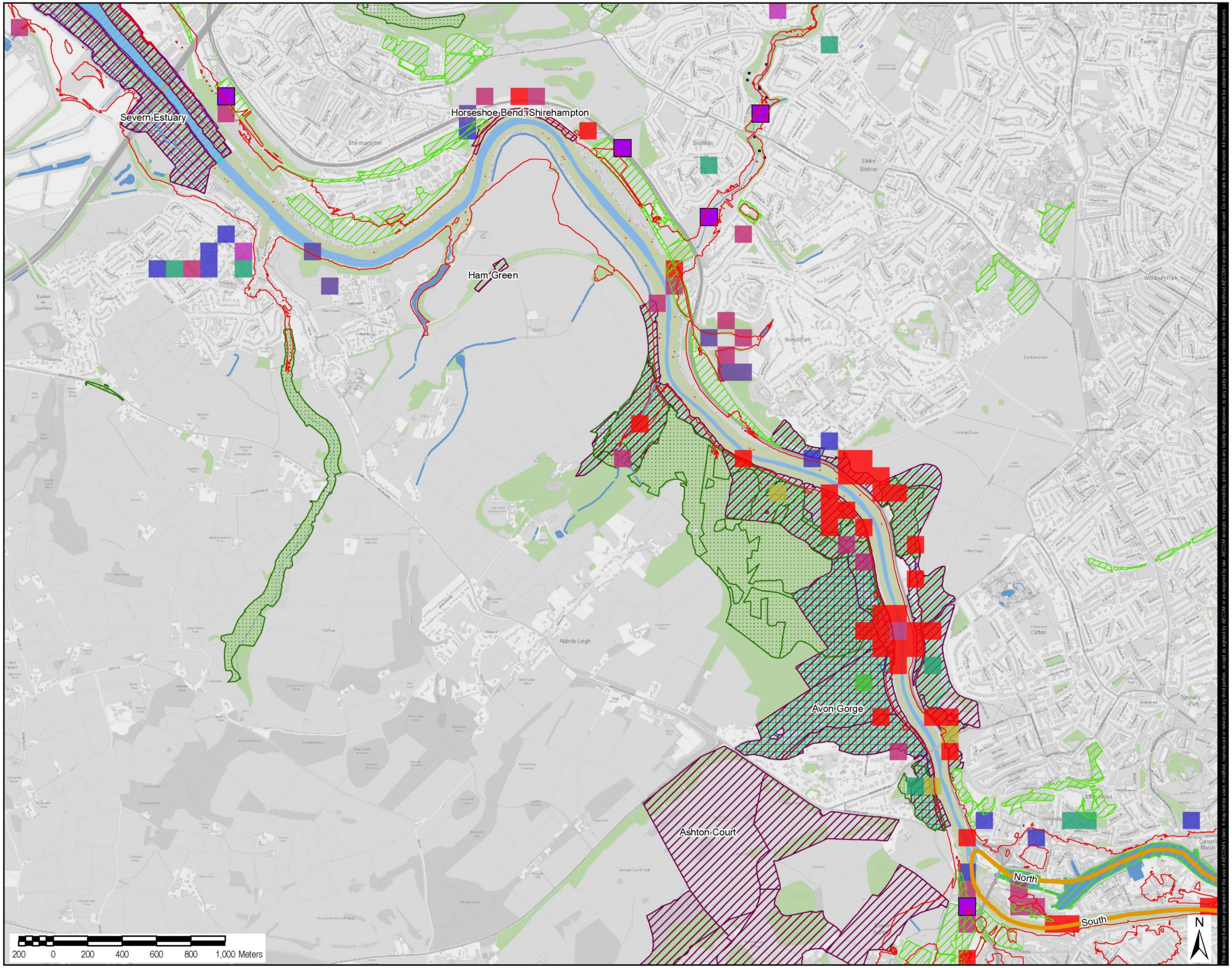
Fish

Data from Reach 1 and Reach 3 indicates that a high biodiversity and biomass are present within these Reaches, and therefore it is likely that Reach 2 is also an important habitat. There is an identified data gap with regard to the importance of fish in Reach 2.

Flora

Invasive Species

The following invasive non-native species have been recorded within the Reach 2 Study Area: Japanese knotweed; Himalayan balsam (*Impatiens glandulifera*); variegated yellow archangel (*Lamiastrum galeobdolon subsp. Argentatum*); wall contoneaster (*Cotoneaster horizontalis*) and Virginia creeper.



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- SNCI Sites
- Wildlife Corridors
- Surface Water - Linear
- Ancient Woodland
- Site of Special Scientific Interest - Environment Agency
- Special Protection Areas - Environment Agency
- Special Areas of Conservation - Environment Agency
- RAMSAR - Environment Agency
- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland calcareous grassland
- Lowland dry acid grassland
- No main habitat but additional habitats
- Traditional orchard
- National Nature Reserves - Environment Agency
- Local Nature Reserves - Environment Agency
- Important Bird Areas - RSPB
- Woodland - OS Open Data
- Foreshore - OS Open Data
- Tidal Water - OS Open Data
- Surface Water - OS Open Data

BRERC Schedule 8 of Wildlife and Countryside Act 1981 - Sites and Species

- Common
- Local
- Not common / status not well known
- Proposed BRERC Notable 2004 as nationally notable
- Proposed BRERC Notable 2008 as UK BAP listed
- Proposed BRERC Notable 2009 as protected
- Rare
- Scarce
- Uncommon / Declining
- Widespread / Locally Abundant when breeding
- Widespread / Locally Common

Copyright:

AECOM Internal Project No:

60478613

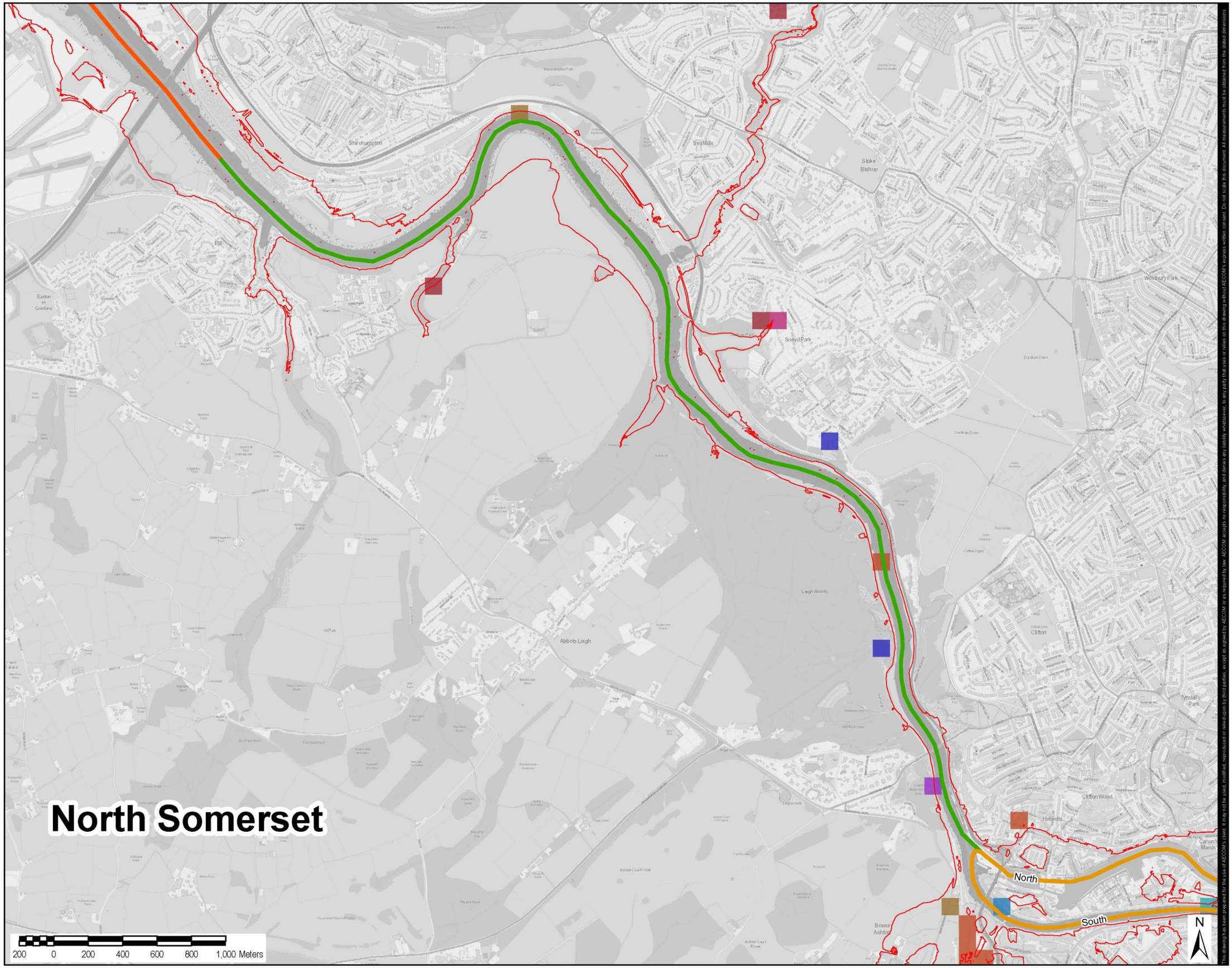
Drawing Title:

FIGURE 5.1B
BIODIVERSITY FLORA AND FAUNA

Scale at A3: 1:20,000

Drawing No:			Rev:
FIGURE 5.1B			V2
Drawn:	Chk'd:	App'd:	Date:
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\5-1_Biodiversity_Pages_v2.mxd



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Brown Long-eared Bat
- Bullhead
- Common Pipistrelle (45kHz)
- Common Porpoise
- Daubenton's Bat
- Great Crested Newt
- Greater Horseshoe Bat
- Leisler's Bat
- Lesser Horseshoe Bat
- Natterer's Bat
- Noctule
- Otter - likely to be present along the entire watercourse
- Pipistrelle (45 or 55kHz)
- Serotine
- Soprano Pipistrelle (55kHz)
- a Myotis bat (unidentified)
- a Vespertilionidae Bat (unidentified)

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 5.2B BIODIVERSITY, FLORA AND FAUNA EUROPEAN PROTECTED SPECIES

Scale at A3: 1:20,000

Drawing No:			Rev:
FIGURE 5.2B			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\5-2_BiodiversityEPS_Pages_v2.mxd

5.2.3 *Reach 3*

Designated sites are included in **Figure 5.1C**. BAP species are included in **Figure 5.2C**.

Designated Sites

Designated sites considered to be relevant to the implementation of The Strategy within the Reach 3 Study Area are included within **Table 5-3**.

Table 5-3 Designated Sites in Reach 3

Site	Condition/Status	Designated for:
Bower Ashton Mineral Railway SNCI	N/A	Biological importance.
Ashton Valley Fields SNCI	N/A	Biological importance.

Fauna

European Protected Species

Multiple numbers of otter records located within the Reach 3 Study Area were returned from the data search.

Other European protected species include: common pipistrelle, soprano pipistrelle, Leisler's bat, brown-long eared bat, noctule, serotine and Myotis bat sp.

Birds

Within Reach 3, 52 records of Schedule 1, Red or Amber listed birds were found. A complete list of species can be found in Appendix A.

Badgers

The data search returned six records of badger within the Reach 3 Study Area and 19 records of badger just outside of the Reach 3 Study Area.

Invasive non-native species

The following invasive non-native species have been recorded within the Reach 3 Study Area: Canada goose; grey squirrel; A record of muntjac (*Muntiacus reevesi*) was returned from the data search just outside of the Reach 3 Study Area.

Fish

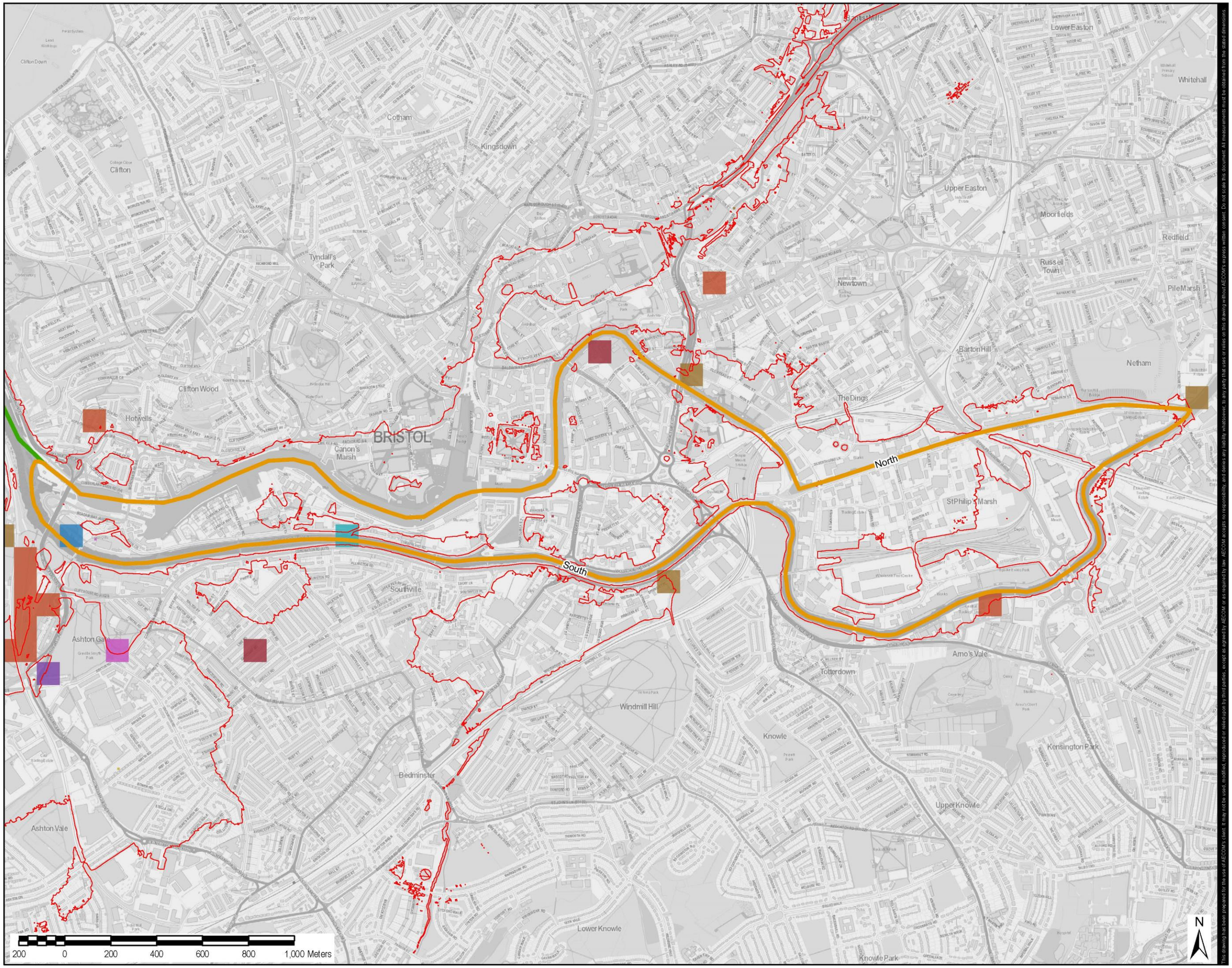
The Bristol Docks Estate Wildlife Survey Assessment[26] reported a rich diversity and high biomass of fish; both freshwater and estuarine species were found.

Flora

Invasive non-native species

The following invasive non-native species have been recorded within the Reach 3 Study Area: wall cotoneaster; Himalayan balsam; Japanese knotweed; giant hogweed (*Heracleum mantegazzianum*); and rhododendron (*Rhododendron ponticum*).

[26] MPEcology (2009) Bristol Docks Estate, Wildlife Survey and Assessment



AECOM

AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Brown Long-eared Bat
- Bullhead
- Common Pipistrelle (45kHz)
- Common Porpoise
- Daubenton's Bat
- Great Crested Newt
- Greater Horseshoe Bat
- Leisler's Bat
- Lesser Horseshoe Bat
- Natterer's Bat
- Noctule
- Otter - likely to be present along the entire watercourse
- Pipistrelle (45 or 55kHz)
- Serotine
- Soprano Pipistrelle (55kHz)
- a Myotis bat (unidentified)
- a Vespertilionidae Bat (unidentified)

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 5.2C BIODIVERSITY, FLORA AND FAUNA EUROPEAN PROTECTED SPECIES

Scale at A3: 1:15,000

Drawing No:			Rev:
FIGURE 5.2C			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\5-2_BiodiversityEPS_Pages_v2.mxd

5.3 Future baseline

Sites of biodiversity importance have the potential to come under growing pressures from an increase in the city's population and associated development. This includes through a loss of habitats and impacts on biodiversity networks, e.g. wildlife corridors. This may be exacerbated by the effects of climate change, which has the potential to lead to changes in the distribution and abundance of species and changes to the composition and character of habitats. Ham Green SSSI is designated as 'unfavourable – no change', and therefore is likely to remain in unfavourable condition in the future without any interventions to better manage the site.

The hold the line policy for this area is likely to lead (from 20 years onwards) to a future loss of Intertidal habitats and saltmarsh through coastal squeeze

5.4 Key Biodiversity issues

The key biodiversity issues identified are:

- There are a number of sites designated for their nature conservation importance within the Study Area, including international designations (Severn Estuary SPA, Severn Estuary SAC and Severn Estuary Ramsar) and national designations (Severn Estuary SSSI). Reasons for their designations and their condition are outlined in **Table 5-1** and **Table 5-2**. The condition and integrity of these sites should not be compromised.
- The Strategy presents an opportunity to remove invasive species;
- There are a number of protected species recorded within Reach 1, 2 and 3 (otter and records of several species of bat and bird)Whilst the Strategy is unlikely to have a discernible effect on commercial fishing, the Severn Estuary is an important nursery ground for fish which may be affected by the measures.

6. POPULATION

6.1 Policy context

National context

National Planning Policy Framework[27]

Key messages include:

- The social role of the planning system involves 'supporting vibrant and healthy communities'.
- A core planning principle is to 'take account of and support local strategies to improve health, social and cultural wellbeing for all'.
- The planning system can play an important role in facilitating social interaction and creating healthy, inclusive communities.
- Promote the retention and development of local services and community facilities such as local shops, meeting places, sports venues, cultural buildings, public houses and places of worship.
- Ensure that developments create safe and accessible environments where crime and disorder, and the fear of crime, do not undermine quality of life or community cohesion.
- Access to high quality open spaces and opportunities for sport and recreation can make an important contribution to the health and well-being of communities.
- The NPPF attaches great importance to the design of the built environment. It explains how good design is a key aspect in sustainable development, and how development should improve the quality of the area over its lifetime, not just in the short term. Good architecture and landscaping are important, with the use of design codes contributing to the delivery of high quality outcomes. Design should reinforce local distinctiveness, raise the standard more generally in the area and address the connections between people and places.

Supplementing the NPPF

Further sustainability context at the national level includes research examining: the implications of an ageing population **(Box 6.1**).

Box 6.1: Implications of an ageing population

The Select Committee on Public Service and Demographic Change report Ready for Ageing?[28] warns that society is underprepared for the ageing population. The report says that *'longer lives can be a great benefit, but there has been a collective failure to address the implications and without urgent action this great boon could turn into a series of miserable crises'*. Key projections about ageing include 51% more people aged 65 and over and 101% more people aged 85 and over in England in 2030 compared to 2010; and a 90% increase in people with moderate or severe need for social care for the same time period. Organisations involved in urban planning will need to adjust to an older population and will have an important role to play in preventing the social isolation of older citizens.

[27] National Planning Policy Framework (2012) [online] @https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf (accessed 04/2016)
[28] Select Committee on Public Service and Demographic Change (2013) Ready for Ageing? [online] @http://www.parliament.uk/business/committees/committees-a-z/lords-select/public-services-committee/report-ready-for-ageing/. Accessed April 2016

Regional context

Severn Estuary Flood Risk Management Plan[29]

Flood Risk Management Plans (FRMPs) are produced every six years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how risk management authorities (RMAs) plan to work together with communities and businesses to manage and reduce flood risk. The Severn Estuary Flood Risk Management Plan (SEFRMP) sets out a 13 objectives that set out he key factors that the measures in the plan should tackle. Relevant objectives are:

- Manage flood and coastal erosion risks, taking account of the needs of communities businesses and the environment and working with natural solutions wherever possible
- Reduce the risk from flooding to people and households
- Ensure that wherever possible investment in flood and coastal risk management provides environmental, social and economic benefits, protects and enhances the natural, built and historic environment and supports the achievement of WFD objectives.
- Target resources to reduce the risk of flooding to communities with the highest flood risk.
- Set out a clear and consistent plan for flood risk management so that communities, businesses and other organisations can make informed decisions about the management of flood risk and associated opportunities for delivering environmental benefits.
- Raise awareness of and engage people, businesses and organisations on flood and coastal erosion risk to encourage them to take action to manage the risks they face.
- Households and businesses at high risk of flooding can receive an appropriate flood warnings service.
- Encourage emergency plans and responses to flood incidents to be effective and communities to respond effectively to flood forecasts, warnings and advice.
- In support of integrated catchment based water management, facilitate decision-making and action at the appropriate level (individual, community, or local council, river catchment, coastal cell or national), foster partnership working and ensure early engagement with stakeholders.
- Reduce the risk of flooding from reservoirs to people, property, infrastructure and the environment.

Severn Estuary Shoreline Management Plan Review[30]

The Severn Estuary Shoreline Management Plan Review (SMP2) provides a policy approach over 100 years. The Theme area 'Severnside, Bristol and Avon' covers the study area and identifies the Severn Estuary SAC, SPA and Ramsar site as well as the Avon Gorge Woodlands SAC as key policy drivers. It identifies a 'hold the line' policy for all Policy Units and epochs.

Local context

City of Bristol Core Strategy[31]

Key messages from the Bristol Core Strategy include:

---

[29] Environment Agency and Natural Resources Wales (2016) *Severn River Basin District Flood Risk Management Plan 2015-2021* [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507832/LIT_10213_SEVERN_FRMP_PART_A.pdf. Accessed 18 May 2016

[30] Environment Agency (2011) Severn Estuary Draft Flood Risk Management Strategy Strategic Environmental Assessment Report [online] @ http://www.severnestuary.net/frms/docs/2013/info/SEA_FRMS_Draft_Report_DG029_complete_ver_2%5B1%5D.pdf Accessed May 2016

[31] City of Bristol (2011) Core Strategy [online] @ https://www2.bristol.gov.uk/committee/2011/ta/ta000/0621_7b_appendixa.pdf. Accessed April 2016

- Ensuring a sustainable future for Bristol - a green capital with sustainable development and growth which meets the needs of the city, now and into the future.
- Mixed, balanced and sustainable communities - throughout the city, where places are shared and communities mixed, that are good places for communities to live in that are socially cohesive, and where there is easy access including by walking and cycling to local community and health services, shops, culture and leisure facilities, employment, education and skills training in a high quality environment.
- Ambitious and sustainable economic growth - a thriving and diverse local economy, maintaining the economic growth of Bristol above the regional and national level of economic growth and ensuring continued competitiveness as a core city. Development and regeneration will take place at accessible and sustainable locations throughout the city providing new employment and training opportunities.
- Appropriate housing provision – providing new homes for the city within, balanced and sustainable communities. This housing will comprise an appropriate mix to promote housing choice for all members of the community including the provision of affordable homes.
- Improved accessibility and connectivity - improved accessibility and connectivity to and between centres and within the city, to key services and places of work and recreation, with improved quality of life, for residents, businesses and visitors alike. Residents and workers will have a reduced need to travel. Congestion will be managed, public transport and walking and cycling provision improved and streets, pedestrian areas and spaces will be safe.

Bristol Central Area Plan[32]

The Central Area Plan explores how Bristol City Centre will develop over the next 15 years to 2026. The plan also deals with an area to the east of the city centre that is not part of the city centre itself, comprising parts of St. Paul's, Easton, St. Jude's, Newtown, The Dings and St. Philip's. The Central Area Plan sets out a range of designations for land which should be safeguarded to deliver policies in the Core Strategy, Site Allocation or Development Management or Bristol Central Area policies. Specifically, the Central Area Plan helps to deliver around 7,400 new homes

Bristol Temple Quarter Spatial Framework[33]

The Bristol Temple Quarter Spatial Framework (TQSF) is a non-statutory planning document that sets out how the Temple Quarter Enterprise Zone could become a thriving new city quarter over 25 years. The TQSF will guide and shape new development in the area, seeking to deliver quality places for people through good planning and design that reflect our distinctiveness, entrepreneurship, culture and Green Capital status. The draft TQSF sets out eight objectives to guide development:

1. Temple Meads transformed into a city gateway befitting a Green Capital City;
2. New public access beneath and around the station complex which kick starts regeneration east of Temple Meads; and
3. A rediscovered green heart to the Quarter at Totterdown Basin.

North Somerset Core Strategy[34]

Key messages from the North Somerset Core Strategy include:

- Deliver sustainable housing development across North Somerset to meet housing needs, through the provision of a minimum of 14,000 new homes by 2026.

---

[32] BCC (2015) *Bristol Central Area Plan* [online] @ https://www.bristol.gov.uk/documents/20182/34540/BCAP%20Adopted%20March%202015%20-%20Main%20Document%20&%20Annex%20-%20Web%20PDF.pdf/d05a0c22-ab91-4530-926a-f26160ab72a5. Accessed 18 May 2016

[33] BCC (2015) *Bristol Temple Quarter Spatial Framework* [online] @ http://www.bristoltemplequarter.com/spatialframework. Accessed 18 May 2016

[34] North Somerset Core Strategy (2012) [online] @https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf. Accessed April 2016

- Prioritise employment growth throughout North Somerset to support greater self-containment, in particular by ensuring that in Weston-Super-Mare housing development is delivered in step with employment growth, brownfield opportunities in Clevedon, Nailsea and Portishead are maximised, and that small and medium enterprises are supported. Support and promote major employers in North Somerset, such as Bristol Airport and Royal Portbury Dock, to ensure continued employment security and economic prosperity.
- Make provision for the needs of an ageing population, prioritising supported living as opposed to residential care.
- Focus strategic development at Weston-Super-Mare as part of an employment-led strategy to deliver improved self-containment, stimulate investment, regenerate and revitalise the town centre to create a thriving and vibrant retail, leisure, tourist, cultural and commercial centre. To support regeneration within communities elsewhere in the town, particularly in the South and Central Wards.

6.2 Baseline review

City of Bristol

According to the most recent Census data available, in 2011 the population of Bristol was 428,234 people.[35] This was an increase of 47,619 since the 2001 Census[36], or an 11% growth in the city's population. The city has a population density of 39.1 Persons per Hectare. The age structure of Bristol is shown in **Table 6-1** the total number of people aged 16+ is 340,467. The largest age group is 35-54. There is a larger proportion of the population over 75 in Bristol (11.4%) compared to the south west (11%) and England (9%).

Table 6-1 – Age Structure

Variable	City of Bristol	South West	England
16-24	61,641	556,528	5,901,807
25-34	76,513	593,296	7,074,052
35-54	108,362	1,426,954	14,624,280
55-64	40,186	680,294	6,134,209
65-74	27,426	528,664	4,513,946
75+	26,339	467,288	3,829,062

North Somerset

According to the most recent Census data available, in 2011 the population of North Somerset was 202,566 people[37]. This was an increase of 14,402 since the 2001 Census, or a 7% growth in the county's population. The county has a population density of 5.4 Persons per Hectare. The age structure of North Somerset is shown in **Table 6-2** the total number of people aged 16+ is 162,604. The largest age group is 35-54. There is a larger proportion of the population over 75 in North Somerset (11.4%) compared to the south west (11%) and England (9%).

[35] Bristol Population Census Data (2011) [online] @https://www.neighbourhood.statistics.gov.uk/dissemination/LeadDatasetList.do?a=7&b=6275035&c=bristol&d=13&g=6388788&i=1001x1003x1032&m=0&r=1&s=1460625050281&enc=1&domainId=61(accessed on 04/2016). Accessed April 2016.

[36] Bristol Census Sheet (2011) [online] Available at : https://www.bristol.gov.uk/documents/20182/35004/Bristol%202001%20Census%20Profile.pdf/00c31fb3-f41d-4053-bf7f-7d0a42b1a6f8. Accessed April 2016.

[37] Office for National Statistics; Neighbourhood Statistics. North Somerset Population Census Data (2011) [online] @http://www.neighbourhood.statistics.gov.uk/dissemination/LeadTableView.do?a=7&b=6275186&c=north+somerset&d=13&e=61&g=6389721&i=1001x1003x1032x1004&m=0&r=1&s=1460561406562&enc=1&dsFamilyId=2491 (Accessed on: 04/2016). Accessed April 2016.

Table 6-2 – Age Structure

Variable	North Somerset	South West	England
16-24	18,112	556,528	5,901,807
25-34	20,911	593,296	7,074,052
35-54	56,079	1,426,954	14,624,280
55-64	27,161	680,294	6,134,209
65-74	21,792	528,664	4,513,946
75+	18,549	467,288	3,829,062

6.3 Future baseline

City of Bristol

The population of Bristol is projected to increase to around 528,200 people by 2037[38]. This will place pressures on services, facilities and amenities, which are likely to face both a higher number of users and a more varied and demanding, set of user requirements.

Proposed housing delivery is set out in the City of Bristol Core Strategy. The Core Strategy sets out policies for the type, and tenure of new housing to be delivered, with a target provision of 30,600 homes to 2026. Most of this provision will take place on previously developed sites. The proposed housing delivery is set out below:

- South Bristol 8,000 dwellings;
- City Centre 7,400;
- Inner East 2,000;
- Northern Arc 3,000; and
- Rest of Bristol 6,000.
- City wide – small unidentifiable sites 4,200.

North Somerset

The population of North Somerset is projected to increase to around 250,000 people by 2035[39] with a particular increase in the over 65 age group. This will place pressures on services, facilities and amenities, which are likely to face both a higher number of users and a more varied and demanding, set of requirements from these users.

Proposed housing delivery is set out in the North Somerset Core Strategy[40]. The Core Strategy sets out policies for the type, and tenure of new housing to be delivered, with a target provision of 14,700 homes to 2026. The broad distribution of new dwellings will be a minimum of:

- Weston urban area (excluding Weston Villages) 3,458 dwellings;
- Weston Villages 5,500 dwellings;
- Clevedon, Nailsea and Portishead 3,715 dwellings;
- Service Villages 805 dwellings; and

[38] Bristol City Council Population Projections (2014) [online] @https://www.bristol.gov.uk/documents/20182/33904/2012-based%20Population%20Projections%20Briefing%20note.pdf/60040fc2-2e94-441f-a8cc-cc9de6a5532b. Accessed April 2016

[39] North Somerset Council Changing Population (2014) [online] @https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/population-chapter.pdf. Accessed April 2016

[40] North Somerset (2012) Core Strategy [online] @ https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf. Accessed April 2016

- Other settlements and countryside 522 dwellings.

Box 6.2: West of England Joint Spatial Plan

The West of England Joint Spatial Plan (JSP) will seek to identify:

- the housing land requirements for the Wider Bristol Housing Market Area (HMA) (Bristol, North Somerset, South Gloucestershire) that will need to be met across the WoE;
- the employment land required within the WoE Functional Economic Market Area (FEMA);
- the most appropriate locations for the housing and employment growth needed; and
- what transport improvements and other infrastructure investment will need to be made in the Plan area to support sustainable growth.

Five spatial scenarios have been subject to pubic consultation (which finished 29 January 2016):

1. Protection of Green Belt.
2. Concentration at Bristol urban area.
3. Transport focus.
4. A more even spread of development across the sub-region - growth at Bristol, but also other towns and expanded settlements.
5. New settlement (or a limited number of expanded settlements).

In the context of the Strategy, options developed will need to consider the effects of the preferred spatial strategy. The Draft Plan is scheduled to be published September 2016.

6.4 Key Population issues

The key population issues identified are:

- A Strategy is required to alleviate the risk of flooding to people, existing property, essential infrastructure and cultural heritage;
- Where appropriate, the Strategy should seek to support improvements to the built environment in the city, with a particular focus on those areas suffering from the highest levels of deprivation;
- Flood risk issues exist in some parts of the areas proposed for future housing delivery in the city, including the city centre; and
- Aging population is likely to put pressure on services, facilities and amenities.
- Investment is needed to maintain the current protection from tidal flood risk at Pill and Shirehampton, and the operation of the Floating Harbour.
- A Strategy is required as currently high tidal levels restrict discharge from watercourses, culverts and sewer overflows presenting a risk of flooding.

7. HUMAN HEALTH

7.1 Policy context

Public Health England (PHE) has published advice in relation to flooding which outlines the main threats to health during and immediately after a flood.[41] In addition to physical injuries, the other main health hazard associated with floods is psychological mental health and wellbeing.

Severn Estuary Flood Risk Management Plan[42]

Flood Risk Management Plans (FRMPs) are produced every six years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how risk management authorities (RMAs) plan to work together with communities and businesses to manage and reduce flood risk. The Severn Estuary Flood Risk Management Plan (SEFRMP) sets out a 13 objectives that set out he key factors that the measures in the plan should tackle. Relevant objectives are:

- Manage flood and coastal erosion risks, taking account of the needs of communities businesses and the environment and working with natural solutions wherever possible.
- Reduce the risk from flooding to people and households.
- Ensure that wherever possible investment in flood and coastal risk management provides environmental, social and economic benefits, protects and enhances the natural, built and historic environment and supports the achievement of WFD objectives.
- Target resources to reduce the risk of flooding to communities with the highest flood risk.
- Set out a clear and consistent plan for flood risk management so that communities, businesses and other organisations can make informed decisions about the management of flood risk and associated opportunities for delivering environmental benefits.
- Raise awareness of and engage people, businesses and organisations on flood and coastal erosion risk to encourage them to take action to manage the risks they face.
- Provide an effective and sustained response to flood and coastal erosion events.
- Households and businesses at high risk of flooding can receive an appropriate flood warnings service.
- Encourage emergency plans and responses to flood incidents to be effective and communities to respond effectively to flood forecasts, warnings and advice.
- In support of integrated catchment based water management, facilitate decision-making and action at the appropriate level (individual, community, or local council, river catchment, coastal cell or national), foster partnership working and ensure early engagement with stakeholders.
- Reduce the risk of flooding from reservoirs to people, property, infrastructure and the environment.

[41] PHE (2014) Health advice: General information about mental health following floods [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/483387/Health_advice_about_mental_health_following_floods_2015.pdf. Accessed 20 May 2016

[42] Environment Agency and Natural Resources Wales (2016) *Severn River Basin District Flood Risk Management Plan 2015-2021* [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507832/LIT_10213_SEVERN_FRMP_PART_A.pdf. Accessed 18 May 2016

Supplementing the NPPF

Further sustainability context at the national level includes research examining: the social and health implications of climate change (**Box 7.1**), and the relationship between the natural world and well-being (**Box 7.2**).

Box 7.1: Climate change, justice and vulnerability

The Joseph Rowntree report Climate change, justice and vulnerability'[43] calls for greater recognition of the social dimensions of vulnerability to climate change when considering adaptation policy. It notes that the effect of an extreme weather event on a person or group is determined not only by their exposure to the event, but also on their vulnerability. This combination of factors can be described in terms of 'Climate Disadvantage'.

The social dimensions of vulnerability must be reflected in climate adaptation policy. For instance, in relation to flooding, there is a need to recognise that:

Low-income households are less able to take measures to make their property resilient to flooding and to respond to and recover from the impacts of floods.

The ability to relocate is affected by wealth, as is the ability to take out insurance against flood damage.

Social networks also affect the ability of residents to respond to flooding. For example, by providing social support and a response network, and by improving the local knowledge base.

Box 7.2: Influence of nature on and community well-being

The report Natural Solutions from the New Economics Foundation looks to highlight evidence from recent studies that demonstrates the important role that the natural world can play in delivering well-being and the delivery of key societal goals such as health, education, urban regeneration and crime reduction.

It points to the relationship between access to nature and positive health outcomes, with both physical and mental health benefits on offer through increased physical activity and environmental experience and contact. The natural environment is also described as potentially being a resource to help reduce crime levels and increase community cohesion by providing a neutral space in which people can meet and interact. In addition, green spaces and other outdoor locations can provide key environments for effective learning, with this particularly being the case for children not engaged in formal learning.

7.2 Baseline review

City of Bristol[44]

The health of people in Bristol is varied compared with the England average. Deprivation is higher than average, 18,700 children live in poverty. Life expectancy for both men and women is lower than the England average, although it has increased by 4.4 years for men and 3.2 years for women in the past 20 years.[45]

More than half (58%) of the Bristol population are overweight or obese. Although the rate is lower than nationally and is relatively stable, since obesity is a key factor in Type 2 Diabetes and coronary heart disease, this rate is of concern. About 20% of Year 6 children are classified as obese, better than the average for England.

Bristol's estimated level of smoking in adults has declined from 23.5% in 2010, to 18.9% in 2014 and is now similar to the England average of 18% but smoking-related deaths in Bristol remain significantly higher than the England average rate.

Alcohol-related and alcohol specific hospital admissions in Bristol are consistently higher than the national average, and have been rising. The rate of alcohol specific hospital stays among those under 18 was 35.5% better than the average for England.

[43] Joseph Rowntree Foundation (2011) Climate change, justice and vulnerability [online] @ http://www.jrf.org.uk/sites/files/jrf/climate-change-social-vulnerability-full.pdf. Accessed April 2016

[44] Bristol Health Profile (2015) [online] @http://www.apho.org.uk/resource/item.aspx?RID=50355 (accessed 04/2016). Accessed April 2016

[45] Joint Strategic Needs Assessment for Bristol (2015) [online] @ https://www.bristol.gov.uk/documents/20182/305531/JSNA+2015+v4/fc4df8f4-5c65-4b2e-8ee3-e6ad56f1004f (accessed 04/2016), Accessed April 2016

Over the last 10 years, all-cause mortality rates have fallen. Early death rates from cancer, heart disease and stroke have also fallen but are worse than the England average.

Teenage pregnancies in Bristol have shown a steep decline since 2007 and are now only slightly higher than the England average.

Healthcare priorities in Bristol include improving mental health, giving children the best start in life, reducing health inequalities, and domestic violence.

North Somerset[46]

The health of people in North Somerset is generally better than the England average. Deprivation is lower than average, however 5,200 children live in poverty. Life expectancy for men is higher than the England average.

Life expectancy for males in North Somerset is 80.1 years which is similar to the life expectancy for males in England which is 79.4 years. For females the figure is 83.4 years which is similar to the England average. There are large inequalities in health within North Somerset. Men living in the most deprived areas live over 9.0 years less than those in the least deprived areas, for females this figure is 6.5 years.[47]

Over the last 10 years, all-cause mortality rates have fallen. Early death rates from cancer, heart disease and stroke have also fallen and are better than the England average.

The estimated rates of physical activity, smoking and excess weight (includes overweight and obese) in adults are all similar to the England average. The number of obese Year 6 children has increased since last year and is now similar to the England average, at 17.5%. Rates of smoking during pregnancy are similar to the England average, with 259 women in North Somerset still smoking during pregnancy, an increase over last year. Breastfeeding initiation is significantly higher than the average for England, with 8 out of 10 new mothers initiating breastfeeding.

Healthcare priorities in North Somerset include addressing mental health, reducing premature mortality, taking account of older people and an ageing population, and tackling inequalities.

7.3 Future baseline

The populations of North Somerset and Bristol are predicted to increase in the future. Crucially, the proportion of the population over the age of 80 years old will increase. This will place pressures on existing health and community facilities that are likely to face increased demand from residents.

7.4 Key Health issues

The key human health issues identified are:

- Stress caused by the construction of flood defences, the inhalation of construction dust, increased noise, and perceived reduction of property prices because of a new flood defence.
- Flooding can result in effects on both physical and psychological health, which could exacerbate existing health issues. Repeated flooding can be a particular issue in relation to psychological health and well-being.

[46] North Somerset Health Profile (2015) [online] @http://www.apho.org.uk/resource/item.aspx?RID=171855. Accessed April 2016

[47] Joint Strategic Needs Assessment North Somerset (2015) [online] @http://www.n-somerset.gov.uk/my-council/statistics-data/jsna/joint-strategic-needs-assessment/. Accessed April 2016

8. SOIL

8.1 Policy context

Soil is an important non-renewable resource. At the European level, the Seventh Environment Action Plan[48] which entered into force in 2014 recognises that soil degradation is a serious challenge. It provides that by 2020 land is managed sustainably, soil is adequately protected and the remediation of contaminated sites is well underway and commits the EU and its Member States to increasing efforts to reduce soil erosion and increase soil organic matter and to remediate contaminated sites.

At the national level, 'Safeguarding our Soils: A Strategy for England' (2009)[49] seeks to improve the quality of England's soils and the NPPF states that the planning system should contribute to and enhance the natural and local environment by remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land.

8.2 Baseline review

A separate desktop contaminated land study is being prepared as part of the development of the Strategy. The recommendations and outputs from this report will inform the option development phase of the Strategy and the SEA. If further data and surveys are necessary to increase certainty in terms of potential contamination sources at vulnerable sites, this will also be established**. Figure 8.1** shows Agricultural Land Classifications in the vicinity of Reaches 1, 2 and 3.

8.2.1 *Reach 1*

It is likely that there are areas of contamination within Avonmouth and Portbury Docks, due to the nature of historical and current land use in the area. If this material is contaminated, the release of this material could have an adverse impact on the SPA/SAC/Ramsar/SSSI designated Severn Estuary. However, if this material is remediated then there might be positive effects as there would be less/no chance of pollutant release.

There are two historic landfill sites called Portway and Land Adjoining Station Road located in Shirehampton in close proximity to the A4 and railway line. The release of this material could also have an adverse effect on the SPA/SAC/Ramsar/SSSI designated Severn Estuary.

There is no high-grade agricultural land within this Reach; however there is an area of good-moderate agricultural land on the western bank of the River Avon surrounding the settlement of Pill. The eastern bank of the River Avon is classified as Urban.

8.2.2 *Reach 2*

The eastern bank of the River Avon is classified as being 'Urban'. There is an area of Grade 2 (Very good) quality agricultural land to the east of Pill. There is an area of woodland on the western bank of the River Avon known as Leigh Woods.

There is a historic landfill 'The Creek' located at Sea Mills. The release of this material could also have an adverse effect on the SPA/SAC/Ramsar/SSSI designated Severn Estuary.

8.2.3 *Reach 3*

Reach contains no high-quality agricultural land, and is classified as 'Urban'. At the western extent of Reach 3, there may be the potential for effects on the Grade 3 land in the study area of Reach 2.

The land uses within Reach 3 includes the residential areas of Clifton and Bedminster, the city centre which mainly contains commercial and recreational uses, as well as some industrial uses around St Philips Marsh. The latter uses may have increased potential for the release of contaminants.

There is a historic landfill site 'Clift House Tannery' located within the Cumberland Basin.

---

[48] European Commission (2015) Soil. @http://ec.europa.eu/environment/soil/index_en.htm. Accessed May 2016

[49] Defra (2009) Safeguarding our Soils: A Strategy for England [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69261/pb13297-soil-strategy-090910.pdf. Accessed 20 May 2016

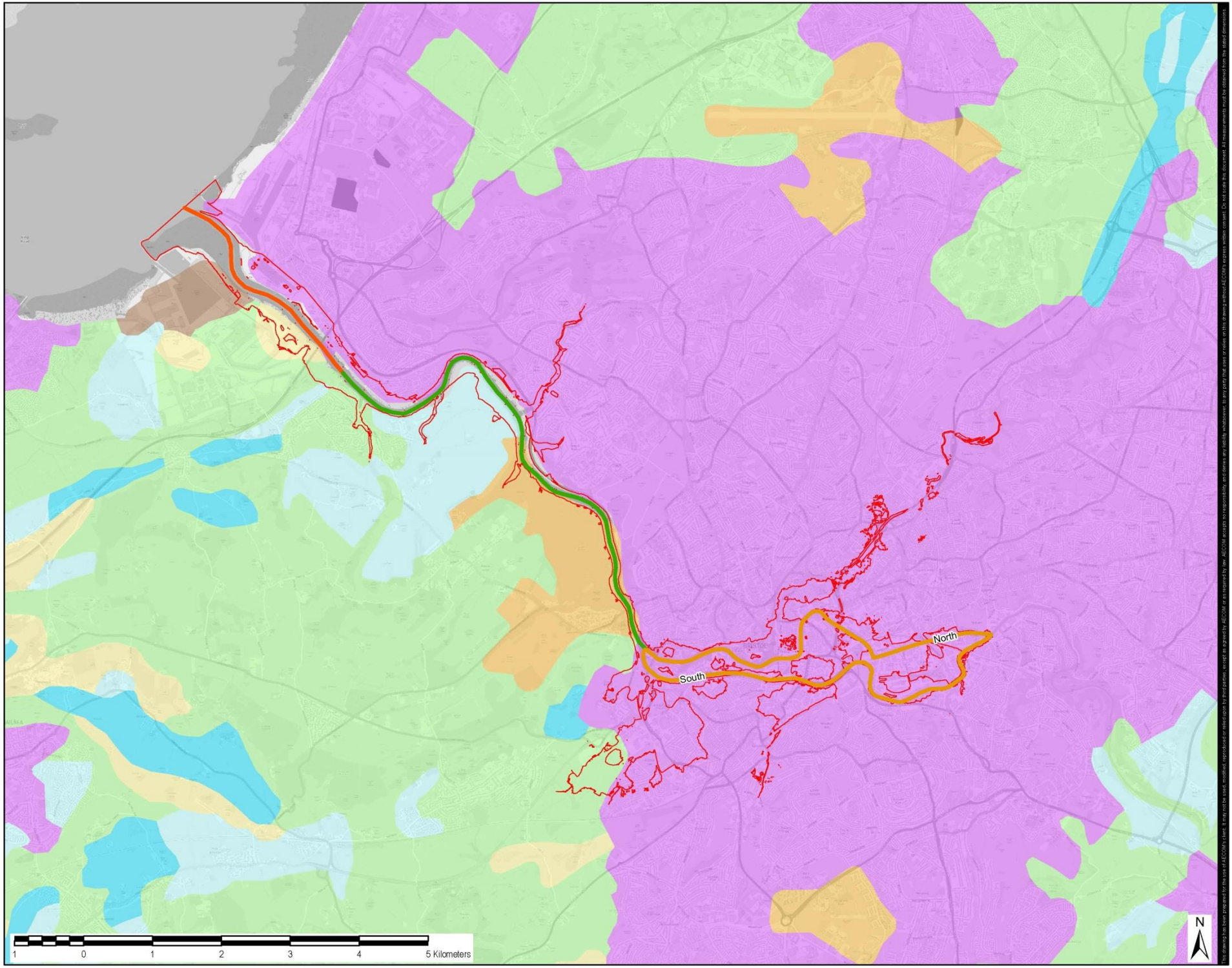
8.3 Future baseline

Contaminated land in the city is likely to continue to be remediated in conjunction with the requirements of Section 57 of the Environment Act 1995 (which establishes the legal framework for dealing with contaminated land in England). Soil is unlikely to be significantly affected by flood risk management options.

8.4 Key Soil issues

The key soil issues identified are:

- Due to the urban nature of the Study Area there is the potential for contamination which may have adverse effects on water quality if pollutants are released into the environment;
- There is the potential for The Strategy to mobilise contamination held in silt banks adjacent to the River which may have adverse effects on water quality if pollutants are released into the environment;
- There is also the potential for contamination within the Avonmouth/Portbury Docks area of Reach 1 which may have adverse effects on water quality if pollutants are released into the environment.



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area

Provisional Agricultural Land Classification © ADAS & Defra

- Grade 1
- Grade 2
- Grade 3
- Grade 4
- Grade 5
- Non Agricultural
- Urban

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 8.1
SOIL

Scale at A3: 1:50,000

Drawing No:			Rev:
FIGURE 8.1			V1
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\8-1_Soil_v1.mxd

9. WATER

9.1 Policy context

European context

Directive 2000/60/EC 'establishing a framework for the Community action in the field of water policy' (the Water Framework Directive or WFD) drives a catchment-based approach to water management. The Environmental Agency (EA) has recently published second River Basin Management Plans (RBMP) which identify baseline classification of waterbodies, statutory objectives for protected areas, statutory objectives for water bodies and a summary programme of measures to achieve statutory objectives. RBMPs will seek to deliver the objectives of the WFD, including:

a) Enhance and prevent further deterioration of aquatic and wetland ecosystems.

b) Reduce the pollution of water, especially by 'priority hazardous' substances; and

c) Ensure the progressive reduction of groundwater pollution.

The WFD has led to the setting up of various protected areas for groundwater such as drinking water protected areas, source protection zones and safeguard zones.

The EU's Blueprint to Safeguard Europe's Water Resources[50] promotes the use of green infrastructure, such as wetlands, floodplains and buffer strips along water courses in order to reduce vulnerability to floods and droughts. It also emphasises the role water efficiency can play in reducing scarcity and water stress.

National Planning Policy Framework

Key messages include:

- Prevent both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.
- Produce strategic policies to deliver the provision of a variety of infrastructure, including that necessary for water supply and wastewater.
- Take account of the effects of climate change in the long term, including factors such as 'flood risk, coastal change, water supply and changes to biodiversity and landscape'. Planning authorities are encouraged to 'adopt proactive strategies' to adaptation.

Supplementing the National Planning Policy Framework

Water for Life[51], sets out the government's vision for a more resilient water sector, where water is valued as a precious resource. Measures must address poorly performing ecosystems, and the combined impacts of climate change and population growth on stressed water resources. Water for Life led to a government consultation on a national strategy on urban pollution in 2012. The consultation report notes that pollutants affecting waterbodies can be broken down into a number of categories including:[52]

- Point Source Pollution: Permitted discharges from factories and wastewater treatment are currently responsible for about 36% of pollution related to failing water bodies; and
- Diffuse pollution: Unplanned pollution from urban and rural activity is responsible for

[50] European Commission (2012) A Blueprint to Safeguard Europe's Water Resources [online] @ http://ec.europa.eu/environment/water/blueprint/pdf/COM-2012-673final_EN_ACT-cov.pdf. Accessed April 2016

[51] Defra (2011) Water for life (The Water White Paper) [online] @ http://www.official-documents.gov.uk/document/cm82/8230/8230.pdf. Accessed April 2016

[52] Defra (2012) Tackling water pollution from the urban environment [online] @https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/82602/consult-udwp-doc-20121120.pdf. Accessed April 2016

49% of the pollution related to failing water bodies.

An Environment Agency strategy[53] implements the requirements of the WFD in relation to groundwater. The strategy highlights that groundwater is at risk from both point source and diffuse pollution. The good quality of groundwater is crucial for water-dependent plants and animals, and for the use of groundwater as a source of drinking water.

The TCPA report 'Climate Change Adaptation by Design'[54] highlights that adaptation to changes in water availability and quality can be addressed at a variety of scales. At the catchment scale greenspace and bluespace strategies should influence development; whilst neighbourhood-level efforts should aim to enhance public spaces. Rainwater harvesting and storage schemes can reduce risk of urban flooding whilst providing additional water supplies.

Regional context

Severn Estuary Flood Risk Management Plan[55]

Flood Risk Management Plans (FRMPs) are produced every 6 years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how risk management authorities (RMAs) plan to work together with communities and businesses to manage and reduce flood risk. The Severn Estuary Flood Risk Management Plan (SEFRMP) sets out a 13 objectives that set out the key factors that the measures in the plan should tackle. Relevant objectives are:

- Reduce the risk from flooding to people and households
- Target resources to reduce the risk of flooding to communities with the highest flood risk
- In support of integrated catchment based water management, facilitate decision-making and action at the appropriate level (individual, community, or local council, river catchment, coastal cell or national), foster partnership working and ensure early engagement with stakeholders.
- Reduce the risk of flooding from reservoirs to people, property, infrastructure and the environment.

Severn Estuary Shoreline Management Plan Review[56]

The Severn Estuary Shoreline Management Plan Review (SMP2) provides a policy approach over 100 years. The Theme area 'Severnside, Bristol and Avon' covers the study area and identifies the Severn Estuary SAC, SPA and Ramsar site as well as the Avon Gorge Woodlands SAC as key policy drivers. It identifies a 'hold the line' policy for all Policy Units and epochs.

9.2 Baseline review

A Water Framework Directive Assessment is being prepared as part of The Strategy. The recommendations and outputs from this report will inform the option development phase of The Strategy and the SEA for The Strategy.

Water Quality

Many rivers, lakes, estuaries and coastal waters are environmentally sensitive areas, and if levels of nutrients released from sewage treatment works are too high this can affect the

[53] Environment Agency (2012) GP3: Groundwater Protection: Policy and Practice [online] @http://www.environment-agency.gov.uk/research/library/publications/144346.aspx. Accessed April 2016

[54] TCPA (2007) Climate change adaptation by design: guide for sustainable communities [online] @http://www.tcpa.org.uk/data/files/bd_cca.pdf. Accessed April 2016

[55] Environment Agency and Natural Resources Wales (2016) Severn River Basin District Flood Risk Management Plan 2015-2021 [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507832/LIT_10213_SEVERN_FRMP_PART_A.pdf. Accessed 18 May 2016

[56] Environment Agency (2011) Severn Estuary Draft Flood Risk Management Strategy Strategic Environmental Assessment Report [online] @ http://www.severnestuary.net/frms/docs/2013/info/SEA_FRMS_Draft_Report_DG029_complete_ver_2%5B1%5D.pdf. Accessed May 2016

established ecosystem. The Environment Agency has changed its monitoring technique to correlate with the WFD technique which aims to assess the whole water environment so action can be directed to where it is most needed. They regularly monitor the quality of rivers in relation to water chemistry, biology and nutrient levels to identify potential areas for improvement. **Table 9.1** below details the water quality of water body's in the vicinity of the Study Area. The main water body that is likely to be affected by the Strategy is the Bristol Avon. **Table 9.2** shows the WFD classification status of groundwater that has the potential to be affected by The Strategy.

Table 9.1 WFD classification status of water bodies in close proximity to the Study Area[57]

River	Water Body ID	WFD Classification	Hydromorphological Classification and justification	Reason for not achieving 'Good Status'	WFD Objective
Bristol Avon (transitional)	GB530905415405	Moderate	Heavily modified	No information on reasons for not achieving 'Good' status provided online (http://environment.data.gov.uk/catchment-planning/WaterBody/GB530905415405.)	• Good Overall Potential by 2021 • Good Ecological Potential by 2021 • Good Chemical Potential by 2021
Frome – Bradley Brook to confluence of Floating Harbour (River)	GB109053027840	Moderate	Heavily modified	Classified as being moderate for phosphate and fish.	• Good Overall Potential by 2027 • Good Ecological Potential by 2027 • Good Chemical Potential by 2015
The Malago – source to confluence of River Avon (Bristol New Cut) (River)	GB109053021970	Moderate	Heavily modified	Classified as being moderate for: phosphate and invertebrates.	• Good Overall Potential by 2027 • Good Ecological Potential by 2027 • Good Chemical Potential by 2015
Trym – source to confluence of River Avon (Bristol) (River)	GB109053027530	Moderate	Heavily modified	Classified as being bad for fish and moderate for invertebrates and phosphate.	• Good Overall Potential by 2027 • Good Ecological Potential by 2027 • Good Chemical Potential by 2015

[57] Environment Agency, WFD Catchment Tool - http://environment.data.gov.uk/catchment-planning/WaterBody/GB109054026650

Chestle Pill (River)	GB1090540266500	Moderate	Artificial	Classified as being poor for: phosphate, fish, dissolved oxygen and moderate for invertebrates.	• Good Overall Potential by 2027 • Good Ecological Potential by 2027 • Good Chemical Potential by 2015

Groundwater

Table 9.2 WFD classification status of groundwater in close proximity to the Study Area

Groundwater Aspect	**Quantitative**	**Chemical**	**Quantitative (by 2021)**	**Chemical (by 2021)**
Bristol Triassic	Good	Poor	Good	Good
Carboniferous Limestone (Bristol)	Good	Poor	Good	Good
Portishead Mercia	Good	Good	Good	Good

The Severn River Basin Management Plan[58] produced under the WFD shows the current ecological and chemical 2015 for surface waters. Generally the ecological status of surface waters is moderate, and the chemical status is classified as good. In terms of the chemical and quantitative 2015 classification for groundwaters this is also typically good.

A WFD Assessment will be required at the Strategy level. This will include an assessment of all water bodies that could be affected by the implementation of the Strategy, including their current water quality.

Abstraction

There are several Groundwater and Surface water abstraction sources that have the potential to be affected by The Strategy. Most of the abstraction sources are for Industrial, Commercial and Public services uses, there are also a few sources which are for agricultural purposes, and one private water supply.

Flood Risk

Bristol has a long history of flooding with the worst floods in the last 125 years occurring in 1882, 1960 and 1968 (First Phase Feasibility Study, 2014). Recent tidal flooding has been recorded in 1981, 1990, 1999 and 2014 at locations including Cumberland Basin Road, Avon Crescent and Cattle Market Road.

Low spots along the banks of the River Avon are the first pathways for flood water to inundate a significant number of properties in central Bristol, either directly, or because water levels become raised in the Floating Harbour and overtop low spots at Avon Crescent, Junction Lock and Bathurst Basin. Other areas at risk include St. Phillips Marsh, Redcliffe (risk significantly increasing in the future) and Temple Gate / Clarence Road (risk significantly increasing in the future).

Existing modelling has shown a strong relationship between tidal / surge return period events and peak water levels in the Floating Harbour. However, there is only a weak relationship between Floating Harbour peak water levels and fluvial return period events of the Rivers Avon and Frome. The predicted flood risk to central Bristol is therefore considered to be tidally dominated.

[58] Environment Agency – The Severn River Basin Management Plan [online] @https://www.gov.uk/government/collections/river-basin-management-plans-2015. Accessed April 2016

At present (i.e. with no allowance for climate change considered), Bristol Central Area Flood Risk Assessment (CAFRA) modelling predicts that there are approximately 300 residential and commercial properties in the city centre that have a greater than 1 in 20 chance of flooding in any given year. CAFRA Workstream 3 identifies that large parts of the city centre have a 1 in 20 chance of flooding in any given year, with low-lying areas of St Philips Marsh, the Cumberland Basin and Netham at even greater risk during the tidally dominated and intermediate events with a joint probability of occurrence of 1 in 20 in any year. Properties in Mina Road and Ashton Gate are predicted to be at risk during the corresponding fluvially-dominated events.

If climate change continues as expected it will result in the continuation / acceleration of rising sea levels. This is expected to increase the depth and extent of flooding in Bristol with the CAFRA modelling suggesting that by 2110 over 400 hectares of the city centre will be either directly inundated or isolated during a 1 in 200 year tidal event coinciding with a 1 in 10 year fluvial flow. This magnitude event would flood approximately 3500 ground floor properties and lead to widespread disruption.

Baseline risk for the area within the Strategy boundaries, and the numbers of properties considered at risk during different time periods and magnitude events will be refined in the next stages of the Strategy development.

9.3 Future baseline

In terms of water quality, the implementation of the River Severn River Basin Management Plan (RBMP) is likely to lead to continued improvements to water quality in watercourses in the area and provide additional protection to groundwater. However further work is required to ensure that the watercourses in the city meet Water Framework Directive targets for chemical and ecological water quality by 2021. Water quality is also likely to continue to be affected by pollution incidents in the city.

Water availability in the wider area may be affected by regional increases in population and an increased occurrence of drought exacerbated by the effects of climate change.

Without the Strategy, flood risk in the city may increase as a result of sea level rise particularly if the 'Hold the Line' strategy is not automatically improved to counteract climate change. It has been assumed that some defences will not be raised and therefore the standard of flood protection may fall over time in response to sea level rise.

9.4 Key Water issues

The key water issues identified are:

- Significant areas are at risk of tidal and coastal flooding.
- The implementation of The Strategy should ensure that the current situation with regard to water quality is not worsened and should seek to improve the status of the water bodies where appropriate. This is linked to Key Issues for soil in terms of potential contamination (see Section 8.4). FRM options should consider their effects on release of contamination, sedimentation and other potential impacts on ecological quality.
- The Strategy should not affect abstraction sources.

10. AIR

10.1 Policy context

European context

The UNECE Gothenburg Protocol sets national emission reduction targets, including for fine particulate matter, to be achieved by 2020.

The EU ambient air quality directives set limits and targets for concentrations of various pollutants in outdoor air for the protection of health and ecosystems. It includes controls over fine particulate matter.

The EU Directives include:

- Directive 2008/50/EC 'on ambient air quality and cleaner air for Europe' and Directive 2004/107/EC 'relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air', which set limits for concentrations of pollutants in outdoor air
- Directive 2001/81/EC 'on national emission ceilings for certain atmospheric pollutants', which sets limits on total annual emissions of important air pollutants for all member states to help reduce 'transboundary air pollution' (pollution that is generated in one country but has an effect in others)

National context[59]

Part IV of The Environment Act 1995[60] sets provisions for protecting air quality in the UK and for local air quality management. This Act introduced the system of local air quality management (LAQM). Since then, local authorities have had to periodically review and assess the current, and likely future, air quality in their areas against national air quality objectives for seven air pollutants included in regulations for that purpose. Where any objective is unlikely to be met by the relevant deadline, local authorities must designate those areas as air quality management areas (AQMAs) and take action, along with others, to work towards meeting the objectives.

The Air Quality (Standards) Regulations 2010[61] transpose into English law the requirements of Directives 2008/50/EC and 2004/107/EC. Equivalent regulations have been made by the devolved administrations in Scotland, Wales and Northern Ireland.

The Air Quality (England) Regulations 2000[62] set national objectives for local authorities in England.

The National Emission Ceilings Regulations 2002 transpose into UK legislation the requirements of Directive 2001/81/EC.

This Air Quality Strategy sets out air quality objectives and policy options to further improve air quality in the UK from today into the long term.

The NPPF

Key messages include:

- Higher levels of walking and cycling could reduce congestion, improve local environmental quality, improve personal health and reduce transport-related CO_2 emissions.
- Plans should contribute towards national objectives for pollutants, taking into account the presence of Air Quality Management Areas.

Local context

City of Bristol Core Strategy[63]

---

[59] National legislation and standards on air quality - https://www.gov.uk/government/publications/2010-to-2015-government-policy-environmental-quality/2010-to-2015-government-policy-environmental-quality#appendix-5-international-european-and-national-standards-for-air-quality

[60] See: http://www.legislation.gov.uk/ukpga/1995/25/contents

[61] See: http://www.legislation.gov.uk/uksi/2010/1001/contents/made

[62] See: http://www.legislation.gov.uk/uksi/2000/928/contents/made

Within the Core Strategy Policy BCS23 states that Development should be sited and designed in a way as to avoid adversely impacting upon:

- Environmental amenity or biodiversity of the surrounding area by reason of fumes, dust, noise, vibration, smell, light or other forms of air, land, water pollution, or creating exposure to contaminated land.
- The quality of underground or surface water bodies.

In locating and designing development, account should also be taken of:

- The impact of existing sources of noise or other pollution on the new development; and
- The impact of the new development on the viability of existing uses by reason of its sensitivity to noise or other pollution.

North Somerset Core Strategy[64]

Within the Core Strategy Policy CS3 focusses on Environmental impacts and flood risk assessment. This states that Development that, on its own or cumulatively, would result in air, water or other environmental pollution or harm to amenity, health or safety will only be permitted if the potential adverse effects would be mitigated to an acceptable level by other control regimes, or by measures included in the proposals, by the imposition of planning conditions or through a planning obligation.

10.2 Baseline review

10.2.1 *Reach 1*

Reach 1 is not located within an Air Quality Management Area (AQMA).

10.2.2 *Reach 2*

Reach 2 is not located within an AQMA.

10.2.3 *Reach 3*

Reach 3 is located within 'AQMA 10' as shown in **Figure 10.1**, which is designated due to elevated concentrations of fine particulate matter (PM_{10}) as a precautionary measure,[65] and nitrogen dioxide (NO_2). This is unlikely to be a constraint to flood defences, although may require more robust emissions management of construction vehicles and equipment.

10.3 Future baseline

Air quality is gradually improving in the UK. There is a chance the AQMA may not be present when construction starts. Bristol City Council will review air quality and AQMA need annually in line with the Environment Act 1995: Local air quality management.

Potential effects on air quality are likely to be limited to short term and temporary effects during the construction phase of engineered flood defences. Air quality is unlikely to be significantly affected by flood risk management options.

10.4 Key Air Quality issues

Key air quality issues include:

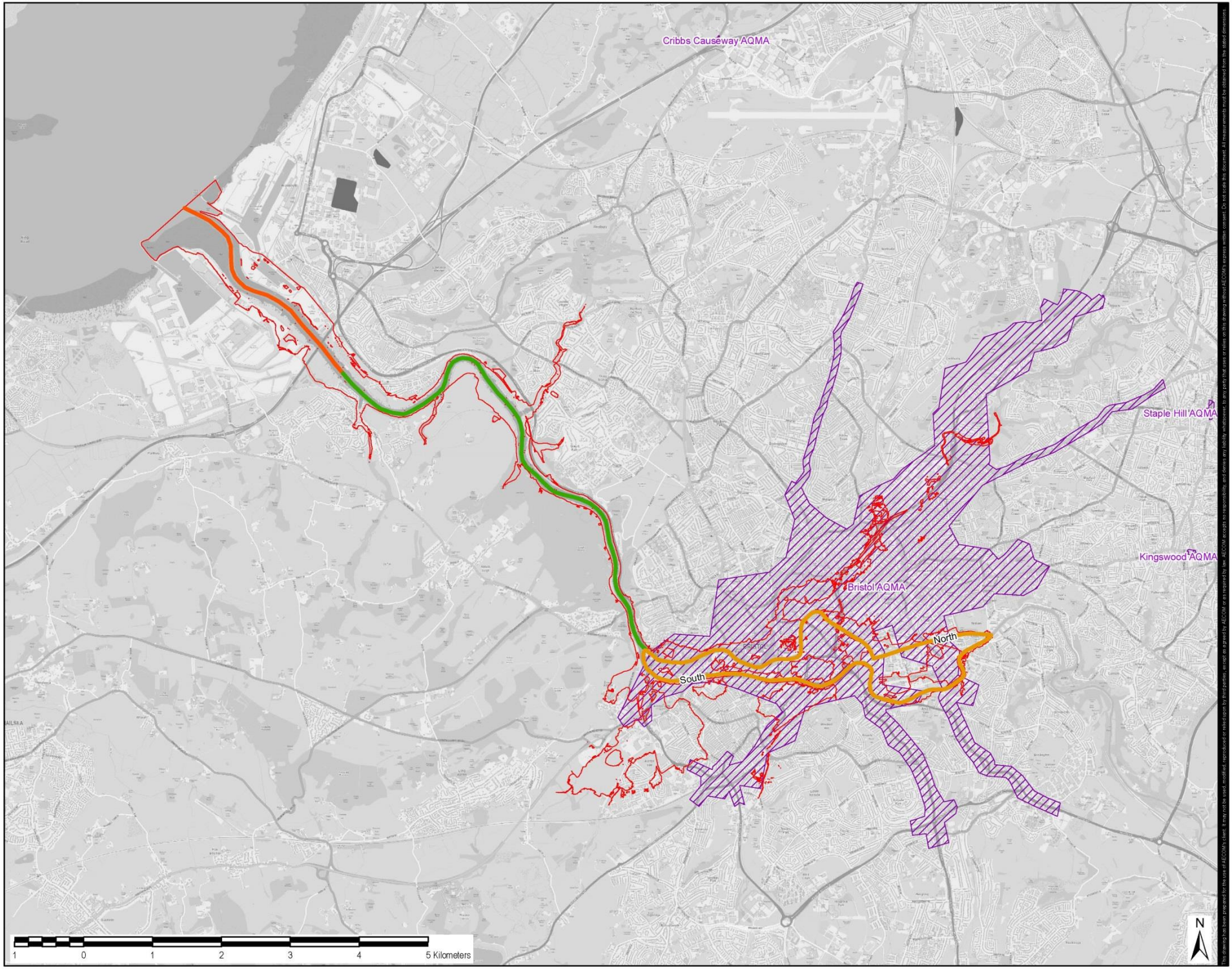
- Reach 3 is located within an AQMA. The Strategy should ensure that the current situation is not exacerbated.

---

[63] City of Bristol (2011) Core Strategy [online] @ https://www2.bristol.gov.uk/committee/2011/ta/ta000/0621_7b_appendixa.pdf. Accessed April 2016.

[64] North Somerset (2012) Core Strategy [online] @ https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf. Accessed April 2016.

[65] BCC (2014) 2014 *Air Quality Progress Report for Bristol City Council* [online] @ https://www.bristol.gov.uk/documents/20182/32675/BCC_AQ_PR_2014_1.0+.pdf/938b64e6-95cd-47ba-8cd9-83c8c4d6e2cc. Accessed 20 May 2016



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Air Quality Managment Areas

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 10.1
AIR QUALITY

Scale at A3: 1:50,000

Drawing No:			Rev:
FIGURE 10.1			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\10-1_Air_v1.mxd

11. CLIMATIC FACTORS

11.1 Policy context

European context

In its 2007 strategy on climate change, the European Commission assesses the costs and benefits of combating climate change and recommends a package of measures to limit global warming to 2° Celsius.[66]

National context

The National Planning Policy Framework (NPPF)[67]

A key message from the NPPF is that supporting the transition to a low carbon future in a changing climate is to be considered 'core planning principle'. Specifically, there is a key role for planning in securing radical reductions in greenhouse gases (GHG), including in terms of meeting the targets set out in the Climate Change Act 2008. The Act sets targets for GHG emission reductions through action in the UK of at least 80% by 2050, and at least 26% by 2020, against a 1990 baseline.

Supplementing the NPPF

In the guidance document 'How local authorities can reduce emissions and manage climate risk'[68] notes that local authorities are well placed to drive and influence emissions reductions in their wider areas, with planning functions described as being a 'key lever in reducing emissions and adapting localities to a changing climate'.

A Forest Research report 'The Benefits of green infrastructure'[69] outlines the important role that green and open spaces can play in the adaptation to and mitigation of climate change. In terms of mitigation, the report highlights the potential for trees and other forms of vegetation to remove CO_2 from the air.

In-line with the mandatory requirements of the Waste Framework Directive, the Waste Management Plan for England[70] includes analysis of the current baseline in terms of waste management and the measures being taken to establish environmentally sound means of re-use, recycling, recovery and disposal of waste.

---

[66] Commission of the European Communities (2007) Limiting Global Climate Change to 2 degrees Celsius: The way ahead for 2020 and beyond [online] @http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0002:FIN:EN:PDF. Accessed April 2016.

[67] National Planning Policy Framework (2012) [online] @https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf. Accessed April 2016.

[68] Committee on Climate Change (2012) How local authorities can reduce emissions and manage climate risk [online] @ http://hmccc.s3.amazonaws.com/Local%20Authorites/1584_CCC_LA%20Report_bookmarked_1b.pdf. Accessed April 2016.

[69] Forest Research (2010) Benefits of green infrastructure [online] @ http://www.forestry.gov.uk/pdf/urgp_benefits_of_green_infrastructure.pdf/$FILE/urgp_benefits_of_green_infrastructure.pdf. Accessed April 2016.

[70] Defra (2013) Waste Management Plan for England [online] @https://www.gov.uk/government/publications/waste-management-plan-for-england. Accessed April 2016.

Local context

City of Bristol Core Strategy[71]

Policy BCS13 sets out a requirement for development in Bristol to take into account the impact of climate change. Development is required, by a variety of means, to both mitigate its own impact on climate change and adapt to the effects of climate change.

BCC is committed, through the Core Cities Climate Change Declaration and the Climate Change Act 2008, to an 80% reduction in CO_2 emissions by 2050.

North Somerset Core Strategy[72]

Policy CS1 Addressing climate change and carbon reduction sets out how North Somerset are committed to reducing carbon emissions and tackling climate change, mitigating further impacts and supporting adaptation to its effects, and sets out principles to guide development.

Tackling climate change is a key priority for the planning system and in particular implementing the national carbon reduction strategy of an 80% reduction in carbon dioxide emissions by 2050.

11.2 Baseline review

Bristol

Bristol's progress on reducing emissions is captured within Bristol's Framework for climate and energy security[73]. It is within this document that it is reported that energy use within the city has reduced by almost 20% and carbon dioxide emissions by almost 18% between 2005 and 2013. During this time there has been a 24% reduction in per capita emissions as Bristol's population has grown by almost 8%. Bristol has the lowest per capita carbon dioxide emissions of the largest cities in England. Bristol has a target to reduce energy use by 50% by 2020 from a 2005 baseline.

North Somerset

North Somerset signed up to Climate Local in 2013 to capture the opportunities and benefits of action on climate change. These include saving money on energy bills, generating income from renewable energy, attracting new jobs and investment in 'green' industries, supporting new sources of energy, managing local flood-risk and water scarcity and protecting the natural environment.

A progress update was published in 2015 which details the progress made in 2015 towards achieving the commitments and actions pledged.[74] These commitments include promoting sustainable travel, encouraging new development with reduced carbon emissions, encouraging waste minimisation, reducing risks and exploit the opportunities from a changing climate etc. Overall good progress is being made. For example as a result of the waste minimisation initiative recycling rates in North Somerset are not at levels between 60-65%. Also, a local flood risk management strategy is now in place and projects are taking place in those areas identified as top priority for flood mitigation.

11.3 Future baseline

Climate change has the potential to increase the occurrence of extreme weather events in the city, and lead to increases in mean summer and winter temperatures, increases in mean precipitation in winter and decreases in mean precipitation in summer. This is likely to increase the risks associated with flooding with an increased need for adaptation.

---

[71] City of Bristol Core Strategy (2011) [online] @https://www2.bristol.gov.uk/committee/2011/ta/ta000/0621_7b_appendixa.pdf. Accessed April 2016.

[72] North Somerset Council Core Strategy (2012) [online] @https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf. Accessed April 2016.

[73] BCC Framework for climate and energy security (2015) [online] @https://www.bristol.gov.uk/documents/20182/33423/Our+Resilient+Future+A+Framework+for+Climate+and+Energy+Security/2ee3fe3d-efa5-425a-b271-14dca33517e6 . Accessed April 2016.

[74] Climate Local Progress Report (2015) [online] @http://www.n-somerset.gov.uk/wp-content/uploads/2016/01/Climate_Local_Progress_report_2015_pdf.pdf (Accessed on 04/2016)

Research into sea level trends and North Atlantic Oscillation influences in The Bristol Channel/Severn Estuary[75] showed a rising Bristol Channel and Severn Estuary mean sea level trend of 2.4 mm yr− 1. A 2050 mean sea level of 0.370 m is projected to inform future management. The implications for the City are increases risk of flooding and a fall in the standard of protection afforded to the City by flood defences (as per Appendix C of the Bristol Tidal Flood Risk Management Strategy – Hydraulic Modelling Review Report). The timeline for asset failure will be in accordance with Appendix C of this report i.e. from 2015 – 2115 all assets functioning as present day (Floating Harbour Water Level Control Structures, and Raised Defence). It is assumed that maintenance work would be carried out to ensure the continued operation and improved resilience of the Floating Harbour Water level control structures (i.e. raising level of electrical control systems during maintenance). Raised defences to be maintained / reconstructed to the existing standard of flood protection to ensure that the flood defence function of the assets is sustained.

The City of Bristol has pledged to become carbon neutral by 2050[76]. In terms of climate change mitigation, per capita emissions of greenhouse gas emissions are likely to continue to decrease as energy efficiency measures, renewable energy production and new technologies become more widely adopted. Road transport has the potential to continue to be an increasingly significant contributor to greenhouse gas emissions in the city.

11.4 Key Climatic issues

Key climatic issues include:

- Sea level rise has the potential to increase flood risk in the Study Area. A Strategy is required to alleviate the risk of flooding to people, existing property, essential infrastructure and cultural heritage; and
- Where possible, low carbon solutions to flood risk issues should be considered to support climate change mitigation.

[75] Phillips, M.R; Crisp, S (2010) Sea level trends and NAO influences: The Bristol Channel/Severn Estuary, Global Planetary Change (73) Pages 211-218 [online] @http://www.sciencedirect.com/science/article/pii/S0921818110001323
[76] Bristol City Council Newsroom [online] @http://news.bristol.gov.uk/bristol-increases-its-ambition-and-aims-to-be-carbon-neutral-by-2050 Accessed April 2016.

12. MATERIAL ASSETS

12.1 Policy context

National Policy context

Material assets are taken to be those whose loss would have the potential to have an effect, often economic, on an area, such as built development and infrastructure.

Making Space for Water (2004)[77] advocates a holistic approach to flooding. Flood and coastal erosion risk management will be clearly embedded across a range of Government policies, including planning, urban and rural development, agriculture, transport, and nature conservation and conservation of the historic environment. There will be a mix of policies designed to minimise the creation of new risks (by the way development policy is implemented in areas of flood risk), to manage risk and to increase resistance and resilience.

Similarly, the NPPF[78] sets out that the purpose of the planning system is to contribute to the achievement of sustainable development. It advocates that new development should take account of environmental issues by accommodating natural hazards and the impact of climate change while avoiding areas at risk of flooding and sea-level rise. It also seeks to ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding.

Regional Policy context

West of England Local Enterprise Partnership Strategic Economic Plan[79]

The Strategic Economic Plan (SEP) sets out a vison that by 2030 the West of England: will be growing and populous; have a buoyant economy; have a rising quality of life for all; provide easier travel; will include competitive cultural attractions; will provide success secured in in 'environmentally friendly' ways; build on its distinctive character and have real influence with regional and national government. The SEP sets out five strategic objectives to achieve this vison:

1. *"Create the right conditions for business to thrive. Give confidence and certainty to our investors to attract and retain investment to stimulate and incentivise growth.*
2. *Ensure a resilient economy, which operates within environmental limits. That is a low carbon and resource efficient economy, increases natural capital, and is proofed against future environmental, economic and social shocks.*
3. *Create places where people want to live and work, through delivery of cultural infrastructure and essential infrastructure, including broadband, transport and housing to unlock suitable locations for economic growth.*
4. *Shape the local workforce to provide people with skills that businesses need to succeed and that will provide them with job opportunities*
5. *Ensure all our communities share in the prosperity, health and well-being and reduce the inequality gap."*[our emphasis]

Severn Estuary Flood Risk Management Plan[80]

Flood Risk Management Plans (FRMPs) are produced every 6 years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how risk management authorities (RMAs) plan to work together with communities and businesses to manage and reduce flood risk. The Severn Estuary Flood Risk Management

---

[77] Defra, Making Space for Water (2004) [online] @http://www.defra.gov.uk/environ/fcd/policy/strategy/htm. Accessed on 04/2016

[78] National Planning Policy Framework (2012) [online] - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

[79] West of England LEP (2015) Strategic Economic Plan[online] @ http://www.westofenglandlep.co.uk/assets/files/About%20Us/Strategic%20Plan/LEP225%20SEP%20All%20Final.pdf . Accessed 16 May 2016.

[80] Environment Agency and Natural Resources Wales (2016) *Severn River Basin District Flood Risk Management Plan 2015-2021* [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507832/LIT_10213_SEVERN_FRMP_PART_A.pdf. Accessed 18 May 2016

Plan (SEFRMP) sets out a 13 objectives that set out he key factors that the measures in the plan should tackle. Relevant objectives are:

- Manage flood and coastal erosion risks, taking account of the needs of communities businesses and the environment and working with natural solutions wherever possible
- Reduce the risk from flooding to people and households
- Ensure that wherever possible investment in flood and coastal risk management provides environmental, social and economic benefits, protects and enhances the natural, built and historic environment and supports the achievement of WFD objectives.
- Target resources to reduce the risk of flooding to communities with the highest flood risk.
- Set out a clear and consistent plan for flood risk management so that communities, businesses and other organisations can make informed decisions about the management of flood risk and associated opportunities for delivering environmental benefits.
- Raise awareness of and engage people, businesses and organisations on flood and coastal erosion risk to encourage them to take action to manage the risks they face.
- Households and businesses at high risk of flooding can receive an appropriate flood warnings service.
- Encourage emergency plans and responses to flood incidents to be effective and communities to respond effectively to flood forecasts, warnings and advice.
- In support of integrated catchment based water management, facilitate decision-making and action at the appropriate level (individual, community, or local council, river catchment, coastal cell or national), foster partnership working and ensure early engagement with stakeholders.
- Reduce the risk of flooding from reservoirs to people, property, infrastructure and the environment.

Severn Estuary Shoreline Management Plan Review[81]

The Severn Estuary Shoreline Management Plan Review (SMP2) provides a policy approach over 100 years. The Theme area 'Severnside, Bristol and Avon' covers the study area and identifies the Severn Estuary SAC, SPA and Ramsar site as well as the Avon Gorge Woodlands SAC as key policy drivers. It identifies a 'hold the line' policy for all Policy Units and epochs.

Local Policy context

City of Bristol Core Strategy[82]

Key transport related policies include:

- BCS1 refers to improvements to transport infrastructure in South Bristol
- BCS2 sets out the approach to Bristol City Centre including access improvements
- BCS10 sets out that the council will support the delivery of significant improvements to transport infrastructure to provide an integrated transport system, which improves accessibility within Bristol and supports the proposed levels of development.

[81] Environment Agency (2011) Severn Estuary Draft Flood Risk Management Strategy Strategic Environmental Assessment Report [online] @ http://www.severnestuary.net/frms/docs/2013/info/SEA_FRMS_Draft_Report_DG029_complete_ver_2%5B1%5D.pdf. Accessed on: 05/2016

[82] City of Bristol, Core Strategy (2011) [online] @https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdfhttps://www2.bristol.gov.uk/committee/2011/ta/ta000/0621_7b_appendixa.pdf . Accessed April 2016.

- BCS11 sets out that development and infrastructure provision will be coordinated to ensure that growth in the city is supported by the provision of infrastructure, services and facilities.
- BCS13 states that development should contribute to both mitigating and adapting to climate change, and to meeting targets to reduce carbon dioxide emissions

Bristol Central Area Plan[83]

The Central Area Plan explores how Bristol City Centre will develop over the next 15 years to 2026. The plan also deals with an area to the east of the city centre that is not part of the city centre itself, comprising parts of St. Paul's, Easton, St. Jude's, Newtown, The Dings and St. Philip's. The Central Area Plan sets out a range of designations for land which should be safeguarded to deliver policies in the Core Strategy, Site Allocation or Development Management or Bristol Central Area policies. Specifically, the Central Area Plan helps to deliver:

- Around 150,000m² of new (net additional) high quality office space;
- The provision of around 7,400 new homes; and
- Improved connectivity by a variety of means of transport.

Bristol Temple Quarter Spatial Framework[84]

The Bristol Temple Quarter Spatial Framework (TQSF) is a non-statutory planning document that sets out how the Temple Quarter Enterprise Zone could become a thriving new city quarter over 25 years. The TQSF will guide and shape new development in the area, seeking to deliver quality places for people through good planning and design that reflect our distinctiveness, entrepreneurship, culture and Green Capital status. The draft TQSF sets out eight objectives to guide development:

- Temple Meads transformed into a city gateway befitting a Green Capital City
- A world-class railway hub with outstanding station facilities
- A rejuvenated and expanded transport interchange
- New mixed use development, including commercial shops, restaurants and bars
- More direct and pleasant pedestrian and cycle routes between the station and the city centre
- New public access beneath and around the station complex which kick starts regeneration east of Temple Meads

North Somerset Core Strategy[85]

Key transport related policy includes:

- CS10: Transportation and movement which sets out that travel management policies and development proposals should encourage an improved and integrated transport network.

[83] BCC (2015) *Bristol Central Area Plan* [online] @ https://www.bristol.gov.uk/documents/20182/34540/BCAP%20Adopted%20March%202015%20-%20Main%20Document%20&%20Annex%20-%20Web%20PDF.pdf/d05a0c22-ab91-4530-926a-f26160ab72a5. Accessed 18 May 2016

[84] BCC (2015) *Bristol Temple Quarter Spatial Framework* [online] @ http://www.bristoltemplequarter.com/spatialframework. Accessed 18 May 2016

[85] North Somerset Core Strategy (2012) [online] @https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf. Accessed April 2016.

Joint Local Transport Plan[86]

The Joint Local Transport Plan (JLTP3) includes Bath, and North East Somerset, Bristol City, North Somerset and South Gloucestershire and aims to deliver transport improvements in the West of England, and covers the period 2011 to 2026.

12.2 Baseline review

Reach 1

Reach 1 is mainly an industrial landscape comprising Avonmouth Docks and Royal Portbury Docks. The M5 crosses the River Avon from Shirehampton to Portbury. Traffic counts showed that in 2014 130052 vehicles crossed the River Avon on the M5. The A4 runs along the eastern bank of the River. Traffic counts on this road were 20479 in 2014[87]. There is a railway track which runs along the northern bank of the River Avon with railway stations at Avonmouth and Shirehampton. There is a Public Right of Way (PRoW) and cycle path which runs along the bank of the River Avon in the south east of Reach 1.

Reach 2

Reach 2 contains the residential areas of Shirehampton and Pill. There is considerable recreational space within this Reach including Shirehampton Golf Course, Old Sneyd Park, Avon Gorge, Durdham Downs, Leigh Woods and Clifton Downs. The A4 runs along the eastern bank of the River Avon, traffic counts show that in 2014 23397 vehicles used this road[88]. A PRoW runs along both sides of Reach 2 which is also part of the cycle network.

Reach 3

Reach 3 comprises the City of Bristol which includes residential and commercially occupied land as well as a large amount of significant infrastructure such as the Floating Harbour. There is a good road network within the city; according to DfT traffic counts 617,052 vehicles travelled within the city centre during 2014, for example[89].

12.3 Future baseline

As the population increases there is expected to be more traffic on roads. Climate change is likely to increase the occurrence of flooding therefore any development should take into account the likely increased chance of flooding.

With regard to Reach 1, the industrial uses present will need to be adequately protected to ensure business are resilient to flooding and that access to the sites remains usable. In Reach 2, the main concern is that the A4 remains usable. Within Reach 3, significant infrastructure such as the Floating Harbour will need to be protected to ensure that the economic activities in the reach are resilient to environmental shocks and extreme weather events.

12.4 Key Asset issues

The key asset issues identified are:

- New and existing development has the potential to be at risk from flooding
- The Strategy should ensure that material assets on the coast, such as walkways, residential/commercial areas in Avonmouth, Pill, Shirehampton and Bristol are not compromised as a result of flooding.
- Given that much of the area is coastal; sea level rise is a serious concern as many identified assets are at risk of flooding.

[86] Joint Local Transport Plan (2011) [online] @http://travelwest.info/wp-content/uploads/2015/03/joint-local-transport-plan.pdf . Accessed April 2016.
[87] Department for Transport ,Traffic Count Data (2014) [online] @ http://www.dft.gov.uk/traffic-counts/cp.php?la=Bristol%2C+City+of (Accessed on 04/2016)
[88] Department for Transport, Traffic Count Data (2014) [online] @http://www.dft.gov.uk/traffic-counts/cp.php?la=Bristol%2C+City+of (Accessed on: 04/2016)
[89] Department for Transport, Traffic Count Data (2014) [online] @http://www.dft.gov.uk/traffic-counts/area.php?region=&la=Bristol%2C+City+of (Accessed on: 04/2016)

13. CULTURAL HERITAGE, INCLUDING ARCHITECTURAL AND ARCHAEOLOGICAL HERITAGE

13.1 Policy context

National Policy context

Individual features within the historic environment are afforded protection through national legislation e.g. through the Listing of buildings or Scheduled Monuments. However, such measures only protect the most valued assets at the national level and therefore locally important assets require separate consideration.

'Heritage Protection For The 21st Century' (2007)[90] seeks to put the historic environment at the heart of the planning system. Similarly, The Historic Environment: A Force for Our Future (2001)[91] recognises that the full potential of the historic environment should be realised and it should be accessible to all.

The National Planning Policy Framework[92] recognises that heritage assets are an irreplaceable resource and should be conserved in a manner appropriate to their significance in order that they can be enjoyed for their contribution to the quality of life of current and future generations.

Regional context

Severn Estuary Flood Risk Management Plan[93]

Flood Risk Management Plans (FRMPs) are produced every 6 years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how risk management authorities (RMAs) plan to work together with communities and businesses to manage and reduce flood risk. The Severn Estuary Flood Risk Management Plan (SEFRMP) sets out a 13 objectives that set out he key factors that the measures in the plan should tackle. Relevant objectives are:

- Ensure that wherever possible investment in flood and coastal risk management provides environmental, social and economic benefits, protects and enhances the natural, built and historic environment and supports the achievement of WFD objectives.

Local context

Bristol Core Strategy[94]

Policy BCS22 sets out that Development proposal's will safeguard or enhance heritage assets and the character and setting of areas of acknowledged importance.

Bristol Temple Quarter Spatial Framework[95]

The Bristol Temple Quarter Spatial Framework (TQSF) is a non-statutory planning document that sets out how the Temple Quarter Enterprise Zone could become a thriving new city quarter over 25 years. The TQSF will guide and shape new development in the area, seeking to deliver quality places for people through good planning and design that reflect our distinctiveness, entrepreneurship, culture and Green Capital status. The draft TQSF sets out eight objectives to guide development:

- Sensitive adaptation of the station's nationally important heritage assets

---

[90] DCMS and WAG (2007*) Heritage Protection For The 21st Century'* [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/78116/hrp_whitepaper_doc1.pdf
[91] http://www.culture.gov.uk/Reference_library/Publications/archive_2001/his_force_future.htm
[92] National Planning Policy Framework (2012) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf
[93] Environment Agency and Natural Resources Wales (2016) *Severn River Basin District Flood Risk Management Plan 2015-2021* [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507832/LIT_10213_SEVERN_FRMP_PART_A.pdf. Accessed 18 May 2016
[94] City of Bristol Core Strategy (2012) - https://www2.bristol.gov.uk/committee/2011/ta/ta000/0621_7b_appendixa.pdf
[95] BCC (2015) *Bristol Temple Quarter Spatial Framework* [online] @ http://www.bristoltemplequarter.com/spatialframework. Accessed 18 May 2016

North Somerset Core Strategy[96]

Policy CS5 focusses on Landscape and the historic environment and states that the council will conserve the historic environment of North Somerset, having regard to the significance of heritage assets.

13.2 Baseline review

There a number of heritage features with Reach 1, Reach 2 and Reach 3, including a number that have protected status, and areas considered worthy of conservation because of their historical or architectural interest.

Reach 1

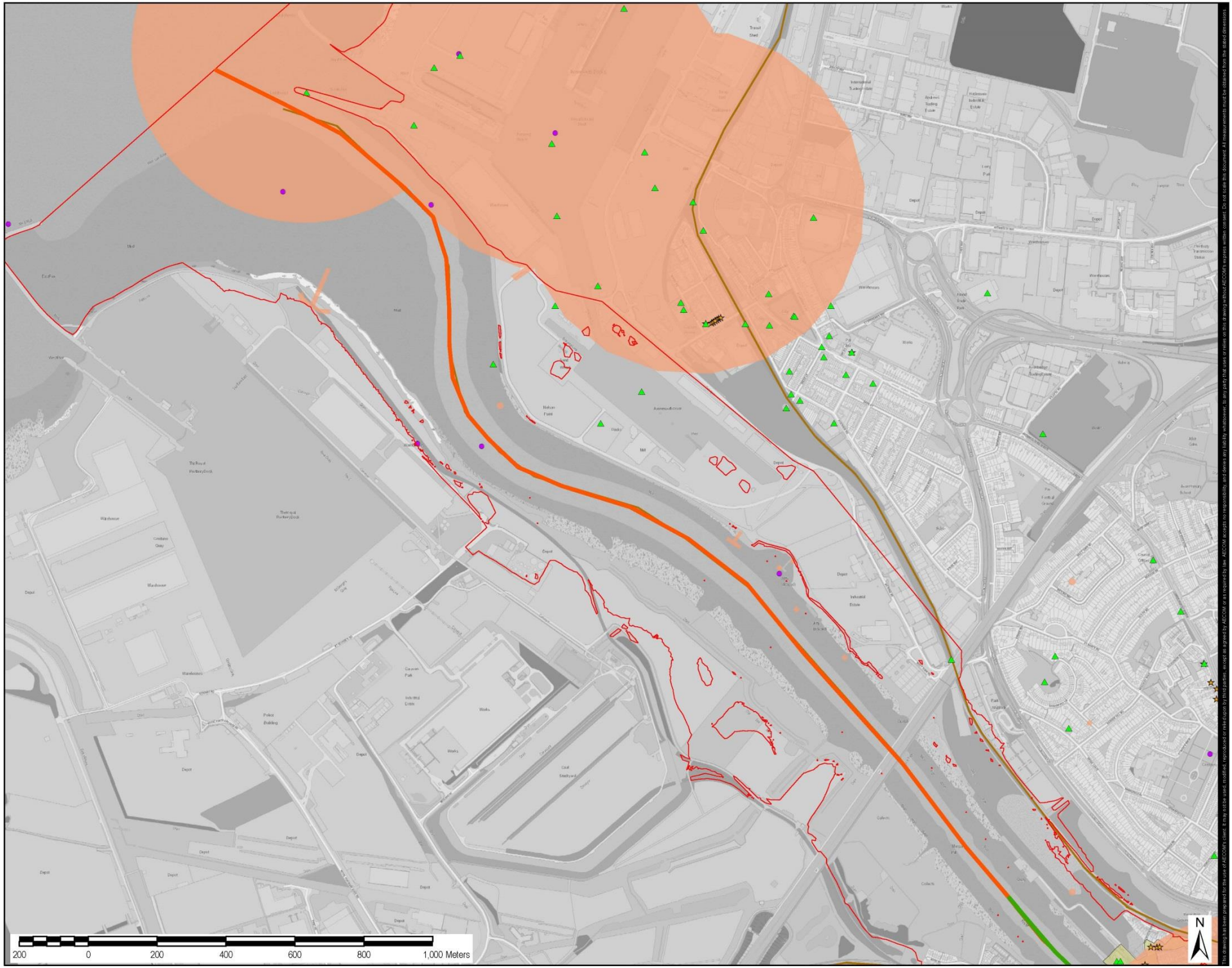
Figure 13-1A illustrates the cultural heritage designations within Reach 1 and designated structural heritage assets.

There are eight Grade II listed buildings located within the vicinity of Reach 1, the majority of which are located behind Royal Edward Docks on the east bank of the River Avon. The setting of which should be a consideration as the options appraisal progresses.

There are several HER monuments within Avonmouth Docks. The HER's which are in close proximity to the River Avon include: a First World War Coastal Battery located at the South Pier of Avonmouth Docks, Royal Edward Pier Station, a Gibbet on the north side of the River Avon at Avonmouth and a Limekiln at Avonmouth Dock.

There are no Registered Park and Gardens, Scheduled Monuments or Grade I or Grade II* Listed buildings surrounding Reach 1. There are five records of Archives and Monuments Information England (AMIE) within Reach 1.

[96] North Somerset Core Strategy (2012) - https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Historic Environment Record
- Heritage Building at Risk - Place of Worship
- Heritage Building at Risk - Building or Structure
- AMIE Monuments
- AMIE Linear Monuments
- AMIE Approximate Locations of Monuments
- Scheduled Monument
- Conservation Areas

Listed Buildings

- Grade I Listing
- Grade II Listing
- Grade II* Listing

Registerd Park and Garden

- Grade II
- Grade II*

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 13.1A
CULTURAL HERITAGE

Scale at A3: 1:10,000

Drawing No:			Rev:
FIGURE 13.1A			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\13-1_CulturalHeritage_Pages_v2.mxd

Reach 2

Figure 13-1B illustrates the cultural heritage designations within Reach 2 and designated structural heritage assets.

There are three Scheduled Monuments within the Study Area surrounding Reach 2 including: Part of the Roman Settlement of Abonae, Clifton Down camp and Stokeleigh Camp which is a promontory fort in Leigh Woods. The Part of the Roman Settlement of Abonae Scheduled Monument is particularly sensitive due to its close proximity with the River Avon.

Listed buildings include the Grade I Clifton Suspension Bridge and numerous Grade II listed and Grade II* listed buildings located inland within the Clifton area of the city.

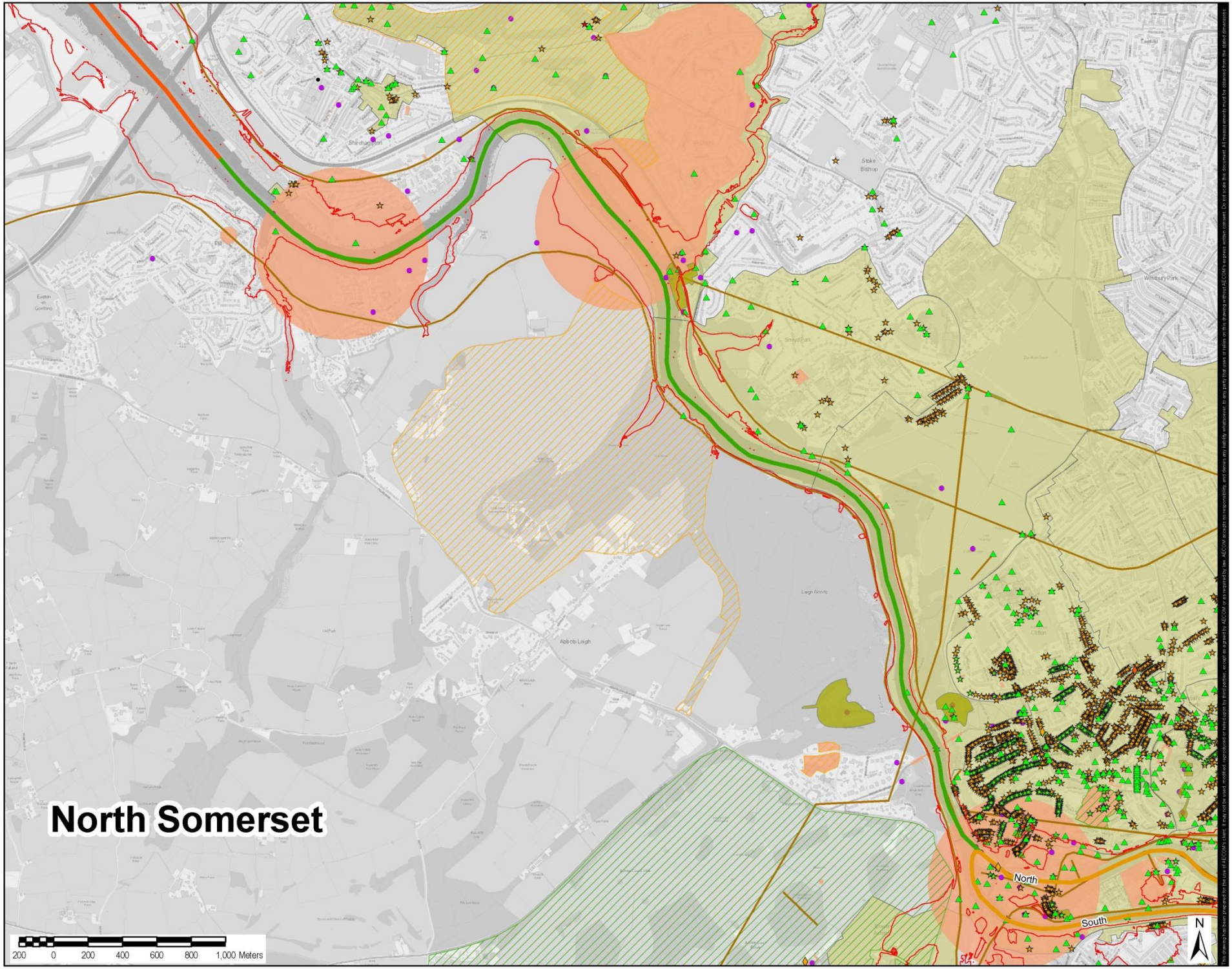
Notably, there are Grade II listed Harbour Walls of Sea Mills Docks which are particularly sensitive as they border the River. There are also several Grade II and Grade II* listed buildings on Hotwell Road which are located on the eastern bank on the River Avon and therefore are particularly sensitive to flooding.

There are several Registered Park and Gardens, including the Grade II Listed Kings Weston House, the Grade II* Blaise Castle and Hamlet, the Grade II Leigh Court, the Grade II Bristol University Botanic Gardens and Rayne Thatch, and the Grade II* Ashton Court. Leigh Court is particularly sensitive as it directly abuts the river on the western bank. However, the remaining Registered Park and Gardens are all in close proximity to the River and therefore the settings of all Registered Park and Gardens should be considered as the options appraisal progresses.

There are two HER located on the eastern bank of the River Avon, south west of Shirehampton Railway Station; these are for Lamplighters Hall and Coal Wharf. There is an additional HER on the east bank of the River Avon in Pill at the confluence of Crockerne Pill and the River Avon for a Custom House. A HER for Coal Wharf Hung Row Cottages located on the bank of the River Avon near Shirehampton. There is a record for a Gunpowder magazine south of Shirehampton Park, as well as for the associated landing stage. In Sea Mills there is a HER for Sea Mills Dock, Sea Mills Station and for an Old Signal Station. West of the railway in Sea Mills is a HER for Limekilns. Within Avon Gorge there is a HER for a Medieval Deer Park located on the west bank of the River. On the east bank of the River south of Old Sneyd Park is a HER for a Brick Yard. There are two HER's near to Clifton Down, these are for Clifton Extension Railway and Hotwells Station. There are a further two HER's in this location for a Quarry which is located below Circular Road. There are many HER's within Clifton: those that are in close proximity to the River are for Hotwells Halt, a possible Roman earthwork within Clifton Down Camp, a Lime Kiln below Vincent Rocks, the BBC Emergency Radio Studio, the Hotwell and for the Old Rownham Ferry. There aretwo records of AMIE within Reach 2 which are located within the River. Conservation Areas which abut Reach 2 on the eastern bank of the River Avon include:

- Kingsweston and Trym Valley
- Sea Mills;
- Sneyd Park;
- The Downs; and
- Clifton.

Conservation enhancement objectives for each of these conservation areas are presented in Appendix B.



AECOM

AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Historic Environment Record
- Heritage Building at Risk - Place of Worship
- Heritage Building at Risk - Building or Structure
- AMIE Monuments
- AMIE Linear Monuments
- AMIE Approximate Locations of Monuments
- Scheduled Monument
- Conservation Areas

Listed Buildings

- Grade I Listing
- Grade II Listing
- Grade II* Listing

Registerd Park and Garden

- Grade II
- Grade II*

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 13.1B
CULTURAL HERITAGE

Scale at A3: 1:20,000

Drawing No:			Rev:
FIGURE 13.1B			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\13-1_CulturalHeritage_Pages_v2.mxd

Reach 3

Figure 13-1C illustrates the cultural heritage designations within Reach 3 and designated structural heritage assets.

Scheduled Monuments in Reach 3 include Underfall Yard which is located just east of Cumberland Basin within Bristol Docks. Due to its close proximity to the river it is particularly sensitive to flooding therefore it is important that the Floating Harbour water level is managed to prevent overtopping. Other Scheduled Monuments less at risk of flooding include Temple Church which is in the area of Redcliffe and Dominican Friars (Quaker's Friars) which is located in the area of Broadmead.

There are several Grade I, Grade II listed and Grade II* listed buildings listed buildings within the city. The most sensitive of which, due to their proximity with the river, are those located within the Floating Harbour which are all Grade II listed with the exception of the swing bridge over Brunels North, West and South entrance, and SS Great Britain which are all Grade II*. The settings of which should be a consideration as the options appraisal progresses. There is one heritage building at risk within Reach 3; this is the Swing Bridge over the North Entrance Lock in the Cumberland Basin.

There are numerous HER within Reach 3. The HER's which are located within the river or in close proximity are mentioned here. Within the Cumberland Basin there are HER's for Harbour Master's House, New Rownham Ferry, Cumberland Buildings, Transit Shed, Nova Scotia Yard and Hydraulic Engine House. Within the Floating Harbour there are HER's for: Great Western Dry Dock, Fairbaim Steam Crane, M Shed, Crane in the Amphitheatre of Canons Marsh, Manfields Boat Yard, Crane at the end of Narrow Quay, Gibb Slip, The Great Crane, Mud Dock and Severn Shed. Within the New Cut there are HER's for: Ashton Swing Bridge, Vauxhall Footbridge, Gaol Ferry, Totterdown Bridge, a Private vehicle Bridge over the River Avon, Netham Dam and New Brislington Bridge.

There are seven records of AMIE within Reach 3 which are located within the River. There are no registered Parks or Gardens within this Reach, however there are several conservation areas including:

- Clifton;
- City Docks;
- Bower Ashton;
- Bedminster;
- Redcliffe;
- City and Queen Square;
- St James' Parade;
- Portland and Brunswick Square; and
- Old Market.

Conservation enhancement objectives for each of these conservation areas are presented in Appendix B.

Drawing on the findings of the PARANASSUS project[97], the vulnerability of historic buildings to tidal flooding in Bristol due to Climate Change is being investigated. This specific research is being undertaken as part of a dissertation at University College London[98]. To date, field data has been collected which identifies buildings listed as historic or heritage buildings within a predicted flood extent of a 1 in 200 year flood event. Evidence from the processed data indicates that there is an increased threat of damage to historical buildings due to climate change.

[97] University College London, Parnassus [online] @http://www.ucl.ac.uk/parnassus. Accessed on: 13/05/2016
[98] Wong, C; Foo, C; (2015) Vulnerability of Historic Buildings to Tidal Flooding in Bristol due to Climate Change

13.3 Future baseline

New development areas in the city have the potential to impact on the fabric and setting of cultural heritage assets. This includes through inappropriate design and layout. Traffic growth also has the potential to lead to effects on the historic environment across in the city.

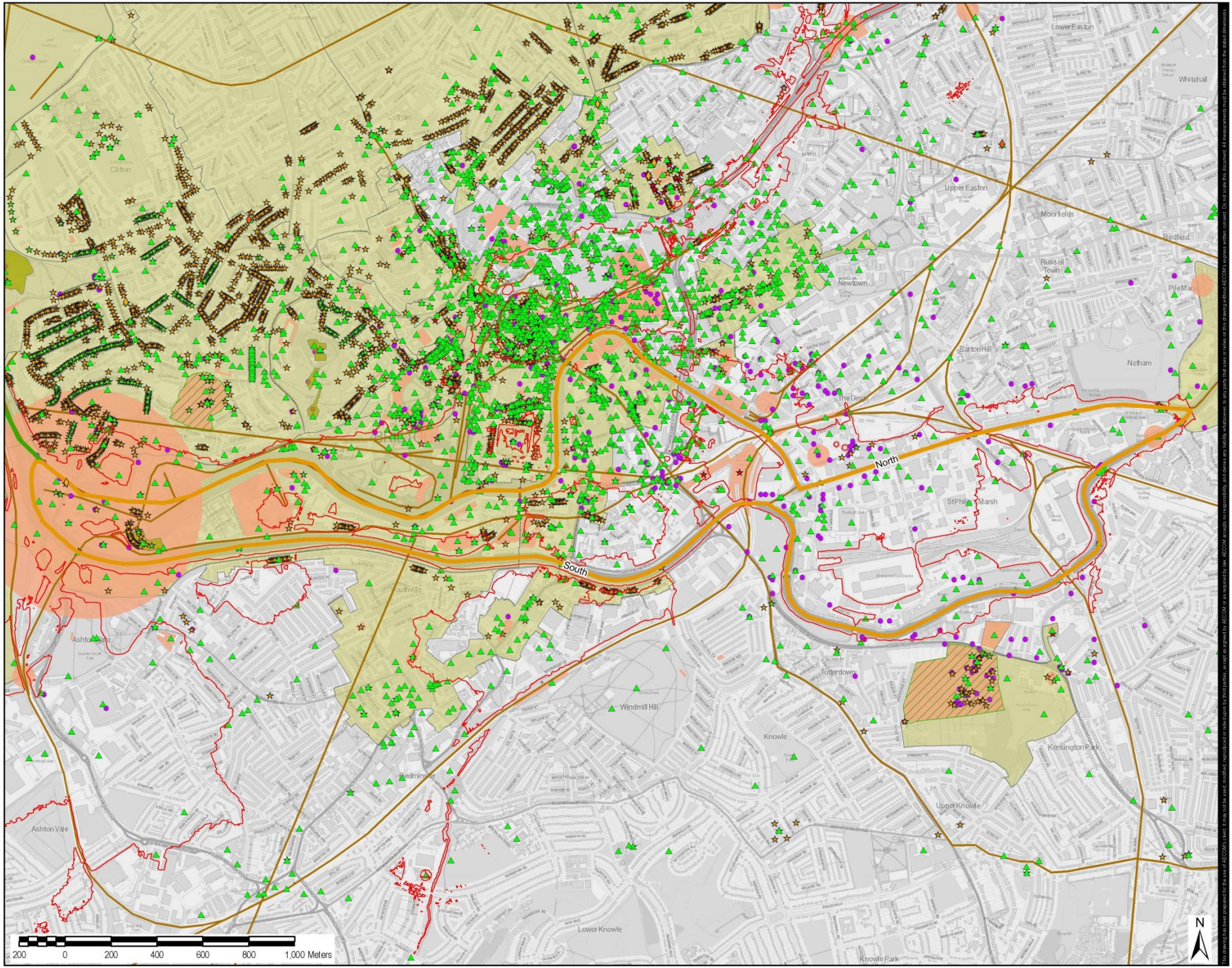
There is one heritage asset at risk within the Study Area. This is the Swing Bridge over the North Entrance Lock of Cumberland basin in Reach 3. The Swing Bridge is a redundant structure, the condition of which is described as being 'very bad'. A number of surveys were carried out in 2015 so it is likely that the condition of the structure will improve in the future.

It should be noted that existing historic environment designations and Local Plan policies will offer a degree of protection to cultural heritage assets and their settings.

13.4 Key Cultural Heritage issues

The key cultural heritage issues identified are:

- The preservation or enhancement of the existing character and setting of cultural heritage assets.
- The preservation or enhancement of the appearance of cultural heritage assets, conservation areas, and nationally and locally listed buildings.
- The conservation and enhancement of local archaeological remains.
- There are a number of Listed Buildings in Bristol which are located in close proximity to the River Avon are therefore vulnerable to flooding. They could also be impacted by the implementation of the Strategy if the defence is in close proximity to residential areas.



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Historic Environment Record
- Heritage Building at Risk - Place of Worship
- Heritage Building at Risk - Building or Structure
- AMIE Monuments
- AMIE Linear Monuments
- AMIE Approximate Locations of Monuments
- Scheduled Monument
- Conservation Areas

Listed Buildings

- Grade I Listing
- Grade II Listing
- Grade II* Listing

Registerd Park and Garden

- Grade II
- Grade II*

Copyright:

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 13.1C
CULTURAL HERITAGE

Scale at A3: 1:15,000

Drawing No:			Rev:
FIGURE 13.1C			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\13-1_CulturalHeritage_Pages_v2.mxd

14. LANDSCAPE

14.1 Policy context

European Policy context

Landscapes are afforded protection for their intrinsic contribution to the character of an area. The European Landscape Convention (2000)[99] promotes actions at the landscape scale from protection and conservation to management, improvement and even the creation of landscapes.

National Policy context

At the national level, 'Our Countryside: The Future - A Fair Deal for Rural England' (2000)[100] recognises the importance of understanding, evaluating and protecting countryside character and diversity. The National Planning Policy Framework (NPPF) (2012) acknowledges the role of the planning system to protect and enhance valued landscapes.

Regional Policy context

Severn Estuary Flood Risk Management Plan[101]

Flood Risk Management Plans (FRMPs) are produced every six years and describe the sources and risks of flooding within a river basin district and catchment. They also include information on how risk management authorities (RMAs) plan to work together with communities and businesses to manage and reduce flood risk. The Severn Estuary Flood Risk Management Plan (SEFRMP) sets out a 13 objectives that set out he key factors that the measures in the plan should tackle. Relevant objectives are:

- Manage flood and coastal erosion risks, taking account of the needs of communities businesses and the environment and working with natural solutions wherever possible
- Ensure that wherever possible investment in flood and coastal risk management provides environmental, social and economic benefits, protects and enhances the natural, built and historic environment and supports the achievement of WFD objectives.

Local Policy context

Bristol Core Strategy[102]

Policy BCS9 states that the integrity and connectivity of the strategic green infrastructure network will be maintained, protected and enhanced. Opportunities to extend the coverage and connectivity of the existing strategic green infrastructure network should be taken.

North Somerset Core Strategy[103]

Policy CS5 considers Landscape and the historic environment. The Policy states that the character, distinctiveness, diversity and quality of North Somerset's landscape and townscape will be protected and enhanced by the careful, sensitive management and design of development. Close regard will be paid to the character of National Character Areas in North Somerset and particularly that of the 11 landscape types and 31 Landscape Character Areas identified in the North Somerset Landscape Character Assessment.

---

[99] See: http://www.coe.int/en/web/landscape

[100] Defra (2000) *Our Countryside: The Future - A Fair Deal for Rural England* [online] @ http://webarchive.nationalarchives.gov.uk/20050301192907/http://defra.gov.uk/rural/ruralwp/whitepaper/default.htm'. Accessed 20 May 2016

[101] Environment Agency and Natural Resources Wales (2016) *Severn River Basin District Flood Risk Management Plan 2015-2021* [online] @ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507832/LIT_10213_SEVERN_FRMP_PART_A.pdf. Accessed 18 May 2016

[102] City of Bristol Core Strategy (2011) [online] @https://www2.bristol.gov.uk/committee/2011/ta/ta000/0621_7b_appendixa.pdf . Accessed April 2016.

[103] North Somerset Core Strategy (2011) [online] @https://www.n-somerset.gov.uk/wp-content/uploads/2015/11/adopted-core-strategy-pdf.pdf . Accessed April 2016.

14.2 Baseline review

Reach 1 is located within National Character Area 106 - Severn and Avon Vales, see **Figure 14.1**.

Particularly relevant policies include:

- SEO 1: Protect and manage the landscape, heritage and biodiversity associated with the Severn Estuary, the river valleys and other hydrological features, planning for a landscape scale expansion of wetlands, intertidal habitats and unimproved grasslands along river floodplains through, restoration, expansion and re-linkage of existing remnant areas of semi-natural habitat.
- SEO 3: Reinforce the existing landscape structure as part of any identified growth of urban areas, hard infrastructure and other settlements ensuring quality green infrastructure is incorporated enhancing health, access, recreation, landscape, biodiversity and geodiversity.

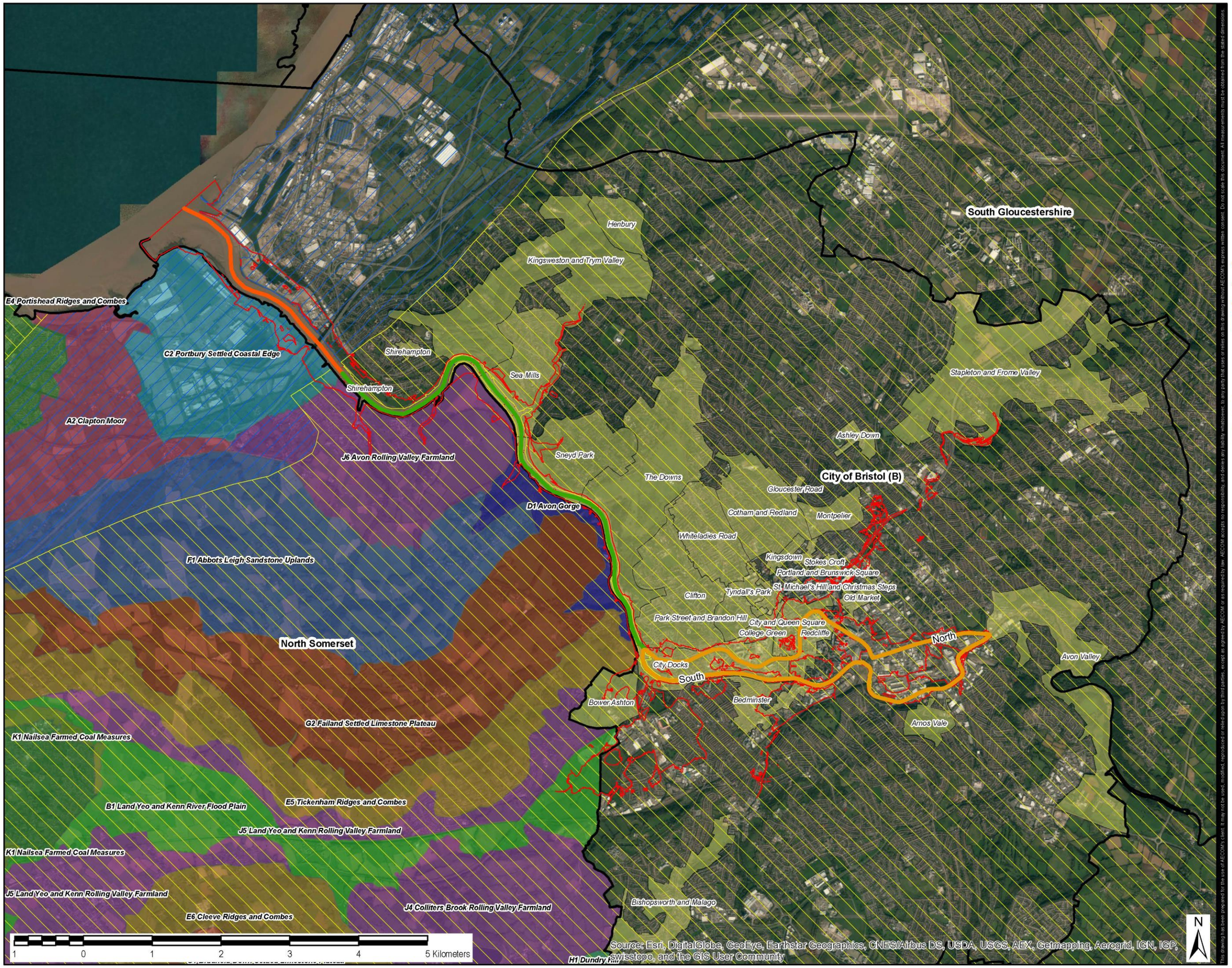
Reach 2 and 3 are all located in the Bristol, Avon Valleys and Ridges National Character Area, see **Figure 14.1**.

Key objectives include:

Bristol, Avon Valleys and Ridges

- SEO 2: Protect and manage the strong sense of history and many historical assets ranging from prehistoric barrows to the mining legacy, as well as the Avon Gorge and the many varied geological exposures within this geologically significant landscape, to enable recreation and access, education, tourism and continued enjoyment of the heritage of the area.
- SEO 4: Protect and manage the landscape, heritage and biodiversity associated with the Avon River corridor, other river valleys and lakes, planning for a landscape-scale enhancement of wetlands, wet woodland and semi-natural grasslands along river flood plains for the benefits to biodiversity, climate regulation, water quality and flooding mitigation.

The Landscape Character Areas within each specific Reach are discussed below. The North Somerset LCA's are defined within North Somerset Landscape Character Assessment. The LCA's within Bristol City Council are linked to conservation areas. Bristol City Council is gradually replacing Conservation Area Enhancement Statements with Conservation Area Character Appraisals.



AECOM Limited
1 Callaghan Square
Cardiff, CF10 5BT
+44 (0)29 2067 4600 tel
www.aecom.com

Project Title:

RIVER AVON TIDAL FLOOD RISK MANAGEMENT STRATEGY

Client:

BRISTOL CITY COUNCIL

LEGEND

- Reach 1
- Reach 2
- Reach 3
- Study Area
- Local Authority Boundary
- Conservation Areas

National Character Areas

- Bristol, Avon Valleys and Ridges
- Severn and Avon Vales

Landscape Classification Area - North Somerset

LCA

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- Urban

AECOM Internal Project No:

60478613

Drawing Title:

FIGURE 14.1
LANDSCAPE

Scale at A3: 1:50,000

Drawing No:			Rev:
FIGURE 14.1			V2
Drawn:	**Chk'd:**	**App'd:**	**Date:**
GM	SM	NT	22/04/16

Filename: P:\UKCDF1-IE\Projects\IGIS Management\001 Projects\River Avon Tidal Flood Risk\02_Maps\Strategic EA Report\14-1_Landscape_v1.mxd

Reach 1

Portbury Settled Coastal Edge Landscape Character Area (LCA) is located on the western bank of the River Avon. The condition of this LCA is described as 'Declining'. Key characteristics of this LCA are: Flat low lying land of Beach and Tidal Flat Deposits. Open level landform contrasts with the adjacent steep wooded limestone ridges. Wide views across inter-tidal bays to the Bristol Channel. View of water in many forms.

The key objective of this LCA is to: Conserve the dramatic working maritime landscape while restoring declining and lost elements of the residual rural landscape such as the rhynes, drainage ditches, and hedgerows, which can also assist the visual relationship between this very different landscape and the surrounding rural areas.

Reach 2

The North Somerset LCA's on the western bank of Reach 2 include:

Avon Rolling Valley Farmland (Declining status)

Key characteristics include: Gently sloping topography shelving down to the north ending in steeper slopes down to banks of the River Avon. Numerous Streams and Ponds. Large open pastoral fields and areas of historic parkland. Strong urban influence from view to Bristol and the large settlement of Pill.

The key objective of this LCA is to: Strengthen the positive landscape features, such as the parkland and belts of woodland, whilst enhancing areas that break the continuity of the landscape, such as the visually intrusive edge of Pill and the impact of the A369.

Avon Gorge (Good status)

Key characteristics include: Distinctive Carboniferous Limestone gorge. Steep slopes creating dramatic narrow valley down to the river. Exposed Limestone faces, with woodland where the vegetation can take hold on the steep slopes. Evidence of quarrying often apparent. Ancient woodland of oak, ash, lime, white beam and yew that is nationally significant for nature conservation. Views channelled along the gorge.

The key objective of this LCA is to: Conserve the sense of wilderness and the drama of emerging from the enclosed wooded slopes into the open space of the gorge itself with its views along the river, to the towering rocky slopes of the north side and to the Clifton suspension bridge.

Encourage public access but retain sense of remoteness through careful design of routes and infrastructure.

Failand Settled Limestone Plateau (Declining status)

Key characteristics include: Large, regular open fields with highly variable hedgerows. Tall woodland belts and clumps including plantations associated with historic estates of Tyntesfield and Ashton Court. Substantial area of ancient and coppice woodland at Leigh Woods. Areas of unimproved calcareous grassland. Hedgerow and scattered trees. Cattle grazing and horse paddocks. Leisure land use.

The key objective of this LCA is to: Conserve the wooded, rural character of the area and enhance elements in decline, particularly the field boundaries and woodland belts and taking opportunities to increase grassland biodiversity by changes in management for instance in mowing regimes along the edges of the sports fields.

Maintain key local landscape features such as the mixed woodland belts and blocks and the drystone walls.

Tickenham Ridges and Combes (Good status)

Key characteristics include: elevated ridges of Limestone and Mudstone. Steep slopes forming a distinctive back drop to the Land Yeo and Kenn Valleys and moors to the south. Intricate enclosed wooded slopes with contrasting wide views out to the open lowlands. Extensive areas of ancient broad-leaved woodland.

The key objective of this LCA is to: Conservation of the woodland, parkland and pasture, with limited areas of restoration and enhancement where elements have been lost or are failing

Encourage public access but retain sense of remoteness and minimise damage through wear and tear by careful design of routes and infrastructure.

The Bristol LCA's on the eastern back of Reach 2 include:

Kingsweston and Trym Valley[104]

The Conservation Area has as its spine the prominent ridge of land linking the villages of Shirehampton and Henbury containing the former great estates of Kingsweston House and Blaise Castle House. The principal roads traversing the area, Napier Miles Road, Shirehampton Road and Kingsweston Road still retain the character of estate roads within a parkland setting and together with their stone boundary walls and rural character do much to retain the natural charm of the area.

Sea Mills[105]

Garden suburb with key features such as: a planned layout and interrelationship between buildings and spaces; low density; simple, cottage style houses given uniformity through their architectural details; verdant and spacious character; relationship to local topography, and picturesque landscape setting; and the extent of green spaces, especially the gardens, which are what make it a "garden" suburb.

Sneyd Park[106]

A gently undulating area located just to the north of Durdham Down and bounded by the Avon Gorge and Valley to the east is the setting for the Sneyd Park Conservation Area, a verdant residential suburb of north Bristol.

The Downs[107]

The Downs is an expansive plateau of open parkland, defined by the Avon Gorge and Westbury Road to the west and east with the slopes of Clifton and Stoke Bishop to the south and north.

Clifton[108]

Clifton in the main is composed of imposing formal classical terraces linked with grand Victorian Rubble Villas, built well back from the scenic edges utilising the firm downland scarp rising from the centre to the Downs above.

Reach 3

The LCA's within this Reach include:

Clifton[109]

Clifton in the main is composed of imposing formal classical terraces linked with grand Victorian Rubble Villas, built well back from the scenic edges utilising the firm downland scarp rising from the centre to the Downs above.

---

[104] Kingsweston and Trym Valley Conservation Statement (1993) [online] @https://www.bristol.gov.uk/documents/20182/32819/22+-+Kingsweston+and+Trym+Valley.pdf/5842926a-764b-4c1b-aa92-39bcd9aa7021 (Accessed on 04/2016)

[105] Sea Mills Character Appraisal & Management Proposals (2011) [online] @https://www.bristol.gov.uk/documents/20182/33832/sea-mills-character-appraisal.pdf/0278d384-f6b8-4dc2-b4e0-e5048c5731f3 . Accessed April 2016.

[106] Sneyd Park Conservation Statement (1993) [online] @https://www.bristol.gov.uk/documents/20182/32819/23+-+Sneyd+Park.pdf/adeb16a8-3395-47c7-a97d-2e4d848a2da5 . Accessed April 2016.

[107] The Downs Conservation Statement (1993) [online] @https://www.bristol.gov.uk/documents/20182/32819/20+-+The+Downs.pdf/0879fbc6-9362-4c7b-b672-651bba672822 . Accessed April 2016.

[108] Clifton Conservation Statement (1993) [online] @https://www.bristol.gov.uk/documents/20182/32819/05+-+Clifton.pdf/04459d90-d434-4fa7-933a-69ec88c2ce6b . Accessed April 2016.

[109] Clifton Conservation Statement (1993) [online] @https://www.bristol.gov.uk/documents/20182/32819/05+-+Clifton.pdf/04459d90-d434-4fa7-933a-69ec88c2ce6b . Accessed April 2016.

City Docks[110]

The topography of this area is formed by the river valley of two rivers - the Frome and the Avon - that have produced a fairly low lying level valley bottom with pronounced hillsides on both the northern and southern sides. The Floating Harbour and the tidal course of the New Cut is a precious and significant asset to Bristol. The Floating Harbour is remarkable for its intimate relationship to the city. The port was never enclosed or separate; as a result, city streets opened onto wharfs and the working of the docks was carried out next to public highways. The physical proximity of the docks to the public realm has been critical in shaping Bristol's sense of place as a great maritime city.

Bower Ashton[111]

This is a pleasant rural area of open pastureland on the south facing slopes leading to Leigh Woods and forming the setting to Ashton Court, part of the Smythe Estate associated with the house. Rownham Hill, flanking the approach to the Avon Gorge, is an important rural boundary to the city and is visible in a wide arc from within the city.

Bedminster[112]

The unique character of Bedminster derives from its surviving historic route structure, complemented by a rich architectural backdrop, which tells the story of the area's evolution from a quiet rural settlement into a seething industrial suburb.

Redcliffe[113]

Redcliffe is an area of great contrasts. The northern portion has a largely commercial/dockside character, dominated by Victorian warehouses and later 20th century buildings that directly front the streets or edge of the Floating Harbour. The southern part has a more residential character, which once had a human scale shown in the fine Georgian terraces of Redcliffe Parade.

City and Queen Square[114]

The Old City is tightly packed, with dense and interconnected development of various historical eras and various styles of architecture. Queen Square is a formal open space with primarily office use but also heavily used for recreation. It is a valuable open space in the heart of the City, and is of considerable architectural and historical interest as an example of 18th century town planning.

St James' Parade[115]

The St James's Parade Conservation Area contains the precinct and setting of the Priory of St James, a Benedictine Priory constructed in the 12th century. It contains the remains of the Priory Church, believed to be the oldest Church in Bristol, as well as part of its burial ground. Within the Conservation Area are three listed buildings as well as a number of other structures. Some of these relate to the Priory and the parish church it became.

---

[110] City Docks Character Appraisal (2011) [online] @https://www.bristol.gov.uk/documents/20182/33832/City%20Docks%20Conservation%20Area%20Appraisal.pdf/4d991ad0-be4c-40a8-b2f6-4e007bb8e601 . Accessed April 2016.

[111] Bower Ashton Conservation Statement (1993) [online] @https://www.bristol.gov.uk/documents/20182/32819/26+-+Bower+Ashton.pdf/72ce745f-cc4b-457c-be5b-214c00cf56c8 . Accessed April 2016.

[112] Bedminster Conservation Area Character Appraisal (2013) [online] @https://www.bristol.gov.uk/documents/20182/239165/BedminsterCAMarch2014update1_0.pdf/b0bfeed5-a280-40ff-93ee-138830f59ec4 . Accessed April 2016.

[113] Redcliffe Character Appraisal (2008) [online] @https://www.bristol.gov.uk/documents/20182/33832/redcliffe-character-appraisal.pdf/3cf50d2e-f95a-44c8-8cf1-9cfad9c0e532. Accessed April 2016.

[114] City and Queen Square Character Appraisal (2009) [online] @https://www.bristol.gov.uk/documents/20182/33832/city-and-queen-square-character-appraisal-red-1.pdf/28a3fc89-f7a7-4588-8205-5ed94fc578b5 . Accessed April 2016.

[115] St James's Parade Character Appraisal (2011) [online] @https://www.bristol.gov.uk/documents/20182/33832/st-james-parade-character-appraisal.pdf/9b965c1c-2205-47f2-8ac1-a8d92e84f25b . Accessed April 2016.

Portland and Brunswick Square[116]

The Portland and Brunswick Square Conservation Area represents one of the best surviving examples of formal Georgian town planning in Bristol. With the highest proportion of listed buildings of any of the city's conservation areas (almost 70%) and the only Grade I listed square in Bristol.

Old Market[117]

The Old Market Conservation Area contains the site of Bristol's earliest market place and was historically the most important gateway into the City, on the road from London. When the Conservation Area was designated in the late 1970s it was one of several in Bristol considered to be of national significance. The Conservation Area contains over 60 listed buildings; some of these are City's oldest buildings, including two of the only remaining frontages jettied over the pavement.

14.3 Future baseline

New development areas in the city have the potential to impact on the fabric of Landscape Character Areas. Increased height of defences or change in defence construction materials will affect local landscape – increasing presence in the landscape and disrupting views.

14.4 Key Landscape and Visual issues

The key landscape and visual issues identified are:

- Inappropriate design and layout may deteriorate the landscape or visual amenity, and also has the potential to prevent access to existing areas.

[116] Portland and Brunswick Square Character Appraisal (2008) [online] @https://www.bristol.gov.uk/documents/20182/33832/portland-and-brunswick-square-character-appraisal.pdf/d93cfc64-1866-4ba8-a4a8-3f0bc411e6ce . Accessed April 2016.

[117] Old Market Character Appraisal (2008) [online] @https://www.bristol.gov.uk/documents/20182/33832/old-market-character-appraisal-red-2.pdf/be5c0518-7d70-4604-9f34-9fbc49169c3e . Accessed April 2016.

15. SCOPING ENVIRONMENTAL ISSUES

The purpose of this report is to define the scope of the assessment of the Strategy. The SEA Regulations outline aspects of the environment that should be considered. However, if there are unlikely to be any significant effects upon a particular receptor it is possible to scope it out of the assessment.

Guidance advises that a set of objectives can be used to structure the assessment of the Strategy. In **Table 15-1** the key issues for each topic covered in the scoping report have been set out. Aligned with these are a series of objectives, or 'questions' that provide a framework for the assessment. Note also that these have been cross referenced to the suggested environmental topics for the SEA Regulations. Where text is marked ~~strikethrough~~ it is proposed that the element is scoped out of the assessment

The assessment will use the objectives as an overarching structure. This will be augmented by the key issues identified. For example, we will assess whether the draft Strategy will 'Protect and / or enhance biodiversity' but also whether the key issues for each Reach will be affected e.g. condition of the SSSI at Ham Green.

Table 15-1: Draft SEA Framework and scope

SEA topic	Key issues	SEA objective (proposed). Will the Strategy:
Biodiversity, flora and fauna	Reach 1 contains a SSSI and the Seven Estuary SPA / SAC	Protect and / or enhance biodiversity?
	Reach 2 contains Ham Green SSSI, a geodiversity SSSI in unfavourable condition. Reach 2 also contains a range of European protected species	
	Reach 3 contains no European sites or SSSIs. It does contain a range of European protected species	
	The Severn Estuary is an important nursery ground for fish which may be affected by the measures.	
Population / human health / material assets	~~Where appropriate, the Strategy should seek to support improvements to the built environment in the city, with a particular focus on those areas suffering from the highest levels of deprivation.~~	The Strategy is tightly focused both in terms of spatial extent and objectives. It is unlikely that the Strategy would be able to have any impact on deprivation or provision / capacity related to services, facilities and amenities.
	~~Aging population is likely to put pressure on services, facilities and amenities.~~	
	Flood risk issues exist in some parts of the areas proposed for future housing delivery in the city, including the city centre.	Minimise the risk of flooding to residential properties and community and economic assets? Improve the broad determinants of health and encourage healthy lifestyles?
	Flooding and erosion can result in effects on both physical and psychological health, which could exacerbate existing health issues. Repeated flooding can be	

SEA topic	Key issues	SEA objective (proposed). Will the Strategy:
	a particular issue in relation to psychological health and well-being.	
	The Strategy should ensure that material assets on the coast, such as walkways, residential/commercial areas in Avonmouth, Pill, Shirehampton and Bristol are not compromised as a result of flooding.	
Soil / water	There is the potential for contamination within the study area (e.g. the Avonmouth / Portbury Docks area of Reach 1) which may have adverse effects on water quality if this is released into the environment.	Protect and / or enhance soil and water quality?
	Reach 2: There is an area of Grade 2 (Very good) quality agricultural land to the east of Pill	
	Significant areas at risk of tidal and coastal flooding.	
	The implementation of The Strategy should ensure that the current situation is not exacerbated and should seek to improve the status of the water bodies where appropriate.	
	The Strategy should not affect abstraction sources.	
~~Air~~	~~Reach 3 is located within an AQMA. The Strategy should ensure that the current situation is not exacerbated.~~	Air quality is unlikely to be significantly affected by flood risk management options. Potential effects on air quality are likely to be limited to short term and temporary effects during the construction phase of engineered flood defences and more appropriately dealt with as part of an environmental impact assessment accompanying a planning application.
Climatic factors	In addition to flood risk management, the Strategy should facilitate the implementation of solutions which support further aspects of climate change adaptation, including linked to the urban heat effect, potential effects on biodiversity and water resources.	Adapt development to the impacts of climate change, ensuring that new development does not contribute to increased risk of flooding for existing property and people elsewhere? Encourage / enable low-carbon energy use / production?
	Where possible, low carbon solutions to flood risk issues should be considered to support climate change mitigation.	
	Given that much of the area is coastal, sea level rise is a serious concern as many identified assets are at risk of flooding.	

SEA topic	Key issues	SEA objective (proposed). Will the Strategy:
Cultural heritage, including architectural and archaeological heritage	The preservation or enhancement of the existing character and setting of cultural heritage assets.	Protect, maintain and/or enhance cultural heritage resources, including its heritage assets, archaeological assets and their setting?
	The preservation or enhancement of the appearance of cultural heritage assets, conservation areas, and nationally and locally listed buildings.	
	The conservation and enhancement of local archaeological remains.	
	There are a number of Listed Buildings in Bristol which are located in close proximity to the River Avon are therefore vulnerable to flooding. They could also be impacted by the implementation of the Strategy if the defence is in close proximity to residential areas.	
Landscape	Inappropriate design and layout may deteriorate the landscape or visual amenity, and also has the potential to prevent access to existing areas.	Protect and / or enhance landscape character and townscape quality?

16. SEA METHODOLOGY

16.1 General approach

The assessment will identify and evaluate the 'likely significant effects' of the preferred approach to the Strategy and any reasonable alternatives on the baseline, drawing on the topics and issues identified through scoping.

Given uncertainties over precisely how the Strategy will be implemented in practice, there is inevitably a need to make assumptions to facilitate SEA, e.g. in relation to detail of the final schemes and the timescales for their delivery (and their effect on an evolving baseline).

Assumptions will be made cautiously, and explained within the assessment. The aim is to strike a balance between comprehensiveness and conciseness/accessibility for the benefit of the non-specialist reader. In many instances, given reasonable assumptions, it is not possible to predict 'significant effects', but it is nevertheless possible to comment on the merits (or otherwise) of the draft Strategy in more general terms.

It is important to note that effects are predicted taking account of the criteria presented within Schedule 1 of the SEA Regulations. So, for example, account is taken of the probability, duration, frequency and reversibility of effects as far as possible. Cumulative effects will also be considered, i.e. the potential for the Strategy to impact an aspect of the baseline when implemented alongside other plans, programmes and projects. These effect 'characteristics' are described within the assessment as appropriate.

In terms of 'scoring' the outcomes of the assessment, it is not proposed to use a 'summing' approach or weighted scoring. Guidance (for Water Resource Management Plans) sets out that "*SEA is a qualitative process. Its outputs are often based on qualitative judgements of the significance of varying types of impacts on different receptors. Such impacts are not readily convertible to numeric indicators and as such may not be directly integrated into the options appraisal process alongside other criteria such as cost or risk, which are more numeric. A system which attempts to aggregate qualitatively assessed impacts runs the risk of implying that two environmental impacts are necessarily greater than one, and that beneficial impacts*

on one receptor can compensate for adverse effects on another. In reality this is not the case…"[118]

The assessment of the Strategy will be guided by an assessment of the 'broad implications' of the proposals within the Strategy. The proposed scale for this assessment is set out below.

↗	Positive implications.
✖	No / negligible implications.
↘	Negative implications.
?	Uncertain implication
N/A	No link to topic

It is important to note that these symbols are not used to indicate significant effects. Effects are identified in the narrative text though being underlined or for significant effects are underlined and recorded in bold text coloured **red** for negative and **green** for positive.

The assessments will be set out in a table format. An example has been provided in **Table 16-1**.

The assessment methodology has been informed by, and viewed to be compatible with, other assessments being undertaken for the Strategy. In terms of the spatial scope of the assessment, it is proposed that the assessment is subdivided into each reach, then amalgamated to consider the overall effect of the strategy. The timeframe of the assessment will be across the three epochs identified in the Baseline review i.e.2015 - 2030, 2030 – 2065, and 2065 – 2115. It is recognised that predicting effects across this timescale will be a change and therefore uncertainty has been built into the assessment framework.

16.2 Structure of the Environmental Report

The SEA Regulations (Schedule 2) sets out the requirements for an environmental report. The environmental report will address the requirements of the SEA Regulations by answering four questions:

1. What's the scope of the SEA?
    a. Parameters must be established through a 'scoping' process to include review of the environmental context / baseline; analysis of key issues / objectives; and consultation.
2. What has the development of the Strategy / SEA involved up to this point?
    a. Preparation of the draft Strategy must have been informed by an earlier stage of SEA and, in particular, 'reasonable alternatives' must have been assessed. 3.
3. What are the SEA findings at this stage?
    a. i.e. in relation to the draft Strategy.
4. What happens next (including monitoring)?

This environmental report will be divided into four sections, one addressing each question. An example table of contents is set out below:

- Introduction
- Background
- SEA explained
- Structure of this environmental report

Section 1: What's the scope of the SEA?

- What is the Strategy seeking to achieve?
- What's the 'context'?
- What's the sustainability 'baseline'

[118] Cascade Consulting (2012) *Strategic Environmental Assessment and Habitats Regulations Assessment – Guidance for Water Resources Management Plans and Drought Plans.*

- What are the key issues / objectives that should be a focus of SEA?

Section 2: What has strategy-making / sea involved up to this point?

Assessment of shortlisted options, likely to include:

- Low defences
- High defences
- Wide Tidal Barrier
- Narrow Tidal Barrier
- Property Level protection and temporary defences
- Do Minimum

Section 3: What are the SEA findings at this stage?

- Methodology
- Biodiversity, flora and fauna
- Population, human health and material assets
- Soil and water
- Climatic factors
- Cultural heritage
- Landscape
- Cumulative and synergistic effects

Section 4: What are the next steps (including monitoring)?

- Strategy finalisation and adoption
- Monitoring

Table 16-1: Example assessment table

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
				ST	MT	LT				
Biodiversity, flora and fauna	Reach 1									
	Reach 2									
	Reach 3									
Population, human health and material assets	Reach 1									
	Reach 2									
	Reach 3									
Soil and water	Reach 1									
	Reach 2									
	Reach 3									
Climatic factors	Reach 1									
	Reach 2									

SEA objective	Plan area	Broad implications of the	Direct / indirect impacts	Temporal scope			Geographic extent	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
	Reach 3									
Cultural heritage	Reach 1									
	Reach 2									
	Reach 3									
Landscape	Reach 1									
	Reach 2									
	Reach 3									
Summary comments: **Recommendations / mitigation:**										

17. NEXT STEPS

SEA scoping (the current stage) is the first stage in a four-stage strategy-making / SEA process (see **Figure 17-1**). The scoping report is the main output at this initial stage.

Figure 17-1: The four stage SEA process

The next stage (Stage 2) will involve appraising 'reasonable alternatives' for a range of options and feeding back findings so that they might be taken into account when preparing the draft Strategy.

Once the draft Strategy has been prepared it will be subjected to SEA and an environmental report prepared.

The environmental report is required to contain a range of specified information, essentially: 1) an appraisal of the draft Strategy and reasonable alternatives, 2) 'outline reasons for selecting the alternatives dealt with'; and 3) other information including a summary of the SEA scope and a description of 'measures envisaged for monitoring'.

The purpose of providing this information in the environmental report is to inform both a) those who might want to comment on the draft Strategy approach / alternatives; and b) those tasked with finalising the Strategy.

Subsequent to consultation on the draft Strategy the strategy will be finalised. At the time of 'adoption' an 'SEA Statement' will be prepared. The role of the SEA Statement is essentially twofold:

1. It must bring the story of strategy-making / SEA up to date. Whereas the environmental report must only explain the reasons behind selecting the draft Strategy approach subsequent to a consideration of alternatives, the SEA Statement must also explain the reasons behind decisions taken subsequent to the consultation on the draft Strategy (and the influence of the environmental report).
2. It must present 'measures decided concerning monitoring' (as opposed to the environmental report, which must present only 'measures *envisaged* concerning monitoring').

17.1 Consultation on the scoping report

Public involvement through consultation is a key element of the SEA process. The SEA Regulations require consultation with statutory consultation bodies but not full consultation with the public at the scoping stage.

The statutory consultation bodies are the Environment Agency, Historic England, and Natural England. The scoping report has been released to these three statutory consultees in addition to the Marine Management Organisation given the nature of the issues in the Seven Estuary and the emerging South West Inshore Marine Plan.

Consultees are invited to comment on the content of this scoping report, in particular the evidence base for the SEA, the identified key issues and the proposed SEA Framework. Please see **Box 17-1** for guidance on responses.

Box 17-1: Guidance for responses

In particular we would welcome comments to the following points:

1. Does the scope of policy context adequately address the scope of the Strategy?
2. Does the scope of the baseline assessment adequately address the scope of the Strategy?
3. Does the SEA framework provide a suitable way to assess the likely significant effects of the Strategy?
4. In terms of plans and programmes that should be considered as part of the cumulative effects assessment, are there any significant ones that should be considered?

Where you can 'fill' data or context gaps, could you please provide wither a weblink or electronic versions of the documents.

This consultation period runs for five weeks from 26 May 2016 until 30 June 2016.Comments on the scoping report should be sent to:

jason.drummond@aecom.com

All comments received on the scoping report will be reviewed and will influence the scope of the SEA where appropriate.

APPENDIX A FLORA AND FAUNA DETAILS

Bird Species Recorded in Reach 1

The following bird species which are all Schedule 1, Red or Amber listed were recorded in the data search within the Reach 1 Study Area: starling (*Sturnus vulgaris*), whinchat (*Saxicola rubetra*), lesser back-backed gull (*Larus fuscus*), black-headed gull (*Chroicocephalus ridibundus*), common sandpiper (*Actitis hypoleucos*), dunlin (*Calidris alpina*), green woodpecker (*Picus viridis*), house martin (*Delichon urbicum*), house sparrow (*Passer domesticus*), kingfisher (*Alcedo atthis*), little grebe (*Tachybaptus ruficollis),* kestrel (*Falco tinnunculus*), mallard (*Anas platyrhynchos*), meadow pipit (*Anthus pratensis*), peregrine falcon (*Falco peregrinus*), redshank (*Tringa totanus*), redwing (*Turdus iliacus*), swallow (*Hirundo rustica*), water rail (*Rallus aquaticus*), willow warbler (*Phylloscopus trochilus*), shelduck (*Tadorna tadorna*), lapwing (*Vanellus vanellus*), reed bunting (*Emberiza schoeniclus*), bullfinch (*Pyrrhula pyrrhula*), herring gull (*Larus argentatus*), curlew (*Numenius arquata*), dunnock (*Prunella modularis*), bullfinch (*Pyrrhula pyrrhula*), linnet (*Carduelis cannabina*), song thrush (*Turdus philomelos*), oystercatcher (*Haematopus ostralegus*), teal (*Anas crecca*), cormorant (*Phalacrocorax carbo*), swift (*Apus apus*), common gull (*Larus canus*), skylark (*Alauda arvensis*) and grey wagtail (*Motacilla cinerea*)

The data search also returned addition records of the following birds outside of the Reach 1 Study Area but within close proximity: green woodpecker (*Picus viridis*); mute swan (*Cygnus olor*); grasshopper warbler (*Locustella naevia*); yellowhammer (*Emberiza citrinella*); black redstart (*Phoenicurus ochruros*); stonechat (*Saxicola torquata*); snipe (*Gallinago gallinago*); ringed plover (*Charadrius hiaticula*); bar-tailed godwit *(Limosa lapponica*); Leach's petrel (*Oceanodroma leucorhoa*); great skua (*Stercorarius skua*); little gull (*Larus minutus*); barn owl *(Tyto alba*); turnstone (*Arenaria interpres*); Mediterranean gull (*Larus melanocephalus*); knot (*Calidris canutus*); Cetti's warbler (*Cettia cetti);* stock dove (*Columba oenas*); gadwall (*Anas strepera*); wigeon (*Anas penelope*); whimbrel (*Numenius phaeopus*).

Bird Species Recorded in Reach 2

Records of birds which are Schedule 1, Red or Amber listed within the Reach 2 Study Area are listed below: shelduck; cormorant; mallard; kestrel; redshank; black-headed gull; house martin; meadow pipit; starling; house sparrow; bullfinch; song thrush; dunnock; herring gull; common gull; swift; willow warbler; reed bunting; skylark; grey wagtail; curlew; lapwing; common sandpiper; dunlin; green woodpecker; redwing; water rail; sand martin (*Riparia riparia*); swallow; oystercatcher; stonechat; teal; stock dove; tufted duck; linnet; lesser black-backed gull; black-headed gull; snipe; mute swan; great black-backed gull; whimbrel; marsh tit (*Poecile palustris*); yellowhammer; goldcrest (*Regulus regulus*); goldeneye (*Bucephala clangula*); greenshank (*Tringa nebularia*); Mediterranean gull; ruff (*Philomachus pugnax*); spotted redshank; wigeon; barn owl; kingfisher; crossbill (*Loxia curvirostra*); ringed plover; peregrine falcon; mistle thrush (*Turdus viscivorus*); hawfinch (*Coccothraustes coccothraustes*); and goshawk (*Accipiter gentilis*).

Bird Species Recorded in Reach 3

Records of Schedule 1, Red or Amber listed birds are listed: barn owl; black redstart; black-headed gull; bullfinch; common gull; common sandpiper; cormorant; dunnock; fieldfare (*Tuurdus pilaris*); goldcrest; grasshopper warbler; great northern diver (*Gavia immer*); green woodpecker; grey wagtail; greylag goose (*Anser anser*); herring gull; house martin; house sparrow; jack snipe (*Lymnocryptes minimus*); kestrel; kingfisher; lapwing; lesser black-backed gull; lesser redpoll (*Carduelis cabaret*); linnet; little egret (*Egretta garzetta*); little grebe; mallard; marsh tit; meadow pipit; Mediterranean gull; mistle thrush; mute swan; oystercatcher; peregrine; red kite (*Milvus milvus*); redshank; redwing; reed bunting; sand martin; skylark; snipe; song thrush; starling; stock dove; swallow; swift; teal; whinchat; wigeon; willow warbler; yellow wagtail (*Motacilla flava*); and yellowhammer.

APPENDIX B CONSERVATION AREA ENHANCEMENT OBJECTIVES

Conservation Area	Enhancement Objectives
Clifton	(1) An environmental traffic management and parking scheme including provision for cyclists needs to be prepared in conjunction with the Highway Authority. (2) The introduction of traffic calming measures, although desirable, must be of a very high quality and in materials traditional to the historic floorscape of the area. (3) Research to the problems of congestion and parking will need to consider the use of traditional bollards and protective street furniture to protect traditionally paved pedestrian footways. (4) To ensure the retention of existing residential use and restrict further office intrusion. (5) To protect the remaining garage areas within the Conservation Area, as a means of taking pressure off on-street parking pertinent throughout the area. As an interim measure, it is proposed that further planning permission on garage areas will be resisted. (6) Conversion of historic buildings should only be allowed where a full survey or audit of the building identifying all the historic features of interest has been submitted to the Planning Authority and agreement reached on their retention and restoration. (7) Conversion of historic buildings into flats should pay respect to the traditional layout and arrangement of internal partitions and staircases. Excessive density resulting in loss of major or principal rooms or resulting in destruction of staircases, or other major historic features will be resisted. With Listed Buildings, Conservation Principles P24 and P25 will apply. (8) Extensions to historic buildings should pay due attention to the City Council's Conservation Policy Handbook, page 10, Extensions and Alterations to Traditional Buildings Within Conservation Areas, Principles P11–P19. (9) To protect existing shopping uses within the Regent Street/Victoria Street/ Mall Area. (10) The City Council's policies relating to the retention of original features, traditional materials and the character of finishes and garden settings are particularly relevant to the Clifton townscape and will be applied (Policies B17, B22 and B23). (11) The Clifton Conservation Area should be continually monitored within the Buildings At Risk Survey, as set out by English Heritage and in operation in the Inner and Central Conservation Areas. 5. CLIFTON BRISTOL LOCAL PLAN 23 (12) Terrace decks, their maintenance and repair, are seen as a major cost burden on individual owners. It is proposed to seek grants from English Heritage to assist in these circumstances. (13) The Underground Room Regulations, a Bristol Local Act should be reassessed and requirements more sensitively tailored to address problems of conservation and traditional character. (14) In respect of Clifton and its particular quality and character, gardens, means of enclosure and traditional railings are particularly vital. The City Council's Principles P33, P34, and P36 will apply with special emphasis on retention of gardens and reinstatement or repair of traditional means of enclosure. (15) As with Terrace Docks, the traditional architectural edges (rails, walls, plinths, etc.) to the historic shared gardens in Clifton are a major financial obligation on their owners or those responsible for maintenance. It is proposed to seek grants from English Heritage to assist in these circumstances. (16) Owners of large historic buildings and gardens need to be encouraged to regularly review their properties and develop a system of continual professional maintenance and repair. The City Council will seek to encourage better management by these owners. (17) The extensions to large historic buildings or new buildings within historic gardens will be carefully considered within the Conservation Area and particular emphasis will be placed on the retention of open space and historic gardens. (18) As an area containing many high quality cast iron feature street furniture, particular attention will be paid to the City Council's Conservation Principle P37 and its related description paragraph 10. (19) Original paving materials will be retained in accord with the City Council's Revised Policy integrated with its Conservation Principles P38 and P39. In addition the city will seek to upgrade key historic streets and settings with the 450 x 450 x 70 mm concrete paving slab and encourage the use of other high quality materials. (20) The northern and western downland and gorge settings to the Conservation Area are an essential

	feature to retaining the urban/rural contrast of Clifton. They are recognised as an important visual edge to Bristol and development weakening or downgrading this attractive feature of Clifton's evolution will be strongly resisted. (21) The City Council will seek to encourage a more managed approach to maintenance of the woodland fringes and feature trees within this outstanding Conservation Area, and look to a continual programme of replanting together with the Civic Society and Clifton and Hotwells Improvement Society. This programme needs to address the relationship between historic building groups, views across the Conservation Area and the development of management in a landscaped urban environment.
City Docks	(1) On Hotwells Road, Cumberland Road and Coronation Road an environmental traffic management scheme, including provisions for cyclists, needs to be prepared in conjunction with the Highway Authority, balancing out the needs of cyclists, pedestrians, public transport, service vehicles, as well as through-traffic. (2) This scheme should promote pedestrian safety by the introduction of pedestrian crossings linking the harbourside to residential areas. (3) The scheme should also include upgrading and possible widening to pavements, provision of attractive traditional street furniture. (4) Pedestrian access from the south to the centre and dockside areas needs to be improved, and a policy promoting access across the waterway developed. (5) Consideration needs to be given to conserving the principal historic buildings characterising the historic docks area. (6) New development needs to be assessed in reference to its historic context, retention of existing views, and its character relating to the forms and materials utilised in the traditional dockside areas. (7) Where leisure uses are proposed, development should assist in the conservation of buildings and enhancement of the Conservation Area. (8) Within any proposals for improvement or development in the Conservation Area, the retention and preservation of the traditional quay walls, quays themselves, original dock furniture and industrial machinery adjacent to the area must form part of the intended scheme. (9) The form and massing of intended development should enhance and retain principal views. (10) Pedestrian access and walkways will form part of any development proposals to an agreed development framework. (11) An environmental landscape framework for the area needs to be developed which identifies opportunities for areas of soft landscaping.
Bower Ashton	(1) An environmental traffic management scheme, including provision for cyclists, needs to be prepared in conjunction with the highway authority. This should address the issue of 'rat-running' in Clanage Road and restricting traffic through the village when there are major events at Ashton Court. (2) New uses for the estate buildings should not lead to over-development and seek to resolve problems of re-using derelict or under-maintained historic buildings. New buildings should also complement the scale and character of the rural and residential environment, and should conform to the City Council's Conservation Principles P2–P10. (3) The City Council will apply Principles P11–P19 in the Conservation Handbook to extensions and alterations to traditional buildings within the Conservation Area. (4) To retain the character of the area of large houses in large plots, subdivision or infill of garden plots will normally not be permitted. Conservation Principle P33 will apply (5) A landscape management plan needs to be prepared in conjunction with the Leisure Services Directorate which includes the following:– (i) screening and tree planting to Ashton Road; (ii) a special landscaping scheme to the roundabout at the junction of Ashton Road and Clanage Road; (iii) screening and planting around the two educational establishments; and (iv) planting to break-up the sportsfield areas. (6) Any development of the open pastureland forming the traditional setting and lying within the historic curtilage of Ashton Court will be resisted.
Bedminster	(1) The Conservation Area boundary needs to be reassessed in the light of the good quality of much of the local area of Southville, North Street and East Street. In addition, the small strip abutting Coronation Road should have the same policies of this Conservation Area and therefore be included within its boundaries. (2) An environmental traffic management scheme, including provision for cyclists, needs to be prepared in conjunction with the Highway Authority. This should address the issue of diverting the principal traffic

	from York Road to Clarence Road and reducing volumes of traffic in Bedminster Parade. (3) As part of the management scheme, a study should be prepared of the car parking and access problems of Bedminster Parade. (4) Policies need to take into account the need to encourage reinvestment in the area, targeted at the refurbishment of the built environment. (5) Policies aimed at encouraging reinvestment in the shopping streets should also aim to improve their physical state and appearance. (6) A strategy needs to be devised to encourage the reuse of the upper floors above shops. (7) The role of contribution that vacant and derelict backland areas could make to enable investment in frontage buildings needs to be investigated and a strategy devised to encourage development and refurbishment. (8) Conversion into flats within the area should take account of the adverse effect of too much car parking and destruction of original features of the traditional buildings. Conservation Principle P33 should apply. (9) Guidance and liaison needs to be put in hand to address the problem of erosion of features which constitute the character of buildings. Conservation Principle P14–P19 should apply. (10) Policies will need to be devised to ensure the protection and suitable use to preserve and enhance the green corridor along the New Cut. This should include the re-establishment of practical connections between the New Cut and Coronation Road and York Road. (11) A brief needs to be prepared for the north end of Bedminster Parade to seek ways and means of reducing traffic intrusion and creating enclosure to enhance this important entrance to the Conservation Area.
Redcliffe	(1) An environmental traffic management and parking scheme including provision for cyclists needs to be prepared in conjunction with the Highway Authority, as part of an overall management scheme for the city centre. (2) This should include provision to downgrade the use of Redcliffe Way and Redcliffe Hill as major traffic routes and enlarge their use by pedestrians and cyclists. Enhancement of the setting to St. Mary Redcliffe will form a priority within this Conservation Area. (3) Resolution of the problems of congestion and parking will need to consider the use of bollards and protective street furniture to protect pedestrian footways. (4) Improved pedestrian access and walkways will need to form part of any development proposal. (5) A policy to upgrade the visual quality of the bridges over the Floating Harbour needs to be evolved, including greater emphasis on pedestrian links at key locations. (6) Where office development is proposed, this should assist in refurbishing priority groups of derelict historic buildings within the area. (7) New development needs to be assessed in reference to its historic context, and its character in enhancing the forms and materials utilised in the traditional dockside, and urban street context. (8) Within the Conservation Area, the Conservation Handbook Principles appropriate to historic buildings conservation will apply (P11–P19) and within the Redcliffe small enterprise park. (9) To combat the loss of diversity and vitality along Victoria Street. (10) Along the harbourside any proposals for improvement or development will need to retain and preserve the traditional quay walls and quaysides where appropriate, and maintain the traditional use of pennant stone as part of the essential character of this Conservation Area. (11) Replacement of unsympathetic post-war development with buildings reinstating the traditional street character with appropriate ground floor uses will be promoted. (12) To ensure retention of existing residential use and promote further provision. (13) As part of a wider strategy, to improve priority streets into the city centre, particularly Victoria Street and Redcliffe Way.
City and Queen Square	(1) An environmental traffic management and parking scheme, including provision for cyclists, needs to be prepared in conjunction with the Highway Authority as part of an overall management scheme for the city centre. (2) This scheme should promote the diversion of through traffic away from the principal historic streets and spaces, incorporate the use of traditional features such as bollards to protect and enhance pedestrian footways and reinstate traditional paving materials and setted ways.

	(3) Pedestrian routes will be protected and extended where practical. The intrusive influence of vehicles in the area need to be assessed and reduced within the proposed traffic management scheme. (4) To maintain diversity and vitality of frontages in this area. (5) To ensure retention of existing residential use and promote further provision. (6) To protect and enhance St. Nicholas Market. (7) To prevent monolithic office incursion on the quaysides. (8) The design guidelines identified within the Local Plan (Policies B1–B27) and the Conservation Policy Handbook will seek to ensure development enhances the future aspect of the Conservation Area, in respect of height, scale and historic street pattern. (9) In conjunction with the City Valuer, new leases will include advice and encouragement for owners and leases to produce a proper management plan. (10) The extent and use of the mediaeval cellarage needs to be established. A strategy for encouraging enhancement, new uses and public access should be prepared. (11) To protect surviving historic paving materials within the area, Principles P38, P39, Pavement and Carriageways within the City Council Conservation Handbook will apply. (12) To restore the original layout of Queen Square, a priority public space project for the area is being prepared in conjunction with the Highway Authority. (13) Policies will be prepared in conjunction with the Highway Authorities and the Utilities to co-ordinate and improve the provision of appropriate street furniture.
St James' Parade	(1) Planning briefs will need to be prepared as appropriate for existing and potential development sites which:– (i) discourage extensive surface parking areas; (ii) protect existing residential uses and encourages additional residential uses. (iii) promote appropriate secure uses for the existing church buildings and ensure their continuing maintenance and repair. (iv) require sympathetic development which re-weaves the frontage of St. James' Parade and enhances the approach to the Priory Church. (2) A scheme for the pedestrianisation and enhancement of Canon Street will need to be prepared. 27. (3) The western element of the St. James' Park is run down and under-used. An overall enhancement scheme, especially for the western element, needs to be prepared to upgrade and improve the attractiveness of this potential opportunity for quiet recreation. (4) The use of pennant stone within walls and traditional buildings is essential to the character of the area and these elements should be retained, maintained and if possible extended in any new development.
Kingsweston and Trym Valley	(1) An environmental landscape management scheme needs to be prepared, emphasising provision for cyclists and pedestrians, in conjunction with the Highway Authority. This should address the need to relate improvements to the estate roads to the historic landscapes of which they form an important element. (2) The insertion of new residential units within the Conservation Area on land forming part of the original estates of Kingsweston and Blaise Castle will be resisted as detrimental to the character and reducing the landscape component of the area. Preservation of the landscape is seen as the principal objective within this Conservation Area. (3) Encouragement will be given to the integration of existing car parks into the landscape through the use of screening typical to the locality to enable a more harmonious relationship with the rural character of the area. (4) Where new car parking is being considered this should be designed to be integrated into the landscaping and utilise planting and materials traditional within the Conservation Area. (5) New uses for the estate buildings should not lead to over-development and should seek to resolve problems of reusing derelict or under-maintained stone buildings. New buildings should also complement the scale and character of the rural and residential environment and should conform to the City Council's Conservation Principles P2–P10. (6) The City Council will apply Principles P11–P19 in the Conservation Handbook to extensions and alterations to traditional buildings within the Conservation Area. (7) A landscape management plan needs to be prepared in conjunction with the Leisure Services Directorate and other interested parties for the estates in public ownership. This will need to address the retention and replenishment of the estate grounds and their continuing maintenance and upkeep. Any development of the open pastureland forming the traditional setting to the estates or included within the estates themselves and framing the principal views will be resisted. A strategy for encouraging clearly delineated access into the area needs to be devised, and should include a comprehensive

	signposting system. (8) As part of a management plan provision will need to be made for the maintenance, clearance and repair of the traditional footpaths within the estates. (9) It will be expected that the traditional stone boundary walls to fields, roads and general curtilages will be retained and repaired. (10) The outstanding contribution of the historic landscape and parkland is made up from a number of contributions such as follies, drives, watercourses and lodges. It is essential that these are retained, improved and given adequate maintenance. The City Council will give encouragement to schemes which will achieve this objective. (11) The City Council in September 1988 adopted a set of policies relating to an extension of the Conservation Area to include Coombe Dingle. These policies are set out in Section 4 in a separate document 'Proposed Extension, Coombe Dingle' which will apply as part of the General Enhancement Policies for this section of the Conservation Area.
Sea Mills	(1) An environmental traffic management and parking scheme, including provision for cyclists, needs to be prepared in conjunction with the Highway Authority. This scheme should consider traffic calming and additional pedestrian crossing points in Shirehampton Road. Consideration should also be given to creating designated parking areas within streets and spaces. (2) A study should be undertaken to identify properties where front garden parking may be acceptable. Associated with this study should be the production of a design guide which stipulates criteria for the creation of hardstandings, materials, landscaping and means of enclosure including hedges. (3) The redevelopment of areas of open land which contributes to the character of the Conservation Area to residential use will be resisted. However, a study should be undertaken to identify those areas of open land which no longer serve a useful purpose for recreational or leisure activities, and which could be developed for residential purposes without harming the character or appearance of the Conservation Area. (4) A strategy relating to the future use, enhancement and management of the recreation ground and tennis courts should be prepared in conjunction with the residents, the Housing and Leisure Services Directorates. (5) The layout, form and appearance of replacement or new houses will need to be sympathetic to the traditional building pattern of the Conservation Area. (6) The City Council will apply Principles P11–P29 in the Conservation Handbook to extensions and alterations to traditional buildings within the Conservation Area. (7) Consideration will be given to the declaration of an Article 4 Direction to bring some of the unsympathetic alterations currently undertaken by residents to their houses, under planning control. (8) A landscape management plan needs to be prepared with residents, the Housing and Leisure Services Directorates on the enhancement of existing open spaces and greens, and the maintenance and replacement of street trees.
Sneyd Park	(1) Sub-division of large gardens will only be considered in those parts of the Conservation Area where the character and pattern of development will not be significantly affected. (2) A study will need to be undertaken to identify properties where sub-division of large gardens may be appropriate. (3) A study will need to be undertaken to identify those areas of open land where development for residential use may be appropriate. (4) The City Council will resist the demolition of original large detached houses in this Conservation Area, as they are essential to the character and appearance of the area. (5) The layout, form, design, landscaping and means of enclosure in new residential developments in the Conservation Area needs to respect the traditional forms characteristic of the area. (6) The City Council will oppose the development of open land in the Avon Valley and Avon Gorge. Elsewhere development of open land will only be permitted in those areas where the character of the Conservation Area will not be harmed. (7) Non-residential uses out of character with the area will be resisted.
The Downs	(1) An environmental traffic management scheme, including provision for cyclists, needs to be prepared in conjunction with the Highway Authority. This should address the issue of over use of the peripheral routes to the Downs and encourage more protected pedestrian and cyclist movement through the spaces.

	(2) As part of the Management Scheme, a study should be prepared investigating the possibility of restricting vehicular use of the principal roads at certain times such as weekends and bank holidays. (3) The effect of Park and Ride, in ameliorating over-intensive use by vehicles, especially at the Suspension Bridge should be assessed in conjunction with the Traffic Management scheme as set out in (1) above. (4) The Downs Edge and its related gardens is particularly sensitive as it makes a significant contribution to the expansive and sylvan quality of the space. Any car parking which intrudes by being visible from the Downs and its related footpaths will be resisted. In this case, the City Council's Conservation Handbook Principle P33 will be applied. (5) Where conversion of large dwelling houses into flats results in a significant increase in car parking provision and acts detrimentally to the quality of the open landscaping in the Conservation Area, it will be resisted. (6) The intensification with residential use of landscaped gardens to older dwelling houses will be resisted. (7) An audit of significant items of street furniture of historic interest needs to be prepared within the Conservation Area and their maintenance and repair should be encouraged on a regular basis. (8) A landscape management scheme needs to be prepared in conjunction with the Leisure Services Directorate to ensure the continuing well maintained open spaces and ensure re-establishment of any trees which have been lost or need replacing. (9) Particular groups of significant villas and large Victorian buildings rely for their effect on a range of quality materials, i.e. natural lias and pennant, rubble and dressed stone. This extends to their outbuildings and boundary walls. This character will be strengthened, maintained, and original features retained and repaired.

Appendix B: Consultation Responses

Public involvement through consultation is a key element of the SEA process. The SEA Regulations require consultation with statutory consultation bodies but not full consultation with the public at the scoping stage.

The following statutory consultation bodies were invited to comment on the Scoping Report:

- **Environment Agency (EA);**
- **Historic England;**
- **Natural England; and**
- **Marine Management Organisation (MMO).**

No comments were received from Historic England, Natural England or the MMO. The comments received from the EA are provided in Table B1, as well as AECOM's response to each of the comments.

Table B1: EA Comments on SEA scoping report along with a response from AECOM

Section	EA comment	Where this will be addressed in the Environmental Report.
<u>In-combination effects</u>	"The report suggests that it will aim to discuss the interrelationship between each of the receptors discussed but I can't seem to see this anywhere in the report. I appreciate it's quite difficult to do this, but this really is an important part of the assessment and shouldn't be discounted."	This will be addressed in the Environmental Report when the preferred option is known
<u>Scoping Environmental Issues</u>	"Chapter 15 – This particular section doesn't seem to use the baseline data collected to robustly justify why a receptor is scoped in/out. The key issues mentioned don't appear to mirror those used to conclude each chapter and the objectives which are drawn out of these (Table 15-1) could be far stronger. E.g. the objective drawn out for 'Biodiversity, flora and fauna' could be stronger. Whilst I appreciate this is a high level, we actually know enough about the baseline environment to perhaps commit to more specific objectives than "protect and enhance biodiversity" – what about achieving compliance, maintaining fish passage etc. This is just an example, similar thoughts on other parts of the table	AECOM have refreshed the table and the evidence base to ensure consistency It is considered that the 'key issues' identified along with the overarching objective provides a suitable framework for assessment of The Strategy. This is highlighted in the Scoping Repot text. "*The assessment will use the objectives as an overarching structure. This will be augmented by the key issues identified."*

	too."	
	"A better understanding/explanation of what is driving the need for the SEA e.g. what triggered its requirement."	**Included in Environmental Repot**
Biodiversity, Flora & Fauna	**"Estuarine designations (SPA, SAC, Ramsar) – it is important to note that your assessment MAY needs to consider the effects of The Strategy on the Somerset Levels and Moors designations as these support each other in that, for example, the same bird species and individuals will utilise both sites across the season. We would imagine that Natural England will flag this in their response too."**	**The Somerset Levels and Moors SPA is over 30 km to the south of the Study Area.** **Birds that use the Severn Estuary SPA may also use the Somerset Levels and Moors since the sites are within 10 km of one another, however it is unlikely that the proposed development could (irrespective of option) affect the bird usage of that site or the movement of birds between the Severn Estuary and Somerset Levels**
	"Opportunity to remove invasive species" – is this realistic? I would advise it's better to just focus on compliance and avoiding the spread as per Schedule 9 of WCA 1981. Removal of invasive in an estuarine environment would be waste of time and money."	**This has been removed from the Environmental Report**
	"Part 5.2 – was baseline data on the Ramsar also obtained?"	**The Ramsar site and European Site have the same boundary**
	"Part 5.2.3 – Fish: Are these the same as in Reach 1? What species?"	**According to the Wildlife Survey and Assessment of the Bristol Docks Estate (2009), it is likely that the New Cut fish population resembles that of the lower reaches of the tidal Avon, comprising a range of species that are essentially estuarine in nature. This information will be added to Appendix A of the Environmental Report**
Population	**"Key issues – "ageing population is likely to put pressure on services, facilities and amenities" – in what way, will The Strategy somehow seek to address this?"**	**By providing high standards of flood defence, services and facilities will be able to be accessed by all including an ageing population.**
	"Was any consideration given to obtaining data on deprived areas – information like this may help to influence The Strategy and give an idea of high priority areas (not sure if this should be in population or human health chapter though?)"	**Yes, but this was discounted as it is not considered that The Strategy would materially be able to affect deprivation (given that the biggest 'lever' is income and it is not clear how this Strategy can influence this.)**
Human Health	**"This appears to discuss everything from obesity, cancer to teenage**	**AECOM have refined the scope to just flooding health effects**

	pregnancy and breastfeeding initiation – what would be more meaningful would perhaps be a brief discussion on mental and physical health impacts of flooding on humans, or baseline data on areas which are considered to be deprived as this may influence how measures are prioritised?"	
Soil	**"Potential for The Strategy to mobilise contamination held in silt banks" – would The Strategy itself do this?"**	**The potential activities suggested through The Strategy have the potential to mobilise contamination during the construction of defences**
Water	**"Was any thought given to achieving compliance under WFD (no deterioration, no prevention of WB's reaching 'good' in future), consideration of mitigation measures associated with HMWB – compliance should be 'key issue' which is drawn out of this chapter?"**	**TBC with WFD assessment**
	"Strategy should not affect abstraction" – do we know at this stage whether these are all legal abstractions though?"	**TBC with WFD assessment**
Climatic Factors	**"I appreciate that sustainability is important, but why wasn't data obtained on the frequency of past flood events, trends in sea level rise etc.?"**	**This information will be included in the Environmental Report**
Archaeology	**"The baseline section provides all the required data needed (both designated and non-designated assets). It provides the relevant policy content, and figures."**	**Noted**
	"The reports will be sufficient to provide early warning of risks when detailed options are made available."	**Noted**
	"In general the document suggests that the overall heritage risk is low and the majority of potential issues would be associated with the setting impacts upon built heritage assets."	**Noted**
Landscape	**"It would be worthwhile making reference to Natural England's "All Landscapes Matter" given that it already makes reference to the ELD"**	**Noted**
	"Going forward, a landscape character	**Noted**

	assessment would be expected to ensure that the protection and enhancement of landscape character is a primary consideration during the Flood Risk management options appraisal and informs the SEA of the final preferred options for The Strategy area."	
	"The results of that study provide the landscape assessment baseline for projects arising from the implementation of The Strategy."	**Noted**

Appendix C: Assessment tables for shortlisted options

Description of Options

Table where option is addressed in Appendix C	Strategic Option ID	Epoch 1 (2015-2030)	Epoch 2 (2030-2065)	Epoch 3 (2065-2115)
Table 1	-	Do Min	Do Min	Do min
Table 2	A	Do Min	Do Min	High Def
Table 3	B	PLP	High Def	High Def
Table 4	C	PLP	Barrier	Barrier
Table 5	D	Low Def	Low Def	High Def
Table 6	E	Low Def	Barrier	Barrier
Table 7	F	High Def	High Def	High Def
Table 8	G	Do Min	Do Min	High Def
Table 9	D1 (Preferred Option)	Low Def	Low Def	High Def

Table 1: Do Min – Do Min – Do Min (baseline for the purposes of SEA)

SEA objective	Plan area	Broad implications without the Strategy	Commentary (likely effects)
Biodiversity, flora and fauna	Reach 1	• Epoch 1, 2 and 3: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. .	The likely evolution of the environment without the Strategy is likely to result in a negative effect on biodiversity, flora and fauna. This will be caused by an increased frequency of flooding up to 2115 as well as increased water depth, water velocity and area covered by flood water. This means that sites of biodiversity value that are at risk of flooding will become more frequently inundated and sites currently not at risk of flooding begin to experience inundation, mainly in Epoch 3 (2065-2115).
	Reach 2	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	The likely evolution of the environment without the Strategy is likely to result in a negative effect on biodiversity, flora and fauna. This will be caused by an increased frequency of flooding up to 2115 as well as increased water depth, water velocity and area covered. This means that sites of biodiversity value that are at risk of flooding will become more frequently inundated and sites currently not at risk of flooding begin to experience inundation, mainly in Epoch 3 (2065-2115). This is likely to be a particular issue in Reach 2 as there are several designated sites within this Reach such as Lamplighters Marsh LNR, Ham Green SSSI, Horseshoe Bend, Shirehampton SSSI, Avon Gorge and Woodlands SAC and SSSI, Leigh Woods NNR and Ashton Court SSSI. Both scenarios may result in a change to the biodiversity value of these sites and a detrimental effect on the conditions of the sites. This latter point could undermine the ability of habitats and species to adapt to the changing climate.
	Reach 3	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	The likely evolution of the environment without the Strategy is likely to result in a negative effect on biodiversity, flora and fauna. This will be caused by an increased frequency of flooding up to 2115 as well as increased water depth, water velocity and area covered. This means that sites of biodiversity value such as Bower Ashton SNCI that are at risk of flooding will become more frequently inundated and sites currently not at risk of flooding begin to experience inundation, mainly in Epoch 3 (2065-2115). Both scenarios may result in a change to the biodiversity value of these sites and a detrimental effect on the conditions of the sites. This latter point could undermine the ability of habitats and species to adapt to the changing climate.
Population, human health and material assets	Reach 1	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	The severity of tidal flooding events is likely to increase; therefore it is likely that fewer material assets including houses and infrastructure will receive adequate flood protection from the current defences, particularly in Epoch 3. This is also likely to have a negative effect on human health due the increase in the risk of flooding and the associated psychological effects flooding causes to people living in high risk areas.
	Reach 2	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	The severity of tidal flooding events is likely to increase; therefore it is likely that less material assets including houses and infrastructure will receive adequate flood protection from the current defences, particularly in Epoch 3. This is also likely to have a negative effect on human health due the increase in the risk of flooding and the associated psychological effects flooding causes to people living in high risk areas.
	Reach 3	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	The severity of tidal flooding events is likely to increase; therefore it is likely that less material assets including houses and infrastructure will receive adequate flood protection from the current defences, particularly in Epoch 3. This is likely to be a particular issue in Reach 3 as the value of the material assets is a lot greater compared to Reach 1 and 2. This is also likely to have a negative effect on human health due the increase in the risk of flooding and the associated psychological effects flooding causes to people living in high risk areas.
Soil and water	Reach 1	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	Under the 'Do Minimum' measure it is likely that the frequency of flooding will increase up to 2115 as well as increased water depth, water velocity and area covered. As such, there may be a negative effect on water quality should any contaminated areas such as roads become inundated by tidal flooding, as contaminants will become mobilised and pathways will be created to waterbodies.
	Reach 2	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	Under the 'Do Minimum' measure it is likely that the frequency of flooding will increase up to 2115 as well as increased water depth, water velocity and area covered. As such, there may be a negative effect on water quality should any contaminated areas such as roads become inundated by tidal flooding, as contaminants will become mobilised and pathways will be created to waterbodies.

SEA objective	Plan area	Broad implications without the Strategy	Commentary (likely effects)
	Reach 3	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	Under the 'Do Minimum' measure it is likely that the frequency of flooding will increase up to 2115 as well as increased water depth, water velocity and area covered. As such, there may be a negative effect on water quality should any contaminated areas such as roads become inundated by tidal flooding, as contaminants will become mobilised and pathways will be created to waterbodies.
Climatic factors	Reach 1	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	No significant effects are predicted as a result of the 'Do Minimum' measure.
	Reach 2	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	No significant effects are predicted as a result of the 'Do Minimum' measure.
	Reach 3	• Epoch 1, 2 and 3: Do minimum - Maintain the existing defence assets and water level control infrastructure and operations.	No significant effects are predicted as a result of the 'Do Minimum' measure.
Cultural heritage	Reach 1	• Epoch 1: Do minimum– not present in Reach 1 in any epoch. • Epoch 2:Do minimum – not present in Reach 1 in any epoch. • Epoch 3:Do minimum – not present in Reach 1 in any epoch.	No significant effects are predicted as a result of the 'Do Minimum' measure.
	Reach 2	• Epoch 1:Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2:Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3:Do minimum – maintain the existing defence assets and water level control infrastructure and operations.	The likely evolution of the environment without the Strategy is likely to result in an increased frequency of flooding up to 2115 as well as increased water depth, water velocity and area covered. This would have a negative effect on cultural heritage as less heritage assets will receive adequate flood protection from the current defences, as a result some cultural heritage assets would become increasingly vulnerable to flooding.

SEA objective	Plan area	Broad implications without the Strategy	Commentary (likely effects)
	Reach 3	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: Do minimum – maintain the existing defence assets and water level control infrastructure and operations.	The likely evolution of the environment without the Strategy is likely to result in an increased frequency of flooding up to 2115 as well as increased water depth, water velocity and area covered. This would have a negative effect on cultural heritage as less heritage assets will receive adequate flood protection from the current defences, as a result some cultural heritage assets would become increasingly vulnerable to flooding.
Landscape	Reach 1	• Epoch 1: Do minimum– not present in Reach 1 in any epoch. • Epoch 2: Do minimum – not present in Reach 1 in any epoch. • Epoch 3: High Defences – not present in Reach 1 in any epoch.	There may be a negative effect on Landscape if the areas affected by flooding are inundated for a long period of time. This may result in a change to the Landscape Character of the area as lakes, pools and ponds are formed.
	Reach 2	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: Do minimum – maintain the existing defence assets and water level control infrastructure and operations.	There may be a negative effect on Landscape if the areas affected by flooding are inundated for a long period of time. This may result in a change to the Landscape Character of the area as lakes, pools and ponds are formed.
	Reach 3	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: Do minimum – maintain the existing defence assets and water level control infrastructure and operations.	There may be a negative effect on Landscape if the areas affected by flooding are inundated for a long period of time. This may result in a change to the Landscape Character of the area as lakes, pools and ponds are formed.

Table 2: Option A (PLP - Low Def - High Def)

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
				ST (2015-2030)	MT (2030-2065)	LT (2065-2115)				
Biodiversity, flora and fauna	Reach 1	• Epoch 1: Property Level Protection – not present in Reach 1 in any epoch. • Epoch 2: Low Defences – not present in Reach 1 in any epoch. • Epoch 3: High Defences – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Property Level Protection – PLP is required on Watch House Road, Pill. • Epoch 2: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 3: High Defences – The Low Defences at Pill and Shirehampton will be upgraded to High Defences. At Pill the Low Defence alignment would also be extended which would bring the northern extent of the alignment adjacent to the Severn Estuary SAC and SPA. At its closest point the Shirehampton alignment will be a minimum of 200 m away from the Severn Estuary SAC and SPA.	• Epoch 1: Property Level Protection – it is considered that the nature of PLP means that there would be no impact on biodiversity, flora and fauna. • Epoch 2: Epoch 2: Low Defences – there would be some impacts caused by the construction of the Low Defences for example disturbance associated with increased noise, dust and vibration through piling. Once operational there should be no impacts on biodiversity, flora and fauna. • Epoch 3: High Defences – there would be an impact on biodiversity, flora and fauna during the construction stage, through disturbance, increased noise and dust levels particularly as the northern extent of the High Defence alignment is adjacent to the European designated site. Once operational there should be no impacts on biodiversity, flora and fauna.	-	✓	✓	City	Temporary	Medium	• Epoch 1: Property Level Protection – it is considered that the nature of PLP means that there would be no effect on biodiversity, flora and fauna. • Epoch 2: Low Defences – construction activities likely to be involved include dredging, piling and excavation. There would be a temporary **negative effect** on the Severn Estuary SPA and SAC in the construction phase as the designated site is in close proximity to the Low Defences. However the effects would be temporary and can be managed through mitigation which will be discussed by the project design team at a later date. • Epoch 3: High Defences – There would be a temporary **negative effect** on the Severn Estuary SPA and SAC during the construction phase as the designated site is adjacent to the High Defences. However the effects would be temporary and can be managed through mitigation which will be discussed by the project design team at a later date. Recommendation: A Habitats Regulations Assessment (HRA) Likely Significant Effect Screening should be undertaken if this option is taken forward to ensure that there are no significant environmental effects caused by this option.
	Reach 3	• Epoch 1: Property Level Protection – PLP is required in locations at Totterdown (Victoria Road), Albert	• Epoch 1: Property Level Protection – it is considered that the nature of PLP means that there would be no impact on		✓	✓	City	Temporary	Medium	• Epoch 1: Property Level Protection – no effects in terms of biodiversity, flora and fauna are expected as a result of this

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
		Road and Bath Road. • Epoch 2: Low Defences – Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: High Defences – the Low Defences along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road will be upgraded to high defences. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. In addition, High defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	biodiversity, flora and fauna. • Epoch 2: Low Defences – there would be some impacts associated with the construction of the Low Defences for example disturbance associated with increased noise, dust and vibration through piling. Once operational there will be no impacts on biodiversity, flora and fauna. • Epoch 3: High Defences – construction activities such as dredging, piling and excavation would result in temporary negative impacts such as disturbance, increased noise and dust levels.							measure. • Epoch 2: Low Defences – the effects on biodiversity, flora and fauna are likely to be **negative** during the construction phase. Construction activities likely to be involved include dredging, piling and excavation. In Reach 3 there are no areas in close proximity (e.g. 200 m) designated for their biodiversity value. However, there are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). These European protected species are likely to use the river corridor and will need to be considered in the detailed planning stage. Negative effects would be managed through project level mitigation. • Epoch 3: High Defences – no significant effects are predicted (see Epoch 2). Recommendation: The piling construction works should be future proofed to take into account the increased piling depths required for future high defences.
Population, human health and material assets	Reach 1	• Epoch 1: Property Level Protection –– not present in Reach 1 in any epoch. • Epoch 2: Low Defences – not present in Reach 1 in any epoch. • Epoch 3: High Defences – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Property Level Protection – PLP is required on Watch House Road, Pill. • Epoch 2: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 3: High Defences – along the River Avon High Defences are required at Pill and Shirehampton.	• Epoch 1: Property Level Protection – flooding can result in negative impacts on both physical and psychological health. This measure will reduce tidal flood risk to properties with the most significant risk and therefore this measure would have a positive impact on the health of people living in these properties. • Epoch 2: Low Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once		✓	✓	City	Temporary construction effect Permanent operational effect	Medium	• Epoch 1: Property Level Protection – flooding can result in negative effects on both physical and psychological health. This measure will reduce tidal flood risk and therefore would contribute positively to the mental health of people living in properties which are at the highest risk of flooding. Resulting in **positive effects**. • Epoch 2: Low Defences – flooding can result in negative effects for both physical and psychological health. This measure will reduce tidal flood risk. These measures would have **a positive effect** on psychological aspects of human health. This measure will have a **positive effect** on

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
			operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 3: High Defences – this measure will have similar positive impacts to those of Low Defences (see Epoch 2). However, these impacts are likely to have a longer timescale in terms of construction and also be more resistant to climate change induced sea level rise.							population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 3: High Defences – this measure will have similar **positive effects** to those of Low Defences (see Epoch 2). However, these effects are likely to have a longer timeframe as the defences are higher. There would be a short-term, temporary **negative effect** on human health through construction of High Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection.
	Reach 3	• Epoch 1: Property Level Protection - PLP is required in locations at Totterdown (Victoria Road), Albert Road and Bath Road. • Epoch 2: Low Defences – Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: High Defences – The Low Defences along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road will be upgraded to high defences. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. In addition, High defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	• Epoch 1: Property Level Protection - flooding can result in negative impacts on both physical and psychological health. This measure will reduce tidal flood risk to properties with the most significant risk and therefore this measure would have a positive impact on the health of people living in these properties. • Epoch 2: Low Defences – flooding can result in effects on both physical and psychological health. This measure will provide a high standard of flood protection compared to the Do Minimum and PLP measures and therefore would have a positive impact on human health. This measure will reduce tidal flood risk in areas in the city proposed for future housing delivery, including the city centre and therefore this measure will also have a positive impact on material assets. • Epoch 3: High Defences – this measure will have similar impacts as to those provided through Low Defences (see Epoch 2). However, these impacts are likely to involve a longer timescale due to the increase in height in the defences.		✓	✓	City	Temporary construction effect Permanent operational effect	Medium	• Epoch 1: Property Level Protection - flooding can result in negative effects on both physical and psychological health. This measure will reduce tidal flood risk and therefore would contribute positively to the mental health of people living in properties which are at the highest risk of flooding. Resulting in **positive effects**. Epoch 2: Low Defences – there would be short-term, temporary **negative effects** on human health through construction of the High Defences e.g. through HGV traffic, noise and dust emissions but once complete, the receptors along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road should experience **significant positive** health effects through the reassurance provided by increased flood protection. The Low Defences would provide a high standard of protection from flooding compared to the PLP and Do Minimum measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 3: High Defences – flooding can result in negative effects on both physical

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
										and psychological health. The construction of High Defences is likely to have a **significant positive effect** on human health as this measure would provide a high standard of flood protection compared to the Do Minimum and PLP measures until 2115. The High Defences would provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality.
Soil and water	Reach 1	• Epoch 1: Property Level Protection – Not present in Reach 1 in any epoch. • Epoch 2: Low Defences – Not present in Reach 1 in any epoch. • Epoch 3: High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Property Level Protection – PLP is required on Watch House Road, Pill. • Epoch 2: Low Defences – Along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 3: High Defences – Low defences at Pill and Shirehampton will be upgraded to High Defences.	• Epoch 1: Property Level Protection – this measure is unlikely to have direct or indirect impacts on water or soil receptors. • Epoch 2: Low Defences – construction activities such as dredging, piling and excavation would result in temporary negative impacts such as soil compaction, or silt / sediment disturbance. However long term direct or indirect impacts on water or soil receptors are expected to be negligible. • Epoch 3: High Defences – no impacts predicted.		✓		City	Temporary construction effect	Medium	• Epoch 1: Property Level Protection – impacts from this measure will not translate into significant effects. • Epoch 2: Low Defences – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previously developed land which would have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 3: High Defences – no effects predicted.
	Reach 3	• Epoch 1: Property Level Protection - PLP is required in locations at Totterdown (Victoria Road), Albert Road and Bath Road. • Epoch 2: Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock	• Epoch 1: Property Level Protection – this measure is unlikely to have direct or indirect impacts on water or soil receptors. • Epoch 2: Low Defences – construction activities such as dredging, piling and excavation would result in temporary negative impacts such as soil compaction, or silt / sediment disturbance. Operational	-	✓	✓	City	Temporary	Medium	• Epoch 1: Property Level Protection – impacts from this measure will not translate into significant effects. • Epoch 2: Low Defences – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
		gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: High Defences – The Low Defences along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road will be upgraded to High Defences. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. In addition, High defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	impacts are expected to be negligible. • Epoch 3: High Defences – see Epoch 2.							impacts. There is the potential of contaminant release from previously developed land which would have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 3: High Defences – no significant effects are predicted see Epoch 2.
Climatic factors	Reach 1	• Epoch 1: Property Level Protection – Not present in Reach 1 in any epoch. • Epoch 2: Low Defences – Not present in Reach 1 in any epoch. • Epoch 3: High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Property Level Protection – PLP is required on Watch House Road, Pill. • Epoch 2: Low Defences – Along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 3: High Defences – Low defences at Pill and Shirehampton will be upgraded to High Defences.	• Epoch 1: Property Level Protection – this measure will protect specific properties at risk from sea level rise and would protect many identified assets which are at risk of flooding. • Epoch 2: Low Defences – this measure will reduce tidal flood risk in Reach 2. However, there would be higher levels of CO_2 emissions associated with construction of these defences. • Epoch 3: High Defences – this measure will have similar impacts (see Epoch 2). However, these impacts are likely to involve longer timescales due to the increased height of the defences.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Property Level Protection – this measure is likely to have a **positive effect** on climatic factors (although minor) as it would reduce tidal flood risk to a small amount of properties within the city. • Epoch 2: Low Defences – impacts from this measure should result in **positive effects** in terms of minimising increases in tidal flood risk predicted due to tidal flooding associated with increased sea levels. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 3: High Defences – this measure will have similar effects to Epoch 2. However, these effects are likely to involve longer timescales due to the increased height of defences.
	Reach 3	• Epoch 1: Property Level Protection - PLP is required in locations at Totterdown (Victoria Road), Albert	• Epoch 1: Property Level Protection – this measure will protect specific properties at risk from sea level rise and would protect	-	✓	✓	City	Temporary construction effects	Medium	• Epoch 1: Property Level Protection - this measure is likely to have a **positive effect** on climatic factors (although minor) as it

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
		Road and Bath Road. • Epoch 2: Low Defences – These are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: High Defences – The Low Defences along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road will be upgraded to High Defences. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. In addition, High defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	many identified assets which are at risk of flooding. • Epoch 2: Low Defences – this measure will reduce tidal flood risk in Reach 3. However, there would be higher levels of CO_2 emissions associated with construction of these defences. • Epoch 3: High Defences – this measure will have similar impacts to Low Defences (see Epoch 2). However, these impacts are likely to have a longer timescale due to the increased height of the defence.					Permanent operational effects		would reduce tidal flood risk to a small amount of properties within the city. • Epoch 2: Low Defences – impacts from this measure would result in **positive effects** in terms of minimising increases in tidal flood risk predicted due to rising sea levels. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 3: High Defences – this measure will have similar effects as for Low Defences (see Epoch 2).
Cultural heritage	Reach 1	• Epoch 1: Property Level Protection – Not present in Reach 1 in any epoch. • Epoch 2: Low Defences – Not present in Reach 1 in any epoch. • Epoch 3: High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Property Level Protection – PLP is required on Watch House Road, Pill. • Epoch 2: Low Defences – Along the River Avon Low Defences are required at Pill and Shirehampton. There are five Grade II Listed Buildings which are within approximately 500 m of the Shirehampton alignment. These are: The Lamplighters Public House, Wellington House and Attached Stables, 105 Station Road, 103 Station Road and Myrtle Hall and Attached Wall. There are two Grade II Listed Buildings within	• Epoch 1: Property Level Protection – The installation of PLP measures into Listed Buildings would have a negative impact on cultural heritage as there would be a material change to the appearance of the Listed Buildings. • Epoch 2: Low Defences – this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, it also has the potential to impact on the setting and character of these assets. This measure is only likely to have an impact two of the seven Grade II Listed Buildings these are: Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Property Level Protection – The Listed Buildings which are likely to be affected are: Grade II Listed Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill. This measure is likely to have an overall **positive effect** on these heritage assets as they would be protected from tidal flooding. However there would be a minor negative impact as the appearance of the Listed Buildings would be modified. • Epoch 2: Low Defences – The only Listed Buildings which are likely to be affected are: Grade II Listed Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
		200 m of the Pill alignment. These are: Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House. • Epoch 3: High Defences – Low defences at Pill and Shirehampton will be upgraded to High Defences.	Garage and Mulberry Cottage Mulberry House in Pill as these are the only assets expected to be visible from the measure. • Epoch 3: High Defences – the geographical scope of impacts will be similar to those of Low Defences (see Epoch 2). The increased height of defences would result in a higher impact in terms of setting and character of assets.							Mulberry Cottage Mulberry House in Pill. The remaining Listed Buildings in Reach 2 are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. Overall this measure will have a mixture of positive and negative effects on cultural heritage. This measure will provide tidal flood risk protection to Listed Buildings in Pill and Shirehampton and therefore would have a **positive effect**. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the Low Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Low Defence measures should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 3: High Defences – the geographical scope of effects will be similar to those of Low Defences (see Epoch 2). Additionally, increased height of defences would result in a more **negative effect** in terms of setting and character of heritage assets. This effect would also be more difficult to mitigate for through design due to the larger heights involved.
	Reach 3	• Epoch 1: Property Level Protection - PLP is required in locations at Totterdown (Victoria Road), Albert Road and Bath Road. • Epoch 2: Low Defences – these are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: High Defences – The Low Defences along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and	• Epoch 1: Property Level Protection – The installation of PLP measures into Listed Buildings would have a negative impact on cultural heritage as there would be a material change to the appearance of the Listed Building's. • Epoch 2: Low Defences – this measure will protect cultural heritage assets and archaeological assets from flooding. This measure would have a negative effect on the setting of cultural heritage assets and archaeological assets. The conservation objectives for both of these areas will be taken into account as the design of these measures progresses. The Strategy should give consideration to principal historic buildings characterising	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Property Level Protection – The Listed Buildings which are likely to be affected are: Grade II Listed 16-19 Freeland Place, The Pump House Public House, Old Dock Cottages, A Bond Tobacco Warehouse, and B Bond Tobacco Warehouse. This measure is likely to have an overall **positive effect** on these heritage assets as they would be protected from tidal flooding. However there would be a minor negative impact as the appearance of the Listed Buildings would be modified. • Epoch 2: Low Defences – this measure will result in **positive effects** in terms of protecting cultural heritage and archaeological assets from flooding. However, this measure would have a

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
		Cumberland Road will be upgraded to high defences. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. In addition, High defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	the historic docks area, as well as aim to retain existing views, and its character relating to the forms and materials utilised in the traditional dockside area in order to enhance the conservation area. • Epoch 3: High Defences - The geographical scope of impacts will be similar to those of Low Defences (see Epoch 2). The increased height of defences would result in a higher impact in terms of setting and character of assets.							**negative effect** on the setting of certain cultural heritage assets. However, the majority of cultural heritage assets and archaeology assets will be screened by buildings along the river, which will minimise this effect. The only Listed Buildings which have the potential to be affected are: *Low Defence at Cumberland Road:* Grade II* Listed Swing Bridge over North Entrance Lock, Grade II* Listed Swing Bridge over South Entrance Lock, Grade II* Listed Brunels South Entrance Lock, Grade II Listed B Bond Tobacco Warehouse, Grade II Listed Ashton Swing Bridge, Grade II Listed A Bond tobacco Warehouse, Grade II Vauxhall Bridge, Grade II Strand Buildings and 6 Grade II Listed Buildings on Cumberland Road. Underfall Yard which is a Scheduled Monument also has the potential to be impacted by this measure. *Low Defence at Bathurst Basin:* Grade II Listed Bedminster Bridge and Grade II Listed Drinking Fountain 3 metres north west of Bedminster Bridge. *Low Defence at Temple Meads:* Grade II Listed Temple Meads Station. *Low Defence at Totterdown:* No Listed Buildings will be affected by this defence. *Low Defence at Clarence Road:* Grade II Langton Street Bridge The Conservation Areas which are likely to be affected by this measure are City Docks and Bedminster. *Low Defence at Netham Lock:* Grade II Listed Netham Lock and Lock Keepers House. This effect can potentially be mitigated by careful design and siting of the Low Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Low Defence measures should be developed to limit any impacts to the setting of heritage assets in the area

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
										• Epoch 3: High Defences – the geographical scope of effects will be similar to those of Low Defences (see Epoch 2). However, there would be additional negative effects along Clarence Road. Additionally, increased height of defences would result in a more **negative effect** in terms of setting, and of cultural heritage assets. This effect would also be more difficult to mitigate for through design due to the larger heights involved.
Landscape	Reach 1	• Epoch 1: Property Level Protection – Not present in Reach 1 in any epoch. • Epoch 2: Low Defences – Not present in Reach 1 in any epoch. • Epoch 3: High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Property Level Protection – PLP is required on Watch House Road, Pill. • Epoch 2: Low Defences – Along the River Avon Low Defences are required at Pill and Shirehampton. Pill is located within Avon Valley Rolling Farmland Landscape Character Area (LCA). The Shirehampton alignment is not located within an LCA. • Epoch 3: High Defences – Low defences at Pill and Shirehampton will be upgraded to High Defences.	• Epoch 1: Property Level Protection - this measure is local to the façade of buildings and will only be installed temporarily when the risk of flooding increases and therefore is unlikely to impact the Landscape Character of the area. • Epoch 2: Low Defences – this measure has the potential to impact on Landscape through inappropriate design and layout. This measure would also have indirect impacts in terms of preventing access to existing areas particularly in Shirehampton. • Epoch 3: High Defences – this measure has the potential to impact on Landscape through inappropriate design and layout. The higher flood defence heights involved would result in a more negative impact relative to Low Defences	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Property Level Protection – this measure is local to the façade of buildings and will only be installed temporarily when the risk of flooding increases and therefore is unlikely to affect the Landscape Character of the area. • Epoch 2: Low Defences – identified impacts would result in **negative effects** on landscape character and setting. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process. • Epoch 3: High Defences – the geographical scope of effects will be similar to those of Low Defences (see Epoch 2). However, the increased height of defences would result in a more **negative effect** in terms of visual effects and landscape character. This effect would also be more difficult to

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope – (epoch where effect occurs)			Geographic extent (city, region)	Permanent / temporary effect	Level of certainty	Commentary / identification of significant effects
										mitigate for through design due to the larger heights involved.
	Reach 3	• Epoch 1: Property Level Protection – PLP is required in locations at Totterdown (Victoria Road), Albert Road and Bath Road. • Epoch 2: Low Defences – these are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: High Defences – The Low Defences along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road will be upgraded to high defences. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. In addition, High Defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	• Epoch 1: Property Level Protection - this measure is not expected to have any impact on the landscape of the area. • Epoch 2: Low Defences – this measure has the potential to impact on Landscape through inappropriate design and layout. This measure would also have indirect impacts in terms of preventing access to existing areas. • Epoch 3: High Defences – this measure has the potential to impact on Landscape through inappropriate design and layout. The higher flood defence heights involved would result in a more negative impact relative to Low Defences.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Property Level Protection - no effect on landscape is expected as this measure will be local to specific properties, and will also only be installed occasionally when the risk of flooding increases. • Epoch 2: Low Defences – identified impacts would result in **negative effects** on landscape character and setting, particularly in regard to defences located within the City Docks and Bedminster Conservation Areas. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process. • Epoch 3: High Defences – the geographical scope of effects will be similar to those of Low Defences (see Epoch 2). However, the increased height of defences would result in a more **negative effect** in terms of visual effects and landscape character. This effect would also be more difficult to mitigate for through design due to the larger heights involved.

Table 3: Option B (PLP – High Def – High Def)

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
				ST (2015-203)	MT (2030-2065)	LT (2065-2115)				
Biodiversity, flora and fauna	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of High Defences – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of High Defences – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of High Defences – along the River Avon High Defences are required at Pill and Shirehampton. At Pill the northern extent of the alignment is adjacent to the Severn Estuary SPA and SAC. The Shirehampton alignment will be a minimum of 200 m away from the Severn Estuary SPA and SAC. • Epoch 3: Maintenance of High Defences – see Epoch 2.	• Epoch 1: PLP – it is considered that the nature of PLP means that there would be no impact on biodiversity, flora and fauna. • Epoch 2: Construction of High Defences – there would be some impacts caused by the construction of the High Defences for example through increased disturbance, noise and dust levels. Once operational there will be no impacts on biodiversity, flora and fauna. • Epoch 3: Maintenance of High Defences – No impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP – it is considered that the nature of PLP means that there would be no effect on biodiversity, flora and fauna. • Epoch 2: Construction of High Defences – construction activities which are likely to be involved includes dredging, piling and excavation. There would be a temporary **negative effect** on the Severn Estuary SPA and SAC in the construction phase due to the close proximity of the High Defences to the designated site. However the effects would be temporary and can be managed through mitigation which will be discussed by the project design team at a later date. Recommendation: A Habitats Regulations Assessment (HRA) Likely Significant Effect Screening should be undertaken if this option is taken forward to ensure that there are no significant environmental effects caused by this option. • Epoch 3: Maintenance of High Defences – No effects predicted.
	Reach 3	• Epoch 1: PLP – PLP are required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. • Epoch 2: Construction of High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland	• Epoch 1: PLP – it is considered that the nature of PLP means that there would be no impact on biodiversity, flora and fauna. • Epoch 2: Construction of High Defences – there would be some impacts associated with the construction of the High Defences for example through disturbance, increased noise and dust levels. Once operational there will be no impacts on biodiversity, flora	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP – no effects in terms of biodiversity, flora and fauna are expected as a result of this measure. • Epoch 2: Construction of High Defences – the effects on biodiversity, flora and fauna are likely to be minor temporary during the construction phase. These areas are not designated for their biodiversity value. However, there are a number of European

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: Maintenance of High Defences – see Epoch 2.	and fauna. • Epoch 3: Maintenance of High Defences – No impacts predicted.							protected species recorded within this Reach (great crested newts, bats, and otter). The effects on European protected species can be managed through mitigation which will be discussed by the project design team at a later date. • Epoch 3: Maintenance of High Defences – No effects predicted.
Population, human health and material assets	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of High Defences – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of High Defences – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of High Defences – High Defences are required at Pill and Shirehampton. • Epoch 3: Maintenance of High Defences – see Epoch 2.	• Epoch 1: PLP – flooding can result in negative impacts on both physical and psychological health. This measure will reduce tidal flood risk to properties with the most significant risk and therefore this measure would have a positive impact on the health of people living in these properties. • Epoch 2: Construction of High Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 3: Maintenance of High Defences – this measure will have similar positive impacts for material assets and human health (see Epoch 2).	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP – flooding can result in negative effects on both physical and psychological health. This measure will reduce tidal flood risk and therefore would contribute positively to the mental health of people living in properties which are at the highest risk of flooding. Resulting in **positive effects**. • Epoch 2: Construction of High Defences – this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of High Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 3: Maintenance of High Defences –

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										this measure will have similar **positive effects** on material assets and Human Health (see Epoch 2).
	Reach 3	• Epoch 1: PLP – PLP are required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3 in order to manage the flood risk in the areas with the most significant risk. • Epoch 2: Construction of High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: Maintenance of High Defences – see Epoch 2.	• Epoch 1: PLP - flooding can result in effects on both physical and psychological health. This measure will reduce flood risk to properties at the highest risk and therefore this measure would have a positive impact on these aspects of human health. • Epoch 2: Construction of High Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 3: Maintenance of High Defences – this measure will have similar positive impacts for material assets and Human Health (see Epoch 2).	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP - this measure is likely to have a **positive effect** on human health as it would contribute positively to the mental health of people living in properties which are at the highest risk of flooding. • Epoch 2: Construction of High Defences – this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of High Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 3: Maintenance of High Defences – this measure will have similar positive effects on material assets and Human Health (see Epoch 2).
Soil and water	Reach 1	• Epoch 1: PLP – Not present in Reach 1 in any epoch. • Epoch 2: Construction of High Defences – Not present in Reach 1 in any epoch. • Epoch 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of High Defences – High Defences are	• Epoch 1: PLP– this measure is unlikely to have direct or indirect impacts on water or soil receptors. • Epoch 2: Construction of High Defences –	-	✓	✓	City	Temporary construction effects	Medium	• Epoch 1: PLP – impacts from this measure will not translate into significant effects. • Epoch 2: Construction of High Defences - impacts from this measure will not translate

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		required at Pill and Shirehampton. • Epoch 3: Maintenance of High Defences – see Epoch 2.	construction activity is likely to result in some temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational there will be no impacts on water or soil receptors. • Epoch 3:Maintenance of High Defences – no impacts predicted.					Permanent operational effects		into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previous industrial land use which have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 3:Maintenance of High Defences – no significant effects predicted.
	Reach 3	• Epoch 1:PLP – PLPare required at Totterdown (Victoria Road), Albert Road and Bath Road. • Epoch 2: Construction of High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: Maintenance of High Defences – see Epoch 2.	• Epoch 1:PLP – these measures are unlikely to have significant direct or indirect impacts on water or soil receptors. • Epoch 2:Construction of High Defences – construction activity is likely to result in some temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational there will be no impacts on water or soil receptors. • Epoch 3:Maintenance of High Defences – no impacts predicted	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP - impacts from these measures will not translate into significant effects. • Epoch 2:Construction of High Defences – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previous industrial land use which have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 3:Maintenance of High Defences – no significant effects predicted.
Climatic factors	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of High Defences – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of High Defences – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1:PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of High Defences – High Defences are required at Pill and Shirehampton. • Epoch 3: Maintenance of High Defences – See Epoch 2.	• Epoch 1: PLP – this measure will protect specific properties at risk from sea level rise and would protect many identified assets which are at risk of flooding. • Epoch 2:Construction of High Defences – this measure will be likely to reduce flood risk in Reach 2. • Epoch 3:Maintenance of High Defences –	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1:PLP – this measure is likely to have a **positive effect** on climatic factors (although minor) as it would reduce tidal flood risk to a small amount of properties within the city. • Epoch 2:Construction of High Defences – impacts from this measure should result in **positive effects** in terms of minimising increases in flood risk predicted due to tidal

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
			no impacts predicted.							flooding associated with increased sea levels. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 3: Maintenance of High Defences – no effects predicted.
	Reach 3	• Epoch 1: PLP – PLP are required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. • Epoch 2: Construction of High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: Maintenance of High Defences – see Epoch 2.	• Epoch 1: PLP – these measures will protect the coastal area from sea level rise and would protect many identified assets which are at risk of flooding. • Epoch 2: Construction of High Defences – the High Defences will provide a high standard of protection until 2115 taking into account climate change and potential sea level rise. • Epoch 3: Maintenance of High Defences – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP – these measures will have a **positive effect** as it will protect certain properties in the city from flooding as a result of sea level rise. • Epoch 2: Construction of High Defences – the High Defences will have a **positive effect** on climate change resilience as this measure will provide a high standard of protection compared to the Do Minimum and PLP measures until 2115 taking into account climate change and potential sea level rise. • Epoch 3: Maintenance of High Defences – No significant effects predicted.
Cultural heritage	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of High Defences – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of High Defences – see Epoch 2.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of High Defences – along the River Avon High Defences are required at Pill and Shirehampton. There are five Grade II Listed Buildings within approximately 500 m of the Shirehampton alignment. These are: The Lamplighters Public House, Wellington House and Attached Stables, 105 Station Road, 103 Station Road and Myrtle Hall and Attached Wall. There are two Grade II Listed Buildings in close proximity to the Pill alignment. These are: Watch	• Epoch 1: PLP – The installation of PLP measures into Listed Buildings would have a negative impact on cultural heritage as there would be a material change to the appearance of the Listed Buildings. • Epoch 2: Construction of High Defences – this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, it also has the potential to impact on the setting and character of these assets. This measure is only likely to have an impact two of the seven Grade II Listed Buildings these are: Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill as these are the only	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP – The Listed Buildings which are likely to be affected are: Grade II Listed Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill. This measure is likely to have an overall **positive effect** on these heritage assets as they would be protected from tidal flooding. However there would be a minor negative impact as the appearance of the Listed Buildings would be modified. • Epoch 2: Construction of High Defences – The only Listed Buildings which are likely to be affected are: Grade II Listed Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House. • Epoch 3: Maintenance of High Defences – see Epoch 2.	assets expected to be visible from the measure. • Epoch 3: Maintenance of High Defences – no impacts predicted.							The remaining Listed Buildings in Reach 2 are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. Overall this measure will have a mixture of positive and negative effects on cultural heritage. This measure will provide tidal flood risk protection to Listed Buildings in Pill and Shirehampton and therefore would have a **positive effect**. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the High Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the High Defence measures should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 3: Maintenance of High Defences – no significant effects predicted.
	Reach 3	• Epoch 1: PLP – PLP are required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. There are no Listed Buildings, Scheduled Monuments or Registered Parks and Gardens that will be impacted by this measure. • Epoch 2: Construction of High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 3: Maintenance of High Defences – see Epoch 2.	• Epoch 1: PLP – The installation of PLP measures into Listed Buildings would have a negative impact on cultural heritage as there would be a material change to the appearance of the Listed Buildings. • Epoch 2: Construction of High Defences – there would be a negative impact on the siting of a High Defence in close proximity to cultural heritage assets. • Epoch 3: Maintenance of High Defences – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP – The Listed Buildings which are likely to be affected are: Grade II Listed 16-19 Freeland Place, The Pump House Public House, Old Dock Cottages, A Bond Tobacco Warehouse, and B Bond Tobacco Warehouse. This measure is likely to have an overall positive effect on these heritage assets as they would be protected from tidal flooding. However there would be a minor negative impact as the appearance of the Listed Buildings would be modified. • Epoch 2: Construction of High Defences – Overall this measure will have a **positive effect** on cultural heritage as this measure will provide flood risk protection to Listed Buildings in close proximity to the River. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. The buildings which are likely to be impacted are: *High Defence at Cumberland Road:* Grade II* Listed Swing Bridge over North Entrance Lock, Grade II* Listed Swing Bridge over South Entrance Lock, Grade II* Listed

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										Brunels South Entrance Lock, Grade II Listed B Bond Tobacco Warehouse, Grade II Listed Ashton Swing Bridge, Grade II Listed A Bond tobacco Warehouse, Grade II Vauxhall Bridge, Grade II Strand Buildings and 6 Grade II Listed Buildings on Cumberland Road. Underfall Yard which is a Scheduled Monument also has the potential to be impacted by this measure. *High Defence at Bathurst Basin:* Grade II Listed Bedminster Bridge and Grade II Listed Drinking Fountain 3 metres north west of Bedminster Bridge. *High Defence at Temple Meads:* Grade II Listed Temple Meads Station. *High Defence at Clarence Road:* Grade II Langton Street Bridge *High Defence at Netham Lock:* Grade II Listed Netham Lock and Lock Keepers House. The Conservation Areas which are likely to be affected by this measure are City Docks and Bedminster. The conservation objectives for both of these areas will be taken into account as the design of these measures progresses. The Strategy should give consideration to principal historic buildings characterising the historic docks area, as well as aim to retain existing views, and its character relating to the forms and materials utilised in the traditional dockside area in order to enhance the conservation area. The remaining Listed Buildings are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. Negative effects can potentially be mitigated by careful design and siting of the High Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the High Defence measures should be developed to limit any effects to the setting of heritage assets in the area.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										• Epoch 3: Maintenance of High Defences – No significant effects predicted.
Landscape	Reach 1	• Epoch 1: PLP – Not present in Reach 1 in any epoch. • Epoch 2: Construction of High Defences – Not present in Reach 1 in any epoch. • Epoch 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of High Defences – Along the River Avon High Defences are required at Pill and Shirehampton. Pill is located within Avon Valley Rolling Farmland Landscape Character Area (LCA). The Shirehampton alignment is not located within an LCA. • Epoch 3: Maintenance of High Defences – See Epoch 2.	• Epoch 1: PLP – this measure is local to the façade of buildings and will only be installed occasionally when the risk of flooding increases and therefore is unlikely to impact the Landscape Character of the area. • Epoch 2: Construction of High Defences – this measure has the potential to impact on Landscape through inappropriate design and layout. This measure would also have indirect impacts in terms of preventing access to existing areas particularly in Shirehampton. • Epoch 3: Maintenance of High Defences – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP – this measure is local to the façade of buildings and will only be installed occasionally when the risk of flooding increases and therefore is unlikely to affect the Landscape Character of the area. • Epoch 2: Construction of High Defences – identified impacts would result **in negative effects** on landscape character and setting. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process. • Epoch 3: Maintenance of High Defences – no significant effects predicted.
	Reach 3	• Epoch 1: PLP – PLP are required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. • Epoch 2: Construction of High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock.	• Epoch 1: PLP – these measures are not expected to have any impact on the landscape of the area. • Epoch 2: Construction of High Defences – this measure would have a negative impact on the landscape of the area, as well as views from the River. • Epoch 3: Maintenance of High Defences – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: PLP - no effect on Landscape is expected as these measures will be local to specific properties, and will also only be installed occasionally when the risk of flooding occurs. • Epoch 2: Construction of High Defences – landscape effects can be mitigated by careful design and siting of the high defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		• Epoch 3: Maintenance of High Defences – see Epoch 2.								the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities a key part of the process. • Epoch 3: Maintenance of High Defences – no significant effects predicted.

Table 4: Option C (PLP – Barrier – Barrier)

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
				ST (2015-203)	MT (2030-2065)	LT (2065-2115)				
Biodiversity, flora and fauna	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road) - The northern extent is likely to lie in a Nibley Road Open Space which is a wildlife corridor. The southern extent is not located in an area of biodiversity value. • Epoch 3: Maintenance of Tidal Barrier– see Epoch 2.	• Epoch 1: PLP – it is considered that the nature of PLP means that there would be no impact on biodiversity, flora and fauna. • Epoch 2: Construction of Tidal Barrier – The Severn Estuary SAC and SPA is located approximately 1.5 km west of the Tidal Barrier. Ham Green SSSI is located approximately 500 m south east of the barrier location. Horseshoe Bend SSSI is located approximately 500 m north east of the barrier. Avon Gorge SSSI and Avon Gorge and Woodlands Special Area of Conservation (SAC) are located approximately 1.5 km east of the barrier. There are a number of European protected species recorded within this Reach. There would be some temporary impacts on biodiversity caused by the construction of the Tidal Barrier, and associated new access road for example disturbance associated with increased noise, dust and vibration as a result of construction activity such as piling. This measure would have a temporary impact on transient species such as fish during the operational stage as the barrier would prevent fish from migrating up and down the river when the barrier is closed. Epoch 3: Maintenance of Tidal Barrier – This measure would have a temporary impact on transient species such as fish when the barrier is closed for maintenance, as the	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: PLP – it is considered that the nature of PLP means that there would be no effect on biodiversity, flora and fauna. • Epoch 2: Construction of Tidal Barrier – The Severn Estuary SAC and SPA are located 1.5 km west of the Tidal Barrier location. The construction phase is expected to last approximately three years. There would be **negative effects** on biodiversity (i.e. fish and birds) as a result of noise and vibration impacts caused by construction activity such as piling. Additionally if a coffer dam is being used within the river this would also have a **negative effect** on biodiversity. This measure would have a **negative effect** on transient species such as fish when the barrier is in operation, as the barrier would prevent fish from moving up and down the River Avon. However, the effect of this is likely to be negligible as it is estimated that the barrier will only be closed occasionally – i.e. a few times per year. However it is accepted that this would increase over the medium and long-term. A gap in the data currently exists concerning fish stocks within the river. A sedimentation survey and fish survey are recommended to address this data gap if a barrier was to be progressed. A Habitats Regulations Assessment (HRA) Likely Significant Effect Screening should be undertaken if this option is taken forward

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
			barrier would prevent fish from migrating up and down the river.							to ensure that there are no significant environmental effects caused by this option. Epoch 3: Maintenance of Tidal Barrier – There may be a **negative effect** on transient species whilst the Tidal Barrier is closed for maintenance as the barrier would prevent fish from migrating up and down the river.
	Reach 3	• Epoch 1: PLP – PLP is required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. • Epoch 2: Construction of Tidal Barrier - not present in Reach 3 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 3 in any epoch.	• Epoch 1: PLP – it is considered that the nature of PLP means that there would be no impact on biodiversity, flora and fauna. Epoch 2: Construction of Tidal Barrier – This measure would have a temporary impact on transient species such as fish during the operational stage as the barrier would prevent fish from migrating up and down the river when the barrier is closed. • Epoch 3: Maintenance of High Defences – This measure would have a temporary impact on transient species such as fish when the barrier is closed for maintenance, as the barrier would prevent fish from migrating up and down the river.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: PLP - no significant effects are expected in terms of biodiversity, flora and fauna as a result of this measure. • Epoch 2: Construction of Tidal Barrier – No effects in terms of construction is expected as the Tidal Barrier is located more than 10 km downstream. Once the barrier is in operation there would be a **negative effect** on transient species in Reach 3, as the barrier will prevent fish from moving up and down the River Avon. • Epoch 3: Maintenance of Tidal Barrier – There may be a **negative effect** on transient species whilst the Tidal Barrier is closed for maintenance as the barrier would prevent fish from migrating up and down the river.
Population, human health and material assets	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of Tidal Barrier - construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road). • Epoch 3: Maintenance of Tidal Barrier– see Epoch 2.	• Epoch 1: PLP – flooding can result in negative impacts on both physical and psychological health. This measure will reduce tidal flood risk to properties with the most significant risk and therefore this measure would have a positive impact on the health of people living in these properties. • Epoch 2: Construction of Tidal Barrier – there would be short term negative impact on human health associated with	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: PLP – flooding can result in negative effects on both physical and psychological health. This measure will reduce tidal flood risk and therefore would contribute positively to the mental health of people living in properties which are at the highest risk of flooding. Resulting in **positive effects**. • Epoch 2: Construction of Tidal Barrier – this measure will have a **positive effect** on human health as this measure will reduce

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
			disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce flood risk and therefore would have a positive impact on these aspects of human health. This measure will impact on material assets by ensuring more land will be under protection from flooding. There would be a negative impact on navigation during the construction phase if a coffer dam is being used within the river. Once the barrier is in operation generally there will be no impact on navigation. However during high flood risk events there would be a short term negative effect when the barrier is closed as river traffic would be prevented from moving upstream or downstream of the barrier. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.							the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary negative effect on human health through construction of Tidal Barrier e.g. through HGV traffic, noise and dust emissions. Once complete the receptors living in Pill, Shirehampton should experience **positive effects** on health through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. There would be temporary **negative effects** on navigation during the construction stage if a coffer dam is being used within the river to construct the Tidal Barrier. Once in operation the barrier will not have any effect on navigation, except occasionally (once or twice a year) when the barrier is closed, this would have a short term **negative** effect on navigation. However it is accepted that this would increase over the medium and long-term. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: PLP – PLP is required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3 in order to manage the flood risk in areas with the most significant risk. • Epoch 2: Construction of Tidal Barrier – construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road in Reach 2. • Epoch 3: Maintenance of Tidal – not present in Reach 3 in any epoch.	• Epoch 1: PLP – flooding can result in effects on both physical and psychological health. This measure will reduce flood risk to properties with the most significant risk and therefore this measure would have a positive impact on the health of people living in these properties. • Epoch 2: construction of Tidal Barrier – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: PLP – this measure is likely to have a minor **positive effect** on the human health as it would improve the health of people living in properties which are at the highest risk of flooding. • Epoch 2: Construction of Tidal Barrier – During construction this measure will have no effect on population, human health and material assets in Reach 3 as the location of the Tidal Barrier would be located over 10 km downstream. This measure will have a **positive effect** on material assets as it will ensure more land will be under protection from flooding and

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
			operational, this measure will reduce flood risk and therefore would have a positive impact on these aspects of human health. This measure will impact on material assets by ensuring more land will be under protection from flooding. • Epoch 3: maintenance of High Defences – no impacts predicted.							therefore available for development. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
Soil and water	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of Tidal Barrier – construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road). • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2.	• Epoch 1: PLP – this measure is unlikely to have direct or indirect impacts on water or soil receptors. • Epoch 2: Construction of Tidal Barrier – construction activity would result in a temporary impact on water quality due to sediment disturbance during construction. Once operational this measure has the potential to have an impact on the water flow and sediment regime in Reach 2. • Epoch 3: Maintenance of Tidal Barrier – this measure has the potential to have an impact on the water flow and sediment regime in Reach 2 when the Tidal Barrier is closed for maintenance.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: PLP – impacts from this measure will not translate into significant effects. • Epoch 2: Construction of Tidal Barrier – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential for contaminant release from previous industrial land use which have **negative effects** in terms of water quality which should be considered at a project design team level. This measure would alter the water flow and sediment regime in Reach 2 which would also result in a change to water quality. The extent of this is unknown, and therefore no conclusions can currently be made on this. Epoch 3: Maintenance of Tidal Barrier – this measure has the potential to temporarily alter the water flow and sediment regime in Reach 2 which would also result in a change to water quality when the Tidal Barrier is raised for maintenance. The extent of this is unknown, and therefore no conclusions can currently be made on this.
	Reach 3	• Epoch 1: PLP – PLP is required at Totterdown (Victoria Road), Albert	• Epoch 1: PLP – this measure will reduce flood risk to properties at the most	-	✓	✓	City	Temporary constructio	High	• Epoch 1: PLP – This measure will have no effect on soil and water in Reach 3 as the

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Road and Bath Road in Reach 3. • Epoch 2: Construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road). • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2.	significant risk. • Epoch 2:Construction of Tidal Barrier – this measure will reduce the risk of tidal flooding upstream of the barrier and therefore would have a positive impact on soil and water. • Epoch 3:Maintenance of Tidal Barrier – no impacts predicted.					n effects Permanent operational effects		PLP measures are local to houses and will have no effect on the wider environment. • Epoch 2: Construction of Tidal Barrier – construction effects of the Tidal Barrier will not be experienced in Reach 3 as the barrier is located more than 10 km downstream of Reach 3. • Epoch 3:Maintenance of Tidal Barrier – no significant effects predicted.
Climatic factors	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1:PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road). • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2.	• Epoch 1: PLP – this measure will protect specific properties at risk from sea level rise and would protect many identified assets which are at risk of flooding. • Epoch 2:Construction of Tidal Barrier – this measure will reduce the risk of tidal flooding as a result of sea level rise. • Epoch 3:Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1:PLP – this measure is likely to have a **positive effect** on climatic factors (although minor) as it would reduce tidal flood risk to a small amount of properties within the city. • Epoch 2:Construction of Tidal Barrier – this measure will reduce the risk of tidal flooding as a result of sea level rise and would protect identified assets which are at risk of flooding. It would therefore be likely to have an overall **positive effect**. • Epoch 3:Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: PLP – PLP is required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. • Epoch 2: Construction of Tidal Barrier - construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road) in Reach 2. • Epoch 3: Maintenance of Tidal Barrier – See Epoch 2.	• Epoch 1:PLP – this measure will reduce the risk of flooding to properties which are at the greatest risk of flooding as a result of sea level rise. • Epoch 2:Construction of Tidal Barrier – this measure will reduce the risk of tidal flooding upstream of the barrier as a result of sea level rise. • Epoch 3:Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	High	• Epoch 1: PLP – this measure will protect certain properties in the city from flooding as a result of sea level rise. It would therefore be likely to have an overall **positive effect**. • Epoch 2:Construction of Tidal Barrier – this measure will reduce the risk of tidal flooding as a result of sea level rise upstream of the barrier, and would protect identified assets which are at risk of flooding. It would therefore be likely to have an overall **positive effect**. • Epoch 3:Maintenance of Tidal Barrier – no effects predicted.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
Cultural heritage	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of Tidal Barrier - construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road). There is a Grade II Listed Building in Shirehampton (Shirehampton Public Hall and Library) which is approximately 50 m from the Tidal barrier. There are three further Grade II Listed Buildings approximately 250 m south of the Tidal Barrier in Pill these are: Eighteenth Century Watergate, Gazebo 25 yards north east of administrative block of Ham Green hospital and Administrative block and 2 flats to Ham Green Hospital. • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2.	• Epoch 1: PLP – The installation of PLP measures into Listed Buildings would have a negative impact on cultural heritage as there would be a material change to the appearance of the Listed Buildings. • Epoch 2: Construction of Tidal Barrier – the Tidal Barrier would offer protection from flooding to designated and undesignated cultural heritage assets and archaeological assets upstream of the barrier in Reach 2 and Reach 3. No impact on the setting of these identified heritage assets is expected as these Listed Buildings are screened by other buildings. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	High	• Epoch 1: PLP – The Listed Buildings which are likely to be affected are: Grade II Listed Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill. This measure is likely to have an overall **positive effect** on these heritage assets as they would be protected from tidal flooding. However there would be a minor negative impact as the appearance of the Listed Buildings would be modified. • Epoch 2: Construction of Tidal Barrier – The Tidal Barrier would offer protection from flooding to designated and undesignated cultural heritage assets and archaeological assets in Reach 2 and Reach 3. However, Listed Buildings in Pill and Shirehampton would not be protected by this measure which would have a **significant negative effect** on these assets. The setting of heritage and archaeological assets upstream of the barrier will be afforded a high level of protection from flooding but without an effect on their setting and therefore this option would have a **significant positive effect**. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: PLP – PLP is required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. There are no Listed Buildings, Scheduled Monuments or Registered Parks and Gardens that will be impacted by this measure. • Epoch 2: Construction of Tidal Barrier – construction of Tidal Barrier in Shirehampton (between	• Epoch 1: PLP – The installation of PLP measures into Listed Buildings would have a negative impact on cultural heritage as there would be a material change to the appearance of the Listed Buildings. • Epoch 2: Construction of Tidal Barrier – the Tidal Barrier would offer protection from flooding to several designated and undesignated cultural heritage assets and archaeological asset in Reach 3. • Epoch 3: Maintenance of Tidal Barrier – no	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: PLP – The Listed Buildings which are likely to be affected are: Grade II Listed 16-19 Freeland Place, The Pump House Public House, Old Dock Cottages, A Bond Tobacco Warehouse, and B Bond Tobacco Warehouse. This measure is likely to have an overall positive effect on these heritage assets as they would be protected from tidal flooding. However there would be a minor negative impact as the appearance of the Listed Buildings would be modified.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Ham Green and Nibley Road). • Epoch 3: Maintenance of Tidal Barrier – See Epoch 2.	impacts predicted.							• Epoch 2: Construction of Tidal Barrier – this measure will have a **significant positive effect** as it will offer flood protection to cultural heritage assets in Reach 3. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
Landscape	Reach 1	• Epoch 1: PLP – not present in Reach 1 in any epoch. • Epoch 2: Construction of Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: PLP – PLP is required on Watch House Road, Pill. • Epoch 2: Construction of Tidal Barrier in Shirehampton (between Ham Green and Nibley Road). The Tidal Barrier is located in Shirehampton Conservation Area to the east and Avon Rolling Valley Farmland to the west. • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2.	• Epoch 1: PLP – this measure is local to the façade of buildings and will only be installed temporarily when the risk of flooding increases and therefore is unlikely to impact the Landscape Character of the area. • Epoch 2: Construction of Tidal Barrier – inappropriate design and layout would deteriorate the landscape and/or visual amenity. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	High	• Epoch 1: PLP – this measure is local to the façade of buildings and will only be installed temporarily when the risk of flooding increases and therefore is unlikely to affect the Landscape Character of the area. • Epoch 2: Construction of Tidal Barrier – inappropriate design and layout would have a **negative effect** on the landscape character and/or visual amenity. This effect could be mitigated by careful design and siting of the barrier. Key viewpoints should be tested as part of the design development process and consultation with local communities a key part of the process. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: PLP – PLP is required at Totterdown (Victoria Road), Albert Road and Bath Road in Reach 3. • Epoch 2: Construction of Tidal Barrier – not present in Reach 3 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 3 in any epoch.	• Epoch 1: PLP – this measure is not expected to have any impact on the landscape of the area. • Epoch 2: Construction of Tidal Barrier – this measure would have a negative impact on the landscape of the area, as well as views from the river. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	High	• Epoch 1: PLP – no effect on Landscape is expected as this measure will be local to specific properties, and will also only be installed occasionally when the risk of flooding increases. • Epoch 2: Construction of Tidal Barrier – this measure will have a **negligible effect** on Reach 3. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.

Table 5: Option D (Low Def – Low Def – High Def)

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
				ST (2015-2030)	MT (2030-2065)	LT (2065-2115)				
Biodiversity, flora and fauna	Reach 1	• Epoch 1: Low Defences – Not present in Reach 1 in any epoch. • Epoch 2: Maintenance of Low Defences – Not present in Reach 1 in any epoch. • Epoch 3: High Defences - Not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2: Maintenance of Low Defences – along the River Avon Low Defences will be maintained at Pill and Shirehampton. • Epoch 3: High defences – the Low Defences will be upgraded to High Defences by raising / lengthening the existing Low Defences. At Pill the Low Defence alignment would also be extended which would bring the northern extent of the alignment adjacent to the Severn Estuary SAC and SPA. At its closest point the Shirehampton alignment will be a minimum of 200 m away from the Severn Estuary SAC and SPA.	• Epoch 1: Low Defences - there would be some temporary impacts caused by the construction of the Low Defences for example disturbance associated with increased noise, dust and vibration as a result of construction activity such as piling. There may be an impact on the SPA and SAC as the Shirehampton alignment is only 200 m away. Once operational there will be no impacts on biodiversity, flora and fauna. • Epoch 2: Maintenance of Low Defences – there would be no impacts as a result of maintaining the Defences. • Epoch 3: High defences – the impacts remain broadly the same as for Epochs 1 and 2. However, there is likely to be a greater impact on the European designated site during the construction phase, as the alignment in Pill is extended substantially and becomes directly adjacent to the SPA and SAC.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences - the effects on biodiversity, flora and fauna are likely to be minor temporary during the construction phase. There would be a temporary **negative effect** on the Severn Estuary SPA and SAC in the construction phase due to the close proximity of the Low Defences to the designated site. However the effects would be temporary and can be managed through mitigation which will be discussed by the project design team at a later date. However, there are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). These European protected species are likely to use the River corridor and will need to be considered in the detailed planning stage. Negative effects would be managed through project level mitigation. Once operational there will be no effects on biodiversity, flora and fauna. • Epoch 2: Maintenance of Low Defences – There would be no effect on biodiversity, flora and fauna as a result of maintaining the defences. • Epoch 3: High Defences: The effects are likely to be similar to Epoch 1. However, there is likely to be a significant **negative effect** on the European designated site during the construction phase as the Pill alignment is directly adjacent to the SPA and SAC. Negative effects would be managed through project level mitigation.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										Recommendation: The piling construction works undertaken in Epoch 1 for Low Defences should be future proofed to take into account the increased piling depths required for the future high defences proposed in Epoch 3. Recommendation: A Habitats Regulations Assessment (HRA) Likely Significant Effect Screening should be undertaken if this option is taken forward to ensure that there are no significant environmental effects caused by this option.
	Reach 3	• Epoch 1: Low Defences - Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 2: Maintenance of Low Defences - the Low Defences and lock gate tie-ins will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences and lock gate tie-ins will be upgraded to High Defences by raising / lengthening the existing Low Defences. Additional High Defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	• Epoch 1: Low Defences – there would be some temporary impacts caused by the construction of the Low Defences for example disturbance associated with construction activity (e.g. piling) causing increased noise, dust and vibration • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – The impacts remain broadly the same as for Epoch 1 and 2. Therefore see Epoch 1.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences – the effects on biodiversity, flora and fauna are likely to be minor temporary during the construction phase. These areas are not designated for their biodiversity value. There are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). These European protected species are likely to use the River corridor and will need to be considered in the detailed planning stage. Negative effects would be managed through project level mitigation. Once operational there will be no effects on biodiversity, flora and fauna. • Epoch 2: Maintenance of Low Defences - No significant effects predicted. • Epoch 3: High Defences: See Epoch 1.
Population, human health and material assets	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Maintenance of Low Defences – not present in Reach 1 in any epoch. • Epoch 3: High defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton.	• Epoch 1: Low Defences - there would be short term negative impacts on human health associated with disturbance caused	-	✓	✓	City	Temporary construction effects	Medium	• Epoch 1: Low Defences - this measure will have a **positive effect** on the psychological aspects of human health as this measure

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		• Epoch 2: Maintenance of Low Defences – the Low Defences and lock gate tie-ins will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High defences – the Low Defences will be upgraded to High Defences by raising / lengthening the existing Low Defences.	by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – this measure will have similar positive and negative impacts for material assets and human health (see Epoch 1).					Permanent operational effects t		will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary negative effect on human health through construction of Low Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 2 - Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – this measure will have similar **positive and negative effects** on material assets and Human Health (see Epoch 1).
	Reach 3	• Epoch 1: Low Defences - Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. • Epoch 2: Maintenance of Low Defences - the Low Defences and lock gate tie-ins will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences and lock gate tie-ins will be upgraded to High Defences by raising / lengthening the existing Low Defences. Additional High Defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	• Epoch 1: Low Defences - there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – this measure will have similar positive impacts for material assets and human health (see Epoch 1).	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1 - Low Defences - this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of Low Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										• Epoch 2 - Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – this measure will have similar **positive and negative effects** on material assets and human health (see Epoch 1).
Soil and water	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Maintenance of Low Defences – not present in Reach 1 in any epoch. • Epoch 3: High defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2: Maintenance of Low Defences - the Low Defences will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences will be upgraded to High Defences by raising / lengthening the existing Low Defences.	• Epoch 1: Low Defences – construction activity is likely to result in temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – temporary impacts associated with upgrading /construction (see Epoch 1). However, these impacts are likely to involve longer timescales due to the increased height of defences.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previously developed land which would have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – temporary effects associated with upgrading /construction (see Epoch 1).
	Reach 3	• Epoch 1: Low Defences - Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. • Epoch 2: Maintenance of Low Defences - the Low Defences and lock gate tie-ins will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences and lock gate tie-ins will be upgraded to High Defences by	• Epoch 1: Low Defences – construction activity is likely to result in temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. • Epoch 2: Maintenance of Low Defences - no impacts predicted. • Epoch 3: High Defences – temporary impacts associated with upgrading /construction (see Epoch 1). However, these impacts are likely to involve longer	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences – there would be some temporary negative effects associated with the disturbance of soils and leaching of contaminants into the River Avon. However these negative effects can be managed through mitigation which will be discussed by the project design team at a later date. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – temporary effects associated with upgrading /construction (see Epoch 1).

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		raising / lengthening the existing Low Defences. Additional High Defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	timescales due to the increased height of defences.							
Climatic factors	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Maintenance of Low Defences – not present in Reach 1 in any epoch. • Epoch 3: High defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2: Maintenance of Low Defences. • Epoch 3: High Defences – the Low Defences will be upgraded to High Defences by raising / lengthening the existing Low Defences.	• Epoch 1: Low Defences – this measure will be likely to reduce tidal flood risk in Reach 3. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to PLP. • Epoch 2: Maintenance of Low Defences- no impacts predicted. • Epoch 3: High Defences – this measure will have similar impacts (see Epoch 1).	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences – the Low Defences will have a **positive effect** on climate change resilience as this measure will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures taking into account climate change and potential sea level rise. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences –this measure will have similar effects (see Epoch 1).
	Reach 3	• Epoch 1: Low Defences – low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. • Epoch 2: Maintenance of Low Defences - the Low Defences and lock gate tie-ins will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences and lock gate tie-ins will be upgraded to High Defences by raising / lengthening the existing Low Defences. Additional High Defences will be required at new locations including Clarence Road	• Epoch 1: Low Defences – this measure will be likely to reduce tidal flood risk in Reach 3. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to PLP. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – this measure will have similar impacts (see Epoch 1).	-	✓	✓	City	Per Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Low Defences – the Low Defences will have a **positive effect** on climate change resilience as this measure will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures taking into account climate change and potential sea level rise. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences –this measure will have similar effects (see Epoch 1).

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		(New Cut) and Hotwells Road (River Avon).								
Cultural heritage	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Maintenance of Low Defences – not present in Reach 1 in any epoch. • Epoch 3: High defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. Along the River Avon Low Defences are required at Pill and Shirehampton. There are five Grade II Listed Buildings which are in close proximity to the Shirehampton alignment. These are: The Lamplighters Public House, Wellington House and Attached Stables, 105 Station Road, 103 Station Road and Myrtle Hall and Attached Wall. There are two Grade II Listed Buildings in close proximity to the Pill alignment. These are: Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House. • Epoch 2: Maintenance of Low Defences - the Low Defences will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences will be upgraded to High Defences by raising / lengthening the existing Low Defences.	• Epoch 1: Low Defences – this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, it also has the potential to impact on the setting and character of these assets. This measure is only likely to have an impact two of the seven Grade II Listed Buildings these are: Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill as these are the only assets expected to be visible from the measure. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – the geographical scope of impacts will be similar to those of Epoch 1 (see Epoch 1). The increased height of defences would result in a higher impact in terms of setting of assets.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences –The only Listed Buildings which are likely to be affected are: Grade II Listed Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill. The remaining Listed Buildings in Reach 2 are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. Overall this measure will have a mixture of positive and negative effects on cultural heritage. This measure will provide tidal flood risk protection to Listed Buildings in Pill and Shirehampton and therefore would have a **positive effect**. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the Low Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Low Defence measures should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – The geographical scope of effects will be similar to those of Epoch 1 (see Epoch 1). Additionally, increased height of defences would result in a more **negative effect** in terms of setting, and character of heritage assets. This effect would also be more difficult to mitigate for through design due to the

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										larger heights involved.
	Reach 3	• Epoch 1: Low Defences – Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. • Epoch 2: Maintenance of Low Defences - the Low Defences and lock gate tie-ins will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences and lock gate tie-ins will be upgraded to High Defences by raising / lengthening the existing Low Defences. Additional High Defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	• Epoch 1: Low Defences – there would be a negative impact caused by siting of a Low Defence in close proximity to cultural heritage assets. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – the geographical scope of impacts will be similar to those of Epoch 1 (see Epoch 1). Additional heritage assets affected include: *High Defence at Clarence Road:* The defence will be located in close proximity to the Grade II listed Langton Street Bridge The increased height of defences would result in a higher impact in terms of setting and character of assets.	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences – there are a number of Listed Buildings within 500 m of the Low Defences. Overall this measure will have a **positive effect** on cultural heritage as this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. The buildings which are likely to be effected are: *Low Defence at Cumberland Road:* Grade II* Listed Swing Bridge over North Entrance Lock, Grade II* Listed Swing Bridge over South Entrance Lock, Grade II* Listed Brunels South Entrance Lock, Grade II Listed B Bond Tobacco Warehouse, Grade II Listed Ashton Swing Bridge, Grade II Listed A Bond tobacco Warehouse, Grade II Vauxhall Bridge, Grade II Strand Buildings and 6 Grade II Listed Buildings on Cumberland Road. Underfall Yard which is a Scheduled Monument also has the potential to be impacted by this measure. *Low Defence at Bathurst Basin:* Grade II Listed Bedminster Bridge and Grade II Listed Drinking Fountain 3 metres north west of Bedminster Bridge. *Low Defence at Temple Meads:* Grade II Listed Temple Meads Station. *Low Defence at Totterdown:* No Listed Buildings are in close proximity to this defence. *Low Defence at Clarence Road:* Grade II Langton Street Bridge *Low Defence at Netham Lock:* Grade II Listed Netham Lock and Lock Keepers House. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – The geographical scope of effects will be similar to those of Epoch 1 (see Epoch 1). However, there would be additional **negative effects** along

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										Clarence Road. Additionally, increased height of defences would result in a more **negative effect** in terms of setting, and character of heritage assets.
Landscape	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Maintenance of Low Defences – not present in Reach 1 in any epoch. • Epoch 3: High defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. Pill is located within Avon Valley Rolling Farmland Landscape Character Area (LCA). The Shirehampton alignment is not located within an LCA. • Epoch 2: Maintenance of Low Defences - the Low Defences will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences will be upgraded to High Defences by raising / lengthening the existing Low Defences.	• Epoch 1: Low Defences - This measure has the potential to impact on Landscape through inappropriate design and layout. This measure would also have indirect impacts in terms of preventing access to existing areas particularly in Shirehampton. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – this measure will have similar impacts (see Epoch 1). The higher flood defence heights involved would result in a more negative impact relative to Low Defences,	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences - Identified impacts would result in **negative effects** on landscape character and setting. Landscape effects can be mitigated by careful design and siting of the Low Defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – The geographical scope of effects will be similar to those of Epoch 1 (see Epoch 1). However, the increased height of defences would result in a more **negative effect** in terms of visual effects and landscape character.
	Reach 3	• This measure is partially located within the City Docks Conservation Area as well as Bedminster Conservation Area. • Epoch 1: Low Defences – this measure involves the construction of low defences at several locations within the New Cut. The main areas where new defences are required are at Cumberland Road, Bathurst Basin Dam, Totterdown, Temple Meads and	• Epoch 1: Low Defences – this measure has the potential to impact on Landscape through inappropriate design and layout. This measure would also have indirect impacts in terms of preventing access to existing areas. • Epoch 2: Maintenance of Low Defences – no impacts predicted. • Epoch 3: High Defences – this measure will have similar impacts (see Epoch 1). The higher flood defence heights involved would result in a more negative impact relative to	-	✓	✓	City	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences: Identified impacts would result in **negative effects** on landscape character and setting, particularly in regard to defences located within the City Docks and Bedminster Conservation Areas. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Netham Dam. • Epoch 2: Maintenance of Low Defences - the Low Defences and lock gate tie-ins will be raised / lengthened to the 1:200 year standard of protection for 2030. • Epoch 3: High Defences – the Low Defences and lock gate tie-ins will be upgraded to High Defences by raising / lengthening the existing Low Defences. Additional High Defences will be required at new locations including Clarence Road (New Cut) and Hotwells Road (River Avon).	Low Defences.							connection to the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process.. • Epoch 2: Maintenance of Low Defences – no effects predicted. • Epoch 3: High Defences – The geographical scope of effects will be similar to those of Epoch 1 (see Epoch 1). However, the increased height of defences would result in a more **negative effect** in terms of visual effects and landscape character. This effect would also be more difficult to mitigate for through design due to the larger heights involved.

Table 6: Option E (Low Def – Barrier – Barrier)

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
				ST (2015-2030)	MT (2030-2065)	LT (2065-2115)				
Biodiversity, flora and fauna	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier - not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. The Shirehampton alignment is approximately 200 m away from the Severn Estuary SPA and SAC. • Epoch 2: Tidal Barrier – construction of a Tidal Barrier east of Horseshoe Bend. The northern extent is likely to lie in a Nibley Road Open Space which is a wildlife corridor. The southern extent is not located in an area of biodiversity value. There are a number of designated sites in close proximity to the Tidal Barrier. The Severn Estuary SPA and SAC are located approximately 1.5 km west of the Tidal Barrier. Ham Green SSSI is located approximately 500 m south east of the barrier location. Horseshoe Bend SSSI is located approximately 500 m north east of the barrier. Avon Gorge SSSI and Avon Gorge and Woodlands Special Area of Conservation (SAC) are located approximately 1.5 km east of the barrier. There are a number of European protected species recorded within this Reach. • Epoch 3: Maintenance of Tidal Barrier – maintenance of a Tidal	• Epoch 1: Low Defences - there would be some temporary impacts caused by the construction of the Low Defences. For example there would be disturbance associated with increased noise, dust and vibration as a result of construction activity such as piling. Once operational there would be no impacts on biodiversity, flora and fauna. • Epoch 2: Tidal Barrier – there would be some temporary impacts caused by the construction of the Tidal Barrier and associated new access road for example disturbance associated with increased noise, dust and vibration as a result of construction activity such as piling. Once operational, this measure would have a temporary minor negative impact on transient species such as fish as when the barrier is closed it would prevent fish from migrating up and down the river. • Epoch 3: Maintenance of Tidal Barrier – This measure would have a temporary impact on transient species such as fish when the barrier is closed for maintenance, as the barrier would prevent fish from migrating up and down the river.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences – construction activities which are likely to be involved include dredging, piling and excavation. There would be a temporary **negative effect** on the Severn Estuary SPA and SAC in the construction phase due to the close proximity of the Low Defences (particularly in Shirehampton) to the designated site. However the effects would be temporary and can be managed through mitigation which will be discussed by the project design team at a later date. • Epoch 2: Tidal Barrier – The Severn Estuary SAC and SPA are located 1.5 km west the Tidal Barrier location. The construction phase is expected last between three years. There would be **negative effects** on biodiversity (i.e. fish and birds) as a result of noise and vibration impacts caused by construction activity such as piling. Additionally if a coffer dam is being used within the river this would also have a **negative effect** on biodiversity. This measure would have a **negative effect** on transient species such as fish when the barrier is in operation, as the barrier would prevent fish from moving up and down the River Avon. However, the effect of this is likely to be negligible as it is estimated that the barrier will only be closed occasionally – i.e. a few times per year. However it is accepted that this would increase over the medium and long-

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Barrier east of Horseshoe Bend in Reach 2.								term. A gap in the data currently exists concerning fish stocks within the river. A sedimentation survey and fish survey are recommended to address this data gap if a barrier was to be progressed. Recommendation: A Habitats Regulations Assessment (HRA) Likely Significant Effect Screening should be undertaken if this option is taken forward to ensure that there are no significant environmental effects caused by this option. • Epoch 3: Maintenance of Tidal Barrier – This measure would have a temporary **negative effect** on transient species such as fish when the barrier is closed for maintenance, as the barrier would prevent fish from migrating up and down the river.
	Reach 3	• Epoch 1: Low Defences - Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Bathurst Basin and Cumberland Road. In addition, lock gate raising/ upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. Avon Gorge and Woodlands SAC are located approximately 300 m from this measure. There are 2 locally designated sites within this Reach: Bower Ashton Mineral Site of Nature Conservation Interest (SNCI) and Ashton Valley Fields SNCI. There are also multiple numbers of otter records which are a European protected species within this Reach. • Epoch 2: Tidal Barrier – N/A. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 3 in any epoch.	• Epoch 1: Low Defences – there would be some temporary impacts caused by the construction of the Low Defences for example disturbance associated with construction activity (e.g. piling) causing increased noise, dust and vibration impacts. • Epoch 2: Tidal Barrier – Once operational, this measure would have a temporary minor negative impact on transient species such as fish as when the barrier is closed it would prevent fish from migrating up and down the river. • Epoch 3: Maintenance of Tidal Barrier – This measure would have a temporary impact on transient species such as fish when the barrier is closed for maintenance, as the barrier would prevent fish from migrating up and down the river.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences - the effects on biodiversity, flora and fauna are likely to be minor temporary during the construction phase. The proposed locations of the Low Defences are not within areas designated for their biodiversity value. However, there are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). These European protected species are likely to use the River corridor and will need to be considered in the detailed planning stage. Negative effects would be managed through project level mitigation. Once operational there will be negligible effects on biodiversity, flora and fauna. • Epoch 2: Tidal Barrier – This measure would have a **negative effect** on transient species such as fish when the barrier is in operation, as the barrier would prevent fish from moving up and down the River Avon. However, the effect of this is likely to be negligible as it is estimated that the barrier will only be closed occasionally – i.e. a few times per year. However it is accepted that this would increase over the medium and long-term. A gap in the data currently exists concerning fish stocks within the river. A sedimentation survey and fish survey are recommended to address this data gap if

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										a barrier was to be progressed. • Epoch 3: Maintenance of Tidal Barrier – This measure would have a temporary impact on transient species such as fish when the barrier is closed for maintenance, as the barrier would prevent fish from migrating up and down the river.
Population, human health and material assets	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Tidal Barrier - not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2: Tidal Barrier – construction of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river. • Epoch 3: Maintenance of Tidal Barrier – maintenance of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river.	• Epoch 1: Low Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 2: Tidal Barrier – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 3: Maintenance of Tidal Barrier – no	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences - this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of Low Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a positive effect on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 2: Tidal Barrier - this measure will have a **positive** effect on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of Low Defences e.g. through HGV traffic, noise and dust

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
			impacts predicted.							emissions but once complete the receptors living upstream of the barrier should experience **positive health effects** through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: Low Defences – this measure involves the construction of Low Defences at several locations within the New Cut. The main areas where new defences are required are at Cumberland Road, Bathurst Basin Dam, Totterdown, Temple Meads and Clarence Road. • Epoch 2: Tidal Barrier - construction of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	• Epoch 1: Low Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 2: Tidal Barrier – flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences - this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of Low Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience **positive health effects** through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 2: Tidal Barrier - this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. Once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a positive effect on

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
Soil and water	Reach 1	• Epoch 1: Low Defences – Not present in Reach 1 in any epoch. • Epoch 2: Tidal Barrier – Not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier -– Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – Along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2: Tidal Barrier – Construction of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river. • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2.	• Epoch 1: Low Defences – construction activity is likely to result in temporary impacts on soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. • Epoch 2: Tidal Barrier – construction activity is likely to result in temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational, this measure has the potential to alter the water flow and sediment regime in Reach 2. • Epoch 3: Maintenance of Tidal Barrier – this measure has the potential to have an impact on the water flow and sediment regime in Reach 2 when the Tidal Barrier is closed for maintenance.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Low Defences – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previously developed land which would have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 2: Tidal Barrier – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previous industrial land use which have **negative effects** in terms of water quality which should be considered at a project design team level. This measure has the potential to alter the water flow and sediment regime in Reach 2 which would also result in a change to water quality. The extent of this is unknown, and therefore no conclusions can currently be made on this. • Epoch 3: Maintenance of Tidal Barrier –

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										this measure has the potential to temporarily alter the water flow and sediment regime in Reach 2 which would also result in a change to water quality when the Tidal Barrier is raised for maintenance. The extent of this is unknown, and therefore no conclusions can currently be made on this.
	Reach 3	• Epoch 1: Low Defences – this measure involves the construction of Low Defences at several locations within the New Cut. The main areas where new defences are required are at Cumberland Road, Bathurst Basin Dam, Totterdown, Temple Meads and Clarence Road. • Epoch 2: Tidal Barrier – not present in Reach 3 in any Epoch. • Epoch 3: Maintenance of Tidal Barrier - not present in Reach 3 in any epoch.	• Epoch 1: Low Defences – construction activity is likely to result in temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational no impacts are expected. • Epoch 2: Tidal Barrier - not present in Reach 3 in any epoch. • Epoch 3: Maintenance of Tidal Barrier - not present in Reach 3 in any epoch.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences - impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previously developed land which would have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 2: Tidal Barrier – construction effects of the Tidal Barrier will not be experienced in Reach 3 as the barrier is located more than 10 km downstream of Reach 3. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 3 in any epoch.
Climatic factors	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier - not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences - along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2: Tidal Barrier – construction of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river in Reach 2. • Epoch 3: Maintenance of a tidal - barrier See Epoch 2.	• Epoch 1: Low Defences – this measure would reduce tidal flood risk in Reach 3. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to PLP. • Epoch 2: Tidal Barrier – this measure will have similar impacts to Low Defences (see Epoch 1). However, these impacts are likely to involve a longer timescales. It will provide a high standard of flood protection. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences – the Low Defences will have a **positive effect** on climate change resilience as this measure will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures taking into account climate change and potential sea level rise. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 2: Tidal Barrier – the Tidal Barrier will have a **positive effect** on climate

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										change resilience as this measure will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures taking into account climate change and potential sea level rise. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: Low Defences – this measure involves the construction of Low Defences at several locations within the New Cut. The main areas where new defences are required are at Cumberland Road, Bathurst Basin Dam, Totterdown, Temple Meads and Clarence Road. • Epoch 2: Tidal Barrier – construction of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river in Reach 2. • Epoch 3: Maintenance of a Tidal Barrier - see Epoch 2.	• Epoch 1: Low Defences – this measure would reduce tidal flood risk in Reach 3. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to PLP. • Epoch 2: Tidal Barrier – this measure would reduce tidal flood risk in Reach 3. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to PLP. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences – the Low Defences will have a **positive effect** on climate change resilience as this measure will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures taking into account climate change and potential sea level rise. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 2: Tidal Barrier – the Tidal Barrier will have a **positive effect** on climate change resilience as this measure will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures taking into account climate change and potential sea level rise. Construction of the Tidal Barrier will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
Cultural heritage	Reach 1	• Epoch 1: Low Defences – not present in Reach 1 in any epoch. • Epoch 2: Tidal Barrier – not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier -– not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the River Avon Low Defences are required at Pill and Shirehampton. There are five Grade II Listed Buildings which are within approximately 500 m of the Shirehampton alignment. These are: The Lamplighters Public House, Wellington House and Attached Stables, 105 Station	• Epoch 1: Low Defences – this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, it also has the potential to impact on the setting and character of these assets. This measure is only likely to have an impact two of the seven Grade II Listed Buildings these are: Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and	-	✓	✓	Local	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences: The only Listed Buildings which are likely to be affected are: Grade II Listed Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill. The remaining Listed Buildings in Reach 2 are considered to be effectively screened from any impact and therefore there will be no effect on these

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Road, 103 Station Road and Myrtle Hall and Attached Wall. There are two Grade II Listed Buildings within 200 m of the Pill alignment. These are: Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House. • Epoch 2: Tidal Barrier – construction of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	Garage and Mulberry Cottage Mulberry House in Pill as these are the only assets expected to be visible from the measure. • Epoch 2: Tidal Barrier – there would be a negative impact associated with siting the Tidal Barrier in close proximity to cultural heritage assets. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.							cultural heritage assets. Overall this measure will have a mixture of positive and negative effects on cultural heritage. This measure will provide tidal flood risk protection to Listed Buildings in Pill and Shirehampton and therefore would have a **positive effect**. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the Low Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Low Defence measures should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 2: Tidal Barrier – The Tidal Barrier would offer protection from flooding to designated and undesignated cultural heritage assets and archaeological assets in Reach 2 and Reach 3. However, Listed Buildings in Pill and Shirehampton would not be protected by this measure which would have a negative effect on these assets. There are five Listed Buildings in close proximity to the proposed Tidal Barrier location. There is a Grade II Shirehampton Public Hall and Library which are approximately 50 m from the Tidal Barrier. There are three further Grade II Listed Buildings approximately 250 m south of the Tidal Barrier in Pill these are: Eighteenth Century Watergate and two flats to Ham Green Hospital. Overall this measure will have a **positive effect** on cultural heritage as this measure will provide tidal flood risk protection to Listed Buildings upstream of the barrier. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. There would be Listed Buildings that are screened from any effect and therefore there will be no effect on these cultural

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the Tidal Barrier away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Tidal Barrier should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: Low Defences – Low Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 2: Tidal Barrier – not present in Reach 3 in any Epoch. • Epoch 3: Maintenance of a Tidal Barrier not present in Reach 3 in any Epoch.	• Epoch 1: Low Defences – there would be a negative impact caused by siting of a Low Defence in close proximity to cultural heritage assets. • Epoch 2: Tidal Barrier – the Strategy would offer protection from flooding to several designated and undesignated cultural heritage assets and archaeological assets in Reach 3. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences – there are a number of Listed Buildings within 500 m of the Low Defences. Overall this measure will have a **positive effect** on cultural heritage as this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River Avon. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. The buildings which would be impacted on are: *Low Defence at Cumberland Road:* Grade II* Listed Swing Bridge over North Entrance Lock, Grade II* Listed Swing Bridge over South Entrance Lock, Grade II* Listed Brunels South Entrance Lock, Grade II Listed B Bond Tobacco Warehouse, Grade II Listed Ashton Swing Bridge, Grade II Listed A Bond tobacco Warehouse, Grade II Vauxhall Bridge, Grade II Strand Buildings and 6 Grade II Listed buildings on Cumberland Road. Underfall Yard which is a Scheduled Monument also has the potential to be impacted by this measure. *Low Defence at Bathurst Basin:* Grade II Listed Bedminster Bridge and Grade II Listed Drinking Fountain 3 metres north west of Bedminster Bridge. *Low Defence at Temple Meads:* Grade II Listed Temple Meads Station. *Low Defence at Clarence Road:* Grade II Langton Street Bridge *Low Defence at Netham Lock:* Grade II Listed Netham Lock and Lock Keepers

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										House. The Conservation Areas which are likely to be affected by this measure are City Docks and Bedminster. The conservation objectives for both of these areas will be taken into account as the design of these measures progresses. The Strategy should give consideration to principal historic buildings characterising the historic docks area, as well as aim to retain existing views, and its character relating to the forms and materials utilised in the traditional dockside area in order to enhance the conservation area. The remaining Listed Buildings are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the Low Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Low Defence measures should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 2: Tidal Barrier – This measure would have a **positive effect** on cultural heritage as a Tidal Barrier would offer protection from flooding to several designated and undesignated cultural heritage assets and archaeological assets in Reach 3. • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2
Landscape	Reach 1	• Epoch 1: Low Defences – Not present in Reach 1 in any epoch. • Epoch 2: Tidal Barrier – Not present in Reach 1 in any epoch. • Epoch 3: Maintenance of Tidal Barrier -– Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Low Defences – along the	• Epoch 1: Low Defences – this measure	-	✓	✓	City	Temporary	High	• Epoch 1: Low Defences: This measure is

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2: Tidal Barrier – construction of a Tidal Barrier east of Horseshoe Bend in Shirehampton across to Pill on the opposite side of the river. The Tidal Barrier is located in Shirehampton Conservation Area to the east and Avon Rolling Valley Farmland to the west. • Epoch 3: Maintenance of Tidal Barrier – see Epoch 2.	would have a negative impact on the landscape of the area, as well as views from the river. • Epoch 2: Tidal Barrier – this measure would have a negative impact on the landscape of the area, as well as views from the river. • Epoch 3: Maintenance of Tidal Barrier – no impacts predicted.					construction effects Permanent operational effects		likely to have a **negative effect** on Landscape. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront Key viewpoints should be tested as part of the design development process and consultation with local communities a key part of the process. • Epoch 2: Tidal Barrier – This measure is likely to have a **negative effect** on Landscape. However, this effect could be mitigated by careful design and siting of the barrier. Key viewpoints should be tested as part of the design development process and consultation with local communities a key part of the process. • Epoch 3: Maintenance of Tidal Barrier – no effects predicted.
	Reach 3	• Epoch 1: Low Defences – this measure involves the construction of low defences at several locations within the New Cut. The main areas where new defences are required are at Cumberland Road, Bathurst Basin Dam, Totterdown, Temple Meads and Netham Dam. This measure is partially located within the City Docks Conservation Area as well as Bedminster Conservation Area. • Epoch 2: Tidal Barrier – not present in Reach 3 in any Epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 3 in any Epoch.	• Epoch 1: Low Defences - this measure would have a negative impact on the landscape of the area, as well as views from the river. • Epoch 2: Tidal Barrier – not present in Reach 3 in any Epoch. • Epoch 3: Maintenance of Tidal Barrier - not present in Reach 3 in any Epoch.	-	✓	✓	City	Temporary construction effects Permanent operational effects	High	• Epoch 1: Low Defences – This measure is likely to have a **negative effect** on Landscape. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront Key viewpoints should be tested as part of the design development process and consultation with local communities a key part of the process. • Epoch 2: Tidal Barrier – not present in Reach 3 in any Epoch. • Epoch 3: Maintenance of Tidal Barrier – not present in Reach 3 in any Epoch.

Table 7: Option F (High Def – High Def – High Def)

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
				ST (2015-203)	MT (2030-2065)	LT (2065-2115)				
Biodiversity, flora and fauna	Reach 1	• Epoch 1: High Defences – Not present in Reach 1 in any epoch. • Epoch 2 and 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: High Defences – Along the River Avon High Defences are required at Pill and Shirehampton. At Pill the northern extent of the alignment is adjacent to the Severn Estuary SPA and SAC. The Shirehampton alignment will be a minimum of 200 m away from the Severn Estuary SPA and SAC site. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	• Epoch 1: High Defences – there would be some impacts caused by the construction of the High Defences for example through disturbance, increased noise and dust levels. Once operational there will be no impacts on biodiversity, flora and fauna. • Epoch 2 and 3: Maintenance of High Defences - No impacts predicted.	-	✓	-	City	Temporary construction effects	Medium	• Epoch 1: High Defences – Construction of High Defences – the effects on biodiversity, flora and fauna are likely to be minor temporary during the construction phase. These areas are not designated for their biodiversity value. However, there are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). The effects on European protected species can be managed through mitigation which will be discussed by the project design team at a later date. Overall this measure is likely to have a **negligible effect** on biodiversity, flora and fauna. Recommendation: A Habitats Regulations Assessment (HRA) Likely Significant Effect Screening should be undertaken if this option is taken forward to ensure that there are no significant environmental effects caused by this option • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.
	Reach 3	• Epoch 1: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	• Epoch 1: High Defences – there would be some impacts associated with the construction of the High Defences for example through disturbance, increased noise and dust levels. Once operational there will be no impacts on biodiversity, flora and fauna. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects	Medium	• Epoch 1: High Defences - the effects on biodiversity, flora and fauna are likely to be minor temporary during the construction phase. These areas are not designated for their biodiversity value. However, there are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). The effects on European protected species can be managed through mitigation which will be discussed by the project design team at a later date. Overall this measure is likely to

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										have a **negligible effect** on biodiversity, flora and fauna. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.
Population, human health and material assets	Reach 1	• Epoch 1: High Defences –– Not present in Reach 1 in any epoch. • Epoch 2 and 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	High	• N/A
	Reach 2	• Epoch 1: High Defences – Along the River Avon Low Defences are required at Pill and Shirehampton. • Epoch 2 and 3: Maintenance of High Defences.	• Epoch 1: High Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: High Defences – there would be a short-term, temporary **negative effect** on human health through construction of High Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
	Reach 3	• Epoch 1: High Defences - High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	• Epoch 1: High Defences - there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1 - High Defences– there would be a short-term, temporary **negative effect** on human health through construction of High Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 2 and 3: Maintenance of High Defences– No significant effects predicted.
Soil and water	Reach 1	• Epoch 1: High Defences – Not present in Reach 1 in any epoch. • Epoch 2 and 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: High Defences – Along the River Avon High Defences are required at Pill and Shirehampton. • Epoch 2 and 3: Maintenance of High Defences – Not present in Reach 2 in any epoch.	• Epoch 1: High Defences – construction activity is likely to result in some temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational there will be no impacts on water or soil receptors. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: High Defences - Impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previous industrial land use which have **negative effects** in terms of water quality which should be considered at a project design team level. • Epoch 2: Maintenance of High Defences – No significant effects predicted.
	Reach 3	• Epoch 1: High Defences - High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction	• Epoch 1: High Defences – construction activity is likely to result in some temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational there will be	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: High Defences - Impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previous industrial land use which have **negative**

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Lock, and at Netham Lock. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	no impacts on water or soil receptors. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.							**effects** in terms of water quality which should be considered at a project design team level. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.
Climatic factors	Reach 1	• Epoch 1: High Defences – Not present in Reach 1 in any epoch. • Epoch 2 and 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: High Defences – Along the River Avon High Defences are required at Hotwells Road, Pill and Shirehampton. • Epoch 2 and 3: Maintenance of High Defences – Not present in Reach 2 in any epoch.	• Epoch 1: High Defences – this measure will be likely to reduce flood risk in Reach 2. However, there would be higher levels of CO_2 emissions associated with construction of these defences. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects	Medium	• Epoch 1: High Defences – impacts from this measure should result in **positive effects** in terms of minimising increases in flood risk predicted due to tidal flooding associated with increased sea levels. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.
	Reach 3	• Epoch 1: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	• Epoch 1: High Defences – this measure will be likely to reduce flood risk in Reach 2. However, there would be higher levels of CO_2 emissions associated with construction of these defences. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects	Medium	• Epoch 1: High Defences – impacts from this measure should result in **positive effects** in terms of minimising increases in flood risk predicted due to tidal flooding associated with increased sea levels. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.
Cultural heritage	Reach 1	• Epoch 1: High Defences – Not present in Reach 1 in any epoch. • Epoch 2: Maintenance of High Defences – Not present in Reach 1 in any epoch. • Epoch 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A

Comment [SS(1]: Delete bullet

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
	Reach 2	• Epoch 1: High Defences – along the River Avon High Defences are required at Pill and Shirehampton. There are five Grade II Listed Buildings which are in close proximity to the Shirehampton alignment. These are: The Lamplighters Public House, Wellington House and Attached Stables, 105 Station Road, 103 Station Road and Myrtle Hall and Attached Wall. There are two Grade II Listed Buildings in close proximity to the Pill alignment. These are: Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House. • Epoch 2 and 3: Maintenance of High Defences – no impacts predicted.	• Epoch 1: High Defences – this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, it also has the potential to impact on the setting and character of these assets. This measure is only likely to have an impact two of the seven Grade II Listed Buildings these are: Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill as these are the only assets expected to be visible from the measure. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: High Defences – The only Listed Buildings which are likely to be affected are: Grade II Listed Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill. The remaining Listed Buildings in Reach 2 are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. Overall this measure will have a mixture of positive and negative effects on cultural heritage. This measure will provide tidal flood risk protection to Listed Buildings in Pill and Shirehampton and therefore would have a **positive effect**. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the Low Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Low Defence measures should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.
	Reach 3	• Epoch 1: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	• Epoch 1: High Defences – there would be a negative impact on the siting of a High Defence in close proximity to cultural heritage assets. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: High Defences – there are a number of Listed Buildings within 500 m of the High Defences. Overall this measure will have a **positive effect** on cultural heritage as this measure will provide flood risk protection to Listed Buildings in close proximity to the River. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. The buildings which are likely to be impacted are: *High Defence at Cumberland Road:* Grade II* Listed Swing Bridge over North Entrance Lock, Grade II* Listed Swing Bridge over South Entrance Lock, Grade II* Listed Brunels South Entrance Lock, Grade II Listed B Bond Tobacco Warehouse, Grade II Listed Ashton Swing Bridge, Grade II

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										Listed A Bond tobacco Warehouse, Grade II Vauxhall Bridge, Grade II Strand Buildings and 6 Grade II Listed Buildings on Cumberland Road. Underfall Yard which is a Scheduled Monument also has the potential to be impacted by this measure. *High Defence at Bathurst Basin:* Grade II Listed Bedminster Bridge and Grade II Listed Drinking Fountain 3 metres north west of Bedminster Bridge. *High Defence at Temple Meads:* Grade II Listed Temple Meads Station. *High Defence at Clarence Road:* Grade II Langton Street Bridge *High Defence at Netham Lock:* Grade II Listed Netham Lock and Lock Keepers House. The Conservation Areas which are likely to be affected by this measure are City Docks and Bedminster. The conservation objectives for both of these areas will be taken into account as the design of these measures progresses. The Strategy should give consideration to principal historic buildings characterising the historic docks area, as well as aim to retain existing views, and its character relating to the forms and materials utilised in the traditional dockside area in order to enhance the conservation area. The remaining Listed Buildings are considered to be effectively screened from any impact and therefore there will be negligible effects on these cultural heritage assets. Negative effects can potentially be mitigated by careful design and siting of the High Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the High Defence measures should be developed to limit any impacts to the setting of heritage assets in the area. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
Landscape	Reach 1	• Epoch 1: High Defences – Not present in Reach 1 in any epoch. • Epoch 2 and 3: Maintenance of High Defences – Not present in Reach 1 in any epoch.	• N/A	-	-	-	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: High Defences – Along the River Avon High Defences are required at Pill and Shirehampton. Pill is located within Avon Valley Rolling Farmland Landscape Character Area (LCA). The Shirehampton alignment is not located within an LCA. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	• Epoch 1: High Defences – Inappropriate design and layout would deteriorate the landscape or visual amenity, this measure also has the potential to prevent access to existing areas. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: High Defences: Landscape effects can be mitigated by careful design and siting of the high defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities a key part of the process. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.
	Reach 3	• Epoch 1: High Defences - High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock. This measure is partially located within the City Docks Conservation Area as well as Bedminster Conservation Area. • Epoch 2 and 3: Maintenance of High Defences – See Epoch 1.	• Epoch 1: High Defences - Inappropriate design and layout would deteriorate the landscape or visual amenity, this measure also has the potential to prevent access to existing areas. • Epoch 2 and 3: Maintenance of High Defences – No impacts predicted.	-	✓	-	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: High Defences: Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities a key part of the process. • Epoch 2 and 3: Maintenance of High Defences – No significant effects predicted.

Table 8: Option G (Do Min – Do Min – High Def)

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
				ST (2015-2033)	MT (2030-2065)	LT (2065-2115)				
Biodiversity, flora and fauna	Reach 1	• Epoch 1: Do minimum – Not present in Reach 1 in any epoch. • Epoch 2: Do minimum – Not present in Reach 1 in any epoch. • Epoch 3: High Defences – Not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – Along the River Avon High Defences are required at Pill and Shirehampton. At Pill the northern extent of the alignment is adjacent to the Severn Estuary SPA and SAC. The Shirehampton alignment will be a minimum of 200 m away from the Severn Estuary SPA and SAC.	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on biodiversity, flora and fauna compared with baseline conditions during Epoch 1. • Epoch 2: Do minimum – there may be an impact on biodiversity sites caused by an increased frequency of flooding up to 2065. Sites in Reach 2 which may be at Risk include Lamplighters Marsh Local Nature Reserve (LNR) and SNCI. • Epoch 3: High Defences – there would be some temporary impacts caused by the construction of the High Defences for example through disturbance, increased noise and dust levels. Once operational there will be no impacts on biodiversity, flora and fauna.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – There are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – There may be an effect on Biodiversity, flora and fauna caused by an increased frequency of flooding up to 2065 as well as increased water depth, water velocity and area covered. This means that sites of biodiversity value that are at risk of flooding will become more frequently inundated and sites currently not at risk of flooding begin to experience inundation. Both scenarios may result in a change to the biodiversity value of these sites and a detrimental effect on the conditions of the sites. This latter point could undermine the ability of habitats and species to adapt to the changing climate. • Epoch 3: High Defences – construction activities which are likely to be involved include dredging, piling and excavation. There would be a temporary **negative effect** on the Severn Estuary SPA and SAC in the construction phase due to the close proximity of the High Defences to the designated site. However the effects would be temporary and can be managed through mitigation which will be discussed by the project design team at a later date. There are also a number of European protected species recorded within this Reach (great crested newts, bats and otter).

Comment [SS(2]: Columns should be equalised in width. Please check throughout

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										These European protected species are likely to use the River corridor and will need to be considered in the detailed planning stage. Negative effects would be managed through project level mitigation. Recommendation: A Habitats Regulations Assessment (HRA) Likely Significant Effect Screening should be undertaken if this option is taken forward to ensure that there are no significant environmental effects caused by this option.
	Reach 3	• Epoch 1: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. Along the River Avon High Defences are required at Hotwells Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock.	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on biodiversity, flora and fauna compared with baseline conditions. • Epoch 2: Do minimum – there may be an impact on biodiversity sites caused by an increased frequency of flooding up to 2065, for example Bower Ashton Mineral Railway SNCI may be at risk. • Epoch 3: High Defences – there would be some impacts associated with the construction of the High Defences for example disturbance associated with increased noise, dust and vibration through piling. Once operational there will be no impacts on biodiversity, flora and fauna.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – There are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – There may be an effect on Biodiversity, flora and fauna caused by an increased frequency of flooding up to 2065 as well as increased water depth, water velocity and area covered. This means that sites of biodiversity value that are at risk of flooding will become more frequently inundated and sites currently not at risk of flooding begin to experience inundation. Both scenarios may result in a change to the biodiversity value of these sites and a detrimental effect on the conditions of the sites. This latter point could undermine the ability of habitats and species to adapt to the changing climate. • Epoch 3: High Defences – construction activities which are likely to be involved include dredging, piling and excavation the effects on biodiversity, flora and fauna are likely to be minor temporary during the construction phase. In Reach 3 there are no areas in close proximity (e.g. 200 m) designated for their biodiversity value. However, there are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). These European protected species are likely to use the River corridor and will need to be considered in the detailed planning stage. Negative effects would be managed through project level mitigation.
Population,	Reach 1	• Epoch 1: Do minimum – Not	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
human health and material assets		present in Reach 1 in any epoch. • Epoch 2: Do minimum – Not present in Reach 1 in any epoch. • Epoch 3: High Defences – Not present in Reach 1 in any epoch.								
	Reach 2	• Epoch 1: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – Along the River Avon High Defences are required at Pill and Shirehampton.	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on population human health and material assets compared with baseline conditions. • Epoch 2: Do minimum – there may be an impact on material assets and on human health as the frequency of flooding increases up until 2065. • Epoch 3: High Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – There are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – As water levels are predicted to rise it is likely that less material assets including houses and infrastructure will receive adequate flood protection from the current defences, as a result there would be a **negative effect** on some material assets as they would become increasingly vulnerable to flooding, This is likely to have a negative effect on human health due the increase in the risk of flooding and the associated psychological effects it causes to people living in high risk areas. • Epoch 3: High Defences – this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of High Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality.
	Reach 3	• Epoch 1: Do minimum – Maintain the existing defence assets and water level control infrastructure	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained,	-	✓	✓	City	Temporary construction effects	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure.

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		and operations. • Epoch 2: Do minimum – Maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. Along the River Avon High Defences are required at Hotwells Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock.	and therefore this flood defence measure is likely to have a negligible impact on Population, human health and material assets compared with baseline conditions. • Epoch 2: Do minimum –there may be an impact on material assets and on human health as the frequency of flooding increases up until 2065. • Epoch 3: High Defences – there would be short term negative impacts on human health associated with disturbance caused by increased noise and dust levels in the construction phase. Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development.					Permanent operational effects		• Epoch 2: Do minimum – As water levels are predicted to rise it is likely that less material assets including houses and infrastructure will receive adequate flood protection from the current defences, as a result there would be a **negative effect** on some material assets as they would become increasingly vulnerable to flooding, This is likely to have a negative effect on human health due the increase in the risk of flooding and the associated psychological effects it causes to people living in high risk areas. • Epoch 3: High Defences – this measure will have a positive effect on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of High Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality.
Soil and water	Reach 1	• Epoch 1: Do minimum – not present in Reach 1 in any epoch. • Epoch 2: Do minimum – not present in Reach 1 in any epoch. • Epoch 3: High Defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on soil and	-	✓	✓	City	Temporary construction effects Permanent	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – There may be a negative effect on water quality should any

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		water level control infrastructure and operations. • Epoch 3: High Defences – along the River Avon High Defences are required at Pill and Shirehampton.	water compared with baseline conditions. • Epoch 2: Do minimum – Tidal flooding is likely to mobilise contaminants and provide a pathway to water bodies. • Epoch 3: High Defences – construction activity is likely to result in some temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational there will be no impacts on water or soil receptors.					operational effects		contaminated land become inundated. • Epoch 3: High Defences – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previous industrial land use which have **negative effects** in terms of water quality which should be considered at a project design team level.
	Reach 3	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. Along the River Avon High Defences are required at Hotwells Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock.	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on soil and water compared with baseline conditions. • Epoch 2: Do minimum – There may be a negative impact on water quality should any of the areas which are inundated be contaminated. • Epoch 3: High Defences – construction activity is likely to result in some temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling would lead to the release of contaminants to the River Avon. Once operational there will be no impacts on water or soil receptors.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – There may be a negative effect on water quality should any contaminated land become inundated. • Epoch 3: High Defences – impacts from this measure will not translate into significant long term effects. However, there would be temporary **negative effects** in the medium term associated with silt and sediment disturbance and other construction impacts. There is the potential of contaminant release from previous industrial land use which have **negative effects** in terms of water quality which should be considered at a project design team level.
Climatic factors	Reach 1	• Epoch 1: Do minimum – Not present in Reach 1 in any epoch. • Epoch 2: Do minimum – Not present in Reach 1 in any epoch. • Epoch 3: High Defences – Not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on climatic factors compared with baseline conditions.	-	✓	✓	City	Temporary construction effects	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – no significant effects (see Epoch 1). • Epoch 3: High Defences – impacts from this

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		and operations. • Epoch 3: High Defences – along the River Avon High Defences are required at Pill and Shirehampton.	• Epoch 2: Do minimum – limited / no impact (See Epoch 1) • Epoch 3: High Defences – this measure will be likely to reduce tidal flood risk in Reach 2. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to Do Minimum.							measure should result in **positive effects** in terms of minimising increases in tidal flood risk predicted due to tidal flooding associated with increased sea levels. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect.
	Reach 3	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. Along the River Avon High Defences are required at Hotwells Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock.	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on climatic factors compared with baseline conditions. • Epoch 2: Do minimum – Limited / no impact (See Epoch 1). • Epoch 3: High Defences – this measure will be likely to reduce tidal flood risk in Reach 2. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to Do Minimum.	-	✓	✓	City	Temporary construction effects	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – no significant effects (see Epoch 1). • Epoch 3: High Defences – impacts from this measure should result in **positive effects** in terms of minimising increases in tidal flood risk predicted due to tidal flooding associated with increased sea levels. Construction of these defences will result in CO_2 emissions, however it is not considered to be a significant effect.
Cultural heritage	Reach 1	• Epoch 1: Do minimum – not present in Reach 1 in any epoch. • Epoch 2: Do minimum – not present in Reach 1 in any epoch. • Epoch 3: High Defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – along the River Avon Low Defences are required at Pill and Shirehampton. There are five Grade II Listed	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on cultural heritage compared with baseline conditions. • Epoch 2: Do minimum – There may be a negative impact on cultural heritage assets as they become increasingly vulnerable to flooding. • Epoch 3: High Defences – this measure will	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – There are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – As water levels are predicted to rise it is likely that less assets will receive adequate flood protection from the current defences, as a result there would be a **negative effect** on some cultural heritage assets as they would become increasingly vulnerable to flooding, • Epoch 3: High Defences – The only Listed

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Buildings which are within approximately 500 m of the Shirehampton alignment. These are: The Lamplighters Public House, Wellington House and Attached Stables, 105 Station Road, 103 Station Road and Myrtle Hall and Attached Wall. There are two Grade II Listed Buildings within 200 m of the Pill alignment. These are: Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House.	provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, it also has the potential to impact on the setting and character of these assets. This measure is only likely to have an impact two of the seven Grade II Listed Buildings these are: Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill as these are the only assets expected to be visible from the measure.							Buildings which are likely to be affected are: Grade II Listed Lamplighters Public House in Shirehampton, and the Watch House, Retaining Walls to the River and Garage and Mulberry Cottage Mulberry House in Pill. The remaining Listed Buildings in Reach 2 are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. Overall this measure will have a mixture of positive and negative effects on cultural heritage. This measure will provide tidal flood risk protection to Listed Buildings in Pill and Shirehampton and therefore would have a positive effect. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. Any negative effects can potentially be mitigated by careful design and siting of the Low Defences away from sensitive heritage assets and previously recorded archaeological deposits to reduce any environmental impact. The form, layout and orientation of the Low Defence measures should be developed to limit any impacts to the setting of heritage assets in the area.
	Reach 3	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – High Defences are required along the New Cut at Netham, Bath Road, Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. Along the River Avon High Defences are required at Hotwells Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock.	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on cultural heritage compared with baseline conditions. • Epoch 2: Do minimum – limited / no impact (See Epoch 1) • Epoch 3: High Defences – there would be a negative impact on the siting of a High Defence in close proximity to cultural heritage assets.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – As water levels are predicted to rise it is likely that less assets will receive adequate flood protection from the current defences, as a result there would be a **negative effect** on some cultural heritage assets as they would become increasingly vulnerable to flooding, • Epoch 3: High Defences – there are a number of Listed Buildings within 500 m of the High Defences. Overall this measure will have a **positive effect** on cultural heritage as this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the river. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. The buildings

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										which are likely to be impacted are: *High Defence at Cumberland Road:* Grade II* Listed Swing Bridge over North Entrance Lock, Grade II* Listed Swing Bridge over South Entrance Lock, Grade II* Listed Brunels South Entrance Lock, Grade II Listed B Bond Tobacco Warehouse, Grade II Listed Ashton Swing Bridge, Grade II Listed A Bond tobacco Warehouse, Grade II Vauxhall Bridge, Grade II Strand Buildings and 6 Grade II Listed buildings on Cumberland Road. Underfall Yard which is a Scheduled Monument also has the potential to be impacted by this measure. *High Defence at Bathurst Basin:* Grade II Listed Bedminster Bridge and Grade II Listed Drinking Fountain 3 metres north west of Bedminster Bridge. *High Defence at Temple Meads:* Grade II Listed Temple Meads Station. *High Defence at Clarence Road:* Grade II Langton Street Bridge *High Defence at Netham Lock:* Grade II Listed Netham Lock and Lock Keepers House. The remaining Listed Buildings are considered to be effectively screened from any impact and therefore there will be no effect on these cultural heritage assets. The Conservation Areas which are likely to be affected by this measure are City Docks and Bedminster. The conservation objectives for both of these areas will be taken into account as the design of these measures progresses. The Strategy should give consideration to principal historic buildings characterising the historic docks area, as well as aim to retain existing views, and its character relating to the forms and materials utilised in the traditional dockside area in order to enhance the conservation area. Negative effects can potentially be mitigated by careful design and siting of the High Defences away from sensitive heritage assets and previously recorded

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
										archaeological deposits to reduce any environmental impact. The form, layout and orientation of the High Defence measures should be developed to limit any impacts to the setting of heritage assets in the area.
Landscape	Reach 1	• Epoch 1: Do minimum – not present in Reach 1 in any epoch. • Epoch 2: Do minimum – not present in Reach 1 in any epoch. • Epoch 3: High Defences – not present in Reach 1 in any epoch.	• N/A	N/A	N/A	N/A	N/A	N/A	N/A	• N/A
	Reach 2	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – along the River Avon Low Defences are required at Pill and Shirehampton. Pill is located within Avon Valley Rolling Farmland Landscape Character Area (LCA). The Shirehampton alignment is not located within an LCA.	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on landscape compared with baseline conditions. • Epoch 2: Do minimum – limited / no impact (See Epoch 1) • Epoch 3: High Defences – this measure has the potential to impact on Landscape through inappropriate design and layout. This measure would also have indirect impacts in terms of preventing access to existing areas particularly in Shirehampton.	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – There may be a negative effect on Landscape if the areas affected by flooding are inundated for a long period of time. This may result in a change to the Landscape Character of the area as Lakes, Pools and Ponds are formed. • Epoch 3: High Defences – identified impacts would result in **negative effects** on landscape character and setting. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process.
	Reach 3	• Epoch 1: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 2: Do minimum – maintain the existing defence assets and water level control infrastructure and operations. • Epoch 3: High Defences – High Defences are required along the New Cut at Netham, Bath Road,	• Epoch 1: Do minimum – overall, this flood defence measure is likely to have a limited / no impact as 'Do minimum' represents what happens if the 'status quo' is maintained, and therefore this flood defence measure is likely to have a negligible impact on landscape compared with baseline conditions. • Epoch 2: Do minimum – limited / no impact (See Epoch 1) • Epoch 3: High Defences – this measure has	-	✓	✓	City	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Do minimum – there are no significant effects (relative to baseline conditions) predicted for this measure. • Epoch 2: Do minimum – There may be a negative effect on Landscape if the areas affected by flooding are inundated for a long period of time. This may result in a change to the Landscape Character of the area as Lakes, Pools and Ponds are formed. • Epoch 3: High Defences – identified impacts would result in negative effects on

SEA objective	Plan area	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Geographic extent (local, city, region)	Permanent / temporary	Level of certainty	Commentary / identification of significant effects
		Totterdown, Temple Meads, Clarence Road, Bathurst Basin and Cumberland Road. Along the River Avon High Defences are required at Hotwells Road. In addition, lock gate raising / upgrades and new defence tie-ins are required at either Entrance Lock or Junction Lock, and at Netham Lock.	the potential to impact on landscape through inappropriate design and layout.							landscape character and setting, particularly in regard to defences located within the City Docks and Bedminster Conservation Areas. Landscape effects can be mitigated by careful design and siting of the Low Defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process.

Table 9: Option D1 (Low Def – Low Def – High Def) (note effects are confined to Reach 3 ONLY)

SEA objective	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Permanent / temporary	Level of certainty	Commentary / identification of significant effects
			ST (2015-203)	MT (2030-2065)	LT (2065-2115)			
Biodiversity, flora and fauna	• Epoch 1: Low Defences – are required at Entrance Lock, Netham, Bathurst Dam and Totterdown. • Epoch 2: Low Defences – are required at Cumberland Road, Cumberland Road East, Commercial Road, Clarence Road and Cattle Market Road. • Epoch 3: High Defences – all Low Defences will be raised to High Defences.	• Epoch 1: Low Defences – there may be some temporary impacts caused by the construction of the Low Defences for example disturbance associated with construction activity (e.g. piling) causing increased noise, dust and vibration, particularly at locations where the alignment is completely/partially frontline i.e. at Netham and Bathurst Dam. • Epoch 2: Low Defences – there may be some temporary impacts caused by the construction of the Low Defences for example disturbance associated with construction activity (e.g. piling) causing increased noise, dust and vibration, particularly at locations where the alignment is completely/partially frontline i.e. at Clarence Road, Commercial Road and Cattle Market Road. • Epoch 3: High Defences – The impacts remain broadly the same as for Epoch 1 although no piling is proposed in this Epoch, and therefore the impact associated with construction activity is expected to be less.	-	✓	✓	Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Low Defences – the effects on biodiversity, flora and fauna are likely to be **negligible** as there are no sites designated at local, national or international level for their biodiversity value in close proximity to the alignments. There are a number of European protected species recorded within this Reach (great crested newts, bats, and otter). These European protected species are likely to use the River corridor and will need to be considered in the detailed planning stage. Any negative effects would be managed through project level mitigation. • Epoch 2: Low Defences – Refer to Epoch 1. • Epoch 3: High Defences: Refer to Epoch 1.

SEA objective	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Permanent / temporary	Level of certainty	Commentary / identification of significant effects
Population, human health and material assets	• Epoch 1: Low Defences – are required at Entrance Lock, Netham, Bathurst Dam and Totterdown. • Epoch 2: Low Defences – are required at Cumberland Road, Cumberland Road East, Commercial Road, Clarence Road and Cattle Market Road. • Epoch 3: High Defences – all Low Defences will be raised to High Defences.	• Epoch 1: Low Defences - there may be a short term negative impact on human health associated with disturbance caused by increased noise and dust levels in the construction phase, particularly where there are residential receptors in close proximity to the alignment such as on Cumberland Road. However construction of the defences will be phased over time and will be staggered in terms of location. This means that the effects will be transient and dispersed. • Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce tidal flood risk and therefore would have a positive impact on these aspects of human health. This measure will have a positive impact on material assets as it will ensure more land will be under protection from flooding and therefore available for development. • Epoch 2: Low Defences – Refer to Epoch 1. • Epoch 3: High Defences – this measure will have similar positive impacts for material assets and human health (see Epoch 1).	-	✓	✓	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1 - Low Defences - this measure will have a **positive effect** on human health as this measure will reduce the risk of flooding, and the associated psychological effects it causes to people living in high risk areas. There would be a short-term, temporary **negative effect** on human health through construction of Low Defences e.g. through HGV traffic, noise and dust emissions but once complete the receptors living in close proximity to the measures should experience positive health effects through the reassurance provided by increased flood protection. This measure will have a **positive effect** on population, human health and material assets as it will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures and therefore would provide opportunities for investment for growth and community vitality. • Epoch 2 - Low Defences – Refer to Epoch 1. • Epoch 3: High Defences – this measure will have substantial **positive effects** on material assets due to the exceptional high level of protection from flooding provided by High Defences.
Soil and water	• Epoch 1: Low Defences – are required at Entrance Lock, Netham, Bathurst Dam and Totterdown. • Epoch 2: Low Defences – are required at Cumberland Road, Cumberland Road East, Commercial Road, Clarence Road and Cattle Market Road. • Epoch 3: High Defences – all Low Defences will be raised to High Defences.	• Epoch 1: Low Defences – construction activity is likely to result in temporary impacts to soils e.g. through compaction caused by HGV vehicles and sediment disturbance associated with excavation. Construction activity such as piling may lead to the release of contaminants to the River Avon, particularly if the alignment is completely/partially frontline such as at Netham and Bathurst Dam. • Epoch 2: Low Defences - Refer to Epoch 1. Frontline sections on the alignment are at Clarence Road, Commercial Road and Cattle Market Road. • Epoch 3: High Defences – temporary impacts associated with upgrading /construction (see Epoch 1). However, these impacts are likely to involve longer timescales due to the increased height of defences.	-	✓	✓	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences – there would be some temporary negative effects associated with the disturbance of soils and leaching of contaminants into the River Avon. However these negative effects can be managed through mitigation which will be discussed by the project design team at a later date. • Epoch 2: Low Defences – no effects predicted. • Epoch 3: High Defences – temporary effects associated with upgrading /construction (see Epoch 1).

SEA objective	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Permanent / temporary	Level of certainty	Commentary / identification of significant effects
Climatic factors	• Epoch 1: Low Defences – are required at Entrance Lock, Netham, Bathurst Dam and Totterdown. • Epoch 2: Low Defences – are required at Cumberland Road, Cumberland Road East, Commercial Road, Clarence Road and Cattle Market Road. • Epoch 3: High Defences – all Low Defences will be raised to High Defences.	• Epoch 1: Low Defences – this measure will be likely to reduce tidal flood risk. However, there would be higher levels of CO_2 emissions associated with construction of these defences compared to PLP. • Epoch 2: Low Defences – Refer to Epoch 1. • Epoch 3: High Defences – this measure will have similar impacts (see Epoch 1).	-	✓	✓	Per Temporary construction effects Permanent operational effects	Medium	• Epoch 1: Low Defences – the Low Defences will have a **positive effect** on climate change resilience as this measure will provide a high standard of protection from flooding compared to the Do Minimum and PLP measures taking into account climate change and potential sea level rise. Construction of these defences will result in some CO_2 emissions, however it is not considered to be a significant effect. • Epoch 2: Low Defences – no effects predicted. • Epoch 3: High Defences –this measure will have similar effects (see Epoch 1).
Cultural heritage	• Epoch 1: Low Defences – are required at Entrance Lock, Netham, Bathurst Dam and Totterdown. • Epoch 2: Low Defences – are required at Cumberland Road, Cumberland Road East, Commercial Road, Clarence Road and Cattle Market Road. • Epoch 3: High Defences – all Low Defences will be raised to High Defences.	• Epoch 1: Low Defences – there would be a negative impact on the setting of heritage assets should the alignment be sited in close proximity. • Epoch 2: Low Defences – Refer to Epoch 1. • Epoch 3: High Defences – the geographical scope of impacts will be similar to those of Epoch 1 (see Epoch 1).	-	✓	✓	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences – there are a number of Listed Buildings within 500 m of the Low Defences. Overall this measure will have a **positive effect** on cultural heritage as this measure will provide tidal flood risk protection to Listed Buildings in close proximity to the River. However, this measure would have a **negative effect** in terms of the setting of some cultural heritage assets. The assets which are likely to be affected are: - **Entrance Lock**: Grade II* Swing Bridge over North Entrance Lock and South Entrance Lock; Grade II* Brunel's South Entrance Lock; Grade II B Bond Tobacco Warehouse; Grade II A Bond Tobacco Warehouse; Grade II Ashton Swing Bridge; Grade II Listed Buildings on Avon Crescent; Grade II Listed Buildings within Underfall Yard; and Underfall Yard Scheduled Ancient Monument. There are also a number of non-statutory designated assets in close proximity to the proposed alignment. - **Netham:** Grade I Avon Bridge; and Grade II Netham Locks Bridge. There are also a number of non-statutory designated assets in close proximity to the proposed alignment. - **Bathurst Dam:** Grade II Bathurst Basin; there are also a number of non-statutory designated assets in close proximity to the proposed alignment. - **Totterdown:** There are no Listed Buildings in close proximity to this alignment; however there are a number of non-statutory designated assets. • Epoch 2: Maintenance of Low Defences – Refer to Epoch 1. The assets which are likely to be

SEA objective	Broad implications of the Strategy	Direct / indirect impacts	Temporal scope (epoch where effect occurs)			Permanent / temporary	Level of certainty	Commentary / identification of significant effects
								affected are: - **Cumberland Road:** Grade II Vauxhall Bridge; there are also a number of non-statutory designated assets in close proximity to the proposed alignment. - **Cumberland Road East**: There are no Listed Buildings in close proximity to this alignment. - **Commercial Road:** There are no Listed Buildings in close proximity to this alignment. - **Clarence Road:** Grade II Langton Street Bridge. - **Cattlemarket Road:** There are no Listed Buildings in close proximity to this alignment. • Epoch 3: High Defences – The geographical scope of effects will be similar to those of Epoch 1 (see Epoch 1). However, there would be additional **negative effects** along Clarence Road. Although the increased height of defences would result in a more **negative effect** in terms of setting, and character of heritage assets.
Landscape	• Epoch 1: Low Defences – are required at Entrance Lock, Netham, Bathurst Dam and Totterdown. • Epoch 2: Low Defences – are required at Cumberland Road, Cumberland Road East, Commercial Road, Clarence Road and Cattle Market Road. • Epoch 3: High Defences – all Low Defences will be raised to High Defences.	• Epoch 1: Low Defences – this measure has the potential to impact on the Landscape Character of the area (particularly at Entrance Lock) as well as impact on key views to and from the River. • Epoch 2: Low Defences – Refer to Epoch 1. • Epoch 3: High Defences – this measure will have similar impacts (see Epoch 1). The higher flood defence heights involved would result in a more negative impact relative to Low Defences.	-	✓	✓	Temporary construction effects Permanent operational effects t	Medium	• Epoch 1: Low Defences: Identified impacts would result in **negative effects** on landscape character and setting, particularly in regard to defences located in Conservation Areas such as City Docks. Landscape effects can be mitigated by careful design and siting of the low defence to ensure that the landscape and townscape quality is protected or enhanced. For example there is the option to install reinforced glass walls as part of the raised defence measures which could help to sustain the views and connection to the waterfront. Key viewpoints should be tested as part of the design development process and consultation with local communities is a key part of the process. • Epoch 2: Low Defences – Refer to Epoch 1. • Epoch 3: High Defences – The geographical scope of effects will be similar to those of Epoch 1 (see Epoch 1). However, the increased height of defences would result in a more **negative effect** in terms of visual effects and landscape character. This effect would also be more difficult to mitigate for through design due to the larger heights involved.

Appendix D: Report to inform a Habitats Regulations Assessment

River Avon Tidal Flood Risk Management Strategy Report to Inform a Habitat Regulations Assessment

No Likely Significant Effects Report

Bristol City Council

September 2017

Quality information

Prepared by	Checked by	Approved by
NT Technical Director	JD Principal Flood and Coastal Specialist	NS Regional Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	10/01/17	Draft for client review	JR	James Riley	Associate Director
2	17/03/17	Updated following client and Environment Agency comments	JR	James Riley	Associate Director
3	31/07/17	Final	JR	David Dales	Technical Reviewer
4	21/09/17	Final	NS	Nikki Smith	Regional Director

Prepared for:

Bristol City Council

Prepared by:

NM
Graduate Ecologist

AECOM Limited
Midpoint
Alencon Link
Basingstoke
Hampshire RG21 7PP
UK

T: +44(0)1256 310200
aecom.com

Table of Contents

Limitations

AECOM Infrastructure & Environment UK Limited ("AECOM") has prepared this Report for the sole use of Bristol City Council ("Client") in accordance with the Agreement under which our services were performed **River Avon Tidal Flood Risk Management Strategy RESP1007626 (23/10/15) and Response to Tender Submission Clarifications (03/11/15) (the "Agreement")**. The report takes into account the particular instructions and requirements of the Client in accordance with the provisions of the Agreement. It is not intended for and cannot be relied upon by any third party. No liability is accepted by AECOM and no responsibility is undertaken to any third party.

Information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report.

The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken in June 2017 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Copyright

1. Introduction

1.1 Background

In 2016 AECOM devised the Bristol City Tidal Flood Risk Management Strategy (TFRMS) on behalf of Bristol City Council. Effective strategic tidal flood risk management is essential for the city of Bristol, not just because of the threat to lives and property but also because of the risk of long-term reputational damage on the city's attractiveness and economic prosperity. This project will deliver a Tidal Flood Risk Management Strategy (TFRMS) (the 'Strategy') for the area of Bristol at risk of flooding from the River Avon, including the city centre (between Cumberland Basin and Netham), Shirehampton and Avonmouth.

The preferred programme of adaptive measures covers a 100 year appraisal period (2015-2115) has been carried out and split into three time epochs:

- Epoch 1: 2015 to 2030 (short term);
- Epoch 2: 2030 to 2065 (medium term); and
- Epoch 3: 2065 to 2115 (long term).

By developing management options in accordance with these time epochs it will allow for an adaptive approach to management to be developed that keeps pace with climate change and potential sea level rise.

Six intervention measures were considered in the short list appraisal. These included:

- Do Minimum;
- Local scale property level protection & temporary / demountable defences;
- High Defences;
- Low Defences;
- Narrow Tidal Barrier; and
- Wide Tidal Barrier.

Following the production of the first draft of this HRA, it was identified that detriment mitigation (i.e. measures to avoid increased flood risk in some parts of the Strategy area due to new defences in other parts) would be required. In the Netham area (DM5) this included:

- Installing a flap on the Brislington Brook outfall;
- Culverting the open section of the Brislington Brook; and
- Providing over-pumping when the Brislington Brook cannot discharge under gravity.

In addition, at Bower Ashton the proposals involve the raising of the existing bank to a height of 10.3 m. This bank will be approximately 480 m long, with an average height increase of 1.4 m, and a maximum height increase of 2.4 m.

1.2 Commission

Bristol City Council has commissioned AECOM to undertake a Tidal Flood Risk Management Strategy along the tidal River Avon. The Strategy is primarily required to mitigate the significant risk of flooding to residential areas which lie behind the waterfront industry.

The study is intended to gain the necessary data and evidence required to build a robust business case for the Strategy, which encompasses a 5km frontage from the Cumberland Road to the Netham Road overbridge. The outputs of the study will include an outline design for the preferred option, and will allow Bristol City Council to develop and submit a strategic Outline Business Case to the Environment Agency to apply for grant aid funding for the Strategy.

Although not specifically required in the scope of the commission, the deliverables of the study will contribute in the future towards planning applications for any flood risk mitigation schemes emanating from the Strategy.

1.3 This Report

Regulation 61(1) of the Conservation of Habitats and Species Regulations 2010 (as amended) states that '*A competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which—*

(a) is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and

(b) is not directly connected with or necessary to the management of that site,

must make an appropriate assessment of the implications for that site in view of that site's conservation objectives'.

Regulation 61(5) states that '*In the light of the conclusions of the assessment, and subject to regulation 62 (considerations of overriding public interest), the competent authority may agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the European site or the European offshore marine site (as the case may be)'.*

The study is only intended to provide sufficient information and analysis to support the development of the outline business case for the Strategy. However, since the Strategy constitutes a plan, it is considered prudent to consider that it falls within the remit of the aforementioned Regulations.

AECOM was appointed by the Council to provide the authority with an independent technical report to inform the Council in its discharge of duties under the Conservation of Habitats & Species Regulations (2010, as amended), specifically as they relate to protection of internationally important wildlife sites.

In accordance with Regulation 61(3) this report should be provided to Natural England for their comment and their comments taken into account in producing a final version of this report.

European Union (EU) Directive 92/43/EEC1 on the conservation of habitats and of wild flora and fauna (known as the 'Habitats Directive') protects habitats and species of European nature conservation importance. Together with Directive 2009/147/EC2 on the conservation of wild birds (the 'Birds Directive'), the Habitats Directive establishes a network of internationally important sites designated for their ecological status. Special Areas of Conservation (SACs) and Sites of Community Importance (SCIs) are designated under the Habitats Directive and promote the protection of flora, fauna and habitats. Special Protection Areas (SPAs) are designated under the Birds Directive in order to protect rare, vulnerable and migratory birds. These sites combine to create a Europe-wide 'Natura 2000' network of designated sites, which are hereafter referred to as 'European Sites'.

The Conservation of Habitats and Species Regulations 2010 (as amended)[3] (the 'Habitats Regulations') incorporate all SPAs into the definition of 'European Sites' and, consequently, the protections afforded to European Sites under the Habitats Directive apply to SPAs designated under the Birds Directive.

In addition to sites designated under European nature conservation legislation, UK Government policy states that internationally important wetlands designated under the Ramsar Convention 1971 (Ramsar sites) are afforded the same protection as SPAs and SACs for the purpose of considering development proposals that may affect them. Paragraph 118 of the National Planning Policy Framework makes it clear that potential Special Protection Areas and proposed Ramsar sites should be treated as if they were already designated.

Since the Strategy only provides sufficient information to support the development of a strategic outline business case, the HRA report must be similarly high-level and cannot examine potential impacts to the definitive extent that will need to be undertaken for the planning application. As such, the HRA focuses on identifying any risks posed by the Strategy to European sites and, where such risks exist, sets out the protocols or mitigation measures that would need to be incorporated into the full project as it is developed for a planning application.

[1] Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora. Adopted 21 May 1992.
[2] Council Directive 2009/147/EEC on the Conservation of wild birds. Adopted 30 November 2009.
[3] The Conservation of Habitats and Species (Amendment) Regulations (SI No. 1927 of 2012). HMSO, 2012.

1.4 Preferred option

The Options Identification and Environmental Appraisal presented a high-level environmental appraisal of 39 strategic options as part of the long list options phase. The 39 options were then reduced to seven options during shortlisting, before a preferred option was selected (Option D). The options considered a range of flood risk intervention measures including: a Do Minimum approach, property level protection / temporary defences, low defences, high defences, and a tidal barrier. The preferred strategic option that was selected encompasses the construction of low defences during Epochs 1 and 2, and then raising these defences in Epoch 3. The exact time within Epoch 3 when the defences are upgraded is flexible and the upgrade will involve crest raising of the low defences rather than starting the construction of new high defences from first principles.

To deliver the preferred option (Option D1), approximately 5 km of new raised defences will be required across the study area. Within central Bristol, new raised defences will be required in core areas, comprising: Cumberland Road, Commercial Road, Clarence Road, Cattle Market Road, Totterdown, and St. Phillips. Defences in these locations should prevent local flooding to the properties and assets situated behind. In addition, new defences at additional core areas including Entrance Lock, Netham, Bathurst Dam, and Cumberland Road underpass will also be required.

An overview of the preferred option is present in the Activity 9B: Options Identification and Environmental Appraisal Addendum.

2. Methodology

There is essentially a four stage process for Habitats Regulations Assessment (HRA):

- **Screening (Stage 1)** – The process of identifying the potential likely significant effects of a project upon a European site, either alone or in-combination with other plans and projects, within the context of the sites conservation objectives. That is the purpose of this report;

- **Appropriate Assessment (Stage 2)** – Considering the effects on the integrity of the European site, either alone or in-combination with other plans and projects, with regard to the site's structure, function and conservation objectives. Where there are adverse effects on the integrity of the European site, an assessment of the efficacy of mitigation measures is carried. If those mitigation options cannot avoid adverse effects then development consent can only be given if Stages 3 and 4 are then followed;

- **Assessment of Alternative Solutions (Stage 3)** – Examining alternative solutions that would avoid or have a lesser adverse effect on the European site; and

- **Imperative Reasons of Overriding Public Interest (IROPI) (Stage 4)** – This is the assessment where no alternative solution exists and where adverse effects remain. The process is to assess whether the development is necessary for IROPI and, if so, the potential compensatory measures needed to maintain the overall coherence of the site or integrity of the European site network. This is not considered to be a standard part of the process and would only be carried out in exceptional circumstances.

All four stages of the process are referred to as the HRA, to clearly distinguish the whole process from the stages within it. This report addresses Stages 1 and 2.

2.1 Likely Significant Effects

Stage 1 is essentially a risk assessment, typically utilising existing data, records and specialist knowledge. The process involves identifying the likely impacts of a project upon a European Site, either alone or in combination with other plans and projects, and considers whether the impacts are likely to be significant. The purpose of the test is to decide whether an Appropriate Assessment is required.

In the determination of Likely Significant Effect, guidance is provided in English Nature's (now Natural England's) Habitats Regulations Guidance Note 3[4] (HRGN3), 'The Determination of Likely Significant Effect under the Habitats Regulations'. This involves a preliminary consideration of whether a qualifying feature is likely to be directly or indirectly affected (in which case there is a presumption that a significant effect is likely). In such a case, a fuller consideration should then be applied, using further analysis and information, to confirm and justify the presence or absence of 'Likely Significant Effect'. Appropriate Assessment (Stage 2) is needed in cases where a Likely Significant Effect is identified. A Likely Significant Effect is, in this context, any effect that may be reasonably predicted as a consequence of a plan or project that may affect the conservation objectives of the features for which the site was designated, but excluding trivial or inconsequential effects.

2.2 Other Plans and Projects

The Conservation of Habitats and Species Regulations (2010, as amended) make it clear that the determination of likely significant effects must not be made in isolation but 'in combination', taking into account the cumulative effects of the specific development for which planning permission is being sought alongside those of other plans or projects. In this case, the projects of particular relevance due to their proximity or potential for similar impacts on the same European sites are:

- The Shoreline Management Plan (SMP2) for the Severn Estuary, which sets coastal defence policy for a wide area including the European sites described in Section 3[5].

There are no additional known cumulative schemes ongoing within the River Avon. An updated check will be made during the EIA Scoping stage to support the HRA of the planning application.

[4] English Nature. Habitats regulations guidance note: The Determination of Likely Significant Effect under The Conservation (Natural Habitats & c) Regulations 1994. HRGN 3. November 1999.
[5] https://www.severnestuarycoastalgroup.org.uk/shoreline-management-plan/

3. European Sites, Interest Features and Conservation Objectives

This document discusses the following European sites as being relevant to the analysis:

- Avon Gorge Woodlands Special Area of Conservation (SAC), located 1.1km downstream of the western boundary of the study area; and
- Severn Estuary Special Protection Area (SPA), located 8.2km downstream of the western boundary of the Strategy frontage;
- Severn Estuary Ramsar site – co-located with the SPA; and
- Severn Estuary SAC - co-located with the SPA and Ramsar site.

3.1 Avon Gorge Woodlands SAC

The SAC is designated for the lime (*Tilio cordata*) woodland which transitions to species rich scrub and calcareous grasslands. The limestone grassland and cliff ledges support a diversity of uncommon species including *Sorbus bristoliensis* and *Sorbus wilmottiana*. The forests are mixed woodland on base-rich soils normally associated with rocky slopes. The SAC is also designated for the semi-natural grassland habitats and scrubland on calcareous substrates.

The conservation objectives for the SAC are as follows:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- *The extent and distribution of qualifying natural habitats*
- *The structure and function (including typical species) of qualifying natural habitats, and*
- *The supporting processes on which qualifying natural habitats rely*

There is no mechanism for the Strategy (which is situated upstream of the SAC) to affect any interest features of the SAC, as the qualifying features are purely terrestrial.

3.2 Severn Estuary SPA

The SPA qualifies as a SPA for its wintering bird species:

- Wintering populations of Bewick's swan (*Cygnus columbianus bewickii*), common shelduck (*Tadorna tadorna*), dunlin (*Calidris alpina alpina*), pintail (*Anas acuta*), redshank (*Tringa totanus*) and curlew (*Numenius arquata*).

The SPA also qualifies for supporting populations of Ringed Plover (*Charadrius hiaticula*) as well as supporting 93,986 individual waterfowl.

The conservation objectives for the SPA are as follows:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- *The extent and distribution of the habitats of the qualifying features*
- *The structure and function of the habitats of the qualifying features*
- *The supporting processes on which the habitats of the qualifying features rely*
- *The population of each of the qualifying features, and,*
- *The distribution of the qualifying features within the site.*

There is no mechanism for the Strategy to affect the wintering bird populations given the distance between the SPA and the Strategy, as the SPA lies outside of the zone of influence.

3.3 Severn Estuary SAC

The SAC is designated for its estuaries, subtidal sandbanks, intertidal mudflats and sandflats, refs and Atlantic salt meadows (*Glauco-Piccinellietalia maritimae*). The SAC is also designated for populations of anadromous fish including sea lamprey (*Petromyzon marinus*), River lamprey (*Lampetra fluviatilis*) and twaite shad (*Alosa fallax).*

The conservation objectives for the SAC are as follows:

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- *The extent and distribution of qualifying natural habitats and habitats of qualifying species*
- *The structure and function (including typical species) of qualifying natural habitats*
- *The structure and function of the habitats of qualifying species*
- *The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely*
- *The populations of qualifying species, and,*
- *The distribution of qualifying species within the site.*

Although the SAC designation only comes up the River Avon as far as the M5 bridge, there is a potential disturbance mechanism where migratory fish for which the SAC is designated travel further up the River Avon, as disturbing (or injuring) these species when outside the SAC could still affect the ability of the SAC to achieve its conservation objectives. This is therefore discussed in the subsequent section of this report.

3.4 Severn Estuary Ramsar site

The Severn Estuary qualifies as a Ramsar as illustrated in Table 1.

Table 1. Ramsar

Ramsar Criterion	Description of Criterion	Severn Estuary
1	A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.	Due to immense tidal range (second-largest in world), this affects both the physical environment and biological communities. Qualifying features include: • H1110 Sandbanks which are slightly covered by sea water all the time • H1130 Estuaries • H1140 Mudflats and sandflats not covered by seawater at low tide • H1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
3	A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.	Due to unusual estuarine communities, reduced diversity and high productivity.

4	A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.	This site is important for the run of migratory fish between sea and river via estuary. Species include Salmon *Salmo salar*, sea trout *S. trutta*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *A. fallax*, and eel *Anguilla anguilla*. It is also of particular importance for migratory birds during spring and autumn.
5	A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.	**Species with peak counts in winter:** 70919 waterfowl (5 year peak mean 1998/99-2002/2003)
6	A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.	**Qualifying Species/populations (as identified at designation):** Species with peak counts in winter: Tundra swan (*Cygnus columbianus bewickii*), greater white-fronted goose (*Anser albifrons albifrons*), common shelduck (*Tadorna tadorna*), gadwall (*Anas strepera strepera*), dunlin (*Calidris alpina alpina*) and common redshank (*Tringa totanus totanus*)
8	A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.	The fish of the whole estuarine and river system is one of the most diverse in Britain, with over 110 species recorded. Salmon *Salmo salar*, sea trout *S. trutta*, sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, allis shad *Alosa alosa*, twaite shad *A. fallax*, and eel *Anguilla anguilla* use the Severn Estuary as a key migration route to their spawning grounds in the many tributaries that flow into the estuary. The site is important as a feeding and nursery ground for many fish species particularly allis shad *Alosa alosa* and twaite shad *A. fallax* which feed on mysid shrimps in the salt wedge.

There is no mechanism for the Strategy to affect the bird assemblages of the Ramsar site as it lies outside of the zone of influence given the distance from the study area. There is a potential disturbance mechanism to migratory fish associated with the Ramsar site, as already discussed for the SAC.

3.5 The Bristol Channel Approaches cSAC

The Bristol Channel Approaches cSAC has been recognised as an area with predicted persistent high densities of harbour porpoise (*Phocoena phocoena*). The entire site has been identified as an important area for porpoises during the winter season.

There is no mechanism for the Strategy to affect harbour porpoise. Although harbour porpoise visit shallow bays, estuaries, and tidal channels less than 200m in depth, and have been known to swim up rivers (including some anecdotal evidence for their occasional presence in the River Avon) the study area lies over 100km from the cSAC. Guidance from the Joint Nature Conservation Committee (JNCC) is that a likely significant effect on an SAC designated for marine mammals is unlikely to arise from works that are located more than 50km from the

SAC[6]. As a general precaution however, any 'in river' impact piling works should cease if there is evidence of dolphin or porpoise being present at the time of piling.

[6] Email correspondence from JNCC to AECOM dated 27/09/16

4. Likely Significant Effects

This chapter presents an analysis of the Likely Significant Effects of the Strategy on the only European sites for which a risk of effect is present: the Severn Estuary SAC and Severn Estuary Ramsar site, with specific reference to their migratory fish qualifying interests.

4.1 Severn Estuary SAC and Ramsar site

The application site is upstream of the Severn Estuary SAC and Ramsar site and as a consequence this section of the river is used as a migratory route for the SAC and Ramsar fish species as part of their life cycles. Any adverse impacts to fish populations in the River Avon would cause an adverse effect on the SAC and Ramsar downstream.

4.1.1 Noise

Migratory fish species for which the Severn Estuary SAC is designated, including sea lamprey and river lamprey could be impacted by noise and vibration resulting from the proposed Strategy where it involves cofferdams or other in-river piling. Likewise migratory fish species, for which the Ramsar site is designated, including Atlantic salmon, twaite shad, allis shad, eel and sea trout, will also be sensitive to underwater noise. Crest raising of the defences may involve the use of cofferdams or other forms of sheet piling. Depending on substrate, sheet piling can be pushed or pressed down to the rock, which is virtually silent, or vibrated down to the rock (which does generate some underwater noise). However, they may also need (at least to start and finish a pile) to be hammered or driven down to the rock and this can generate substantial underwater noise. Noise has been experimentally demonstrated to cause behavioural responses in fish. If noise of sufficient decibels propagated across the cross-section of a watercourse it can also provide an acoustic barrier to movement. If the sound pressure level is sufficiently great underwater noise can also cause injury or death.

The lower Bristol Avon is difficult to survey for fish using the Environment Agency standard techniques, due to the width, depth and flow. Consequently the lower Bristol River Avon has been subject to fisheries surveys using hydroacoustic equipment by the Environment Agency and partners in order to provide fish abundance data for a 20km stretch of the River between Bristol and Bath[7]. The highest abundance of fish was recorded immediately downstream of Bath where roach, bream and perch were recorded. The mean fish density in the most prolific stretch of the Avon was found to compare favourably with other large rivers such as the Severn.

Data supplied by the Environment Agency suggests that there is good evidence of the migratory species for which the River Severn is designated utilising the River Avon. The data suggests that there is evidence of salmon utilising the River Chew, upstream of Bristol (caught during fish surveys), for spawning and sea trout have also been recorded within the River Somerset Frome (anecdotal evidence from anglers). The River Chew merges with the River Avon and thus there is reason to believe that salmon may be utilising the stretch of the River Avon in which the Strategy will be implemented. Data from the Environment Agency also states that eels are routinely caught in fish surveys across the Bristol catchment. There is also the possibility of sea and river lamprey as well as twaite and allis shad being present in low numbers, as they are present in the estuary and the River Avon is passable up to Netham Weir.

The most up-to-date noise thresholds for fish come from the Acoustic Society of America (ASA) guidelines by Popper et al (2014)[8] accredited by the American National Standards Institute (ANSI). These guidelines are based on a review of the latest literature but still reflect the considerable uncertainty that exists in the impact of sound on fish. For example, very few species have been studied in order to determine quantifiable criteria but the Popper thresholds do consider the sensitivity of different fish based on their anatomy. For example, the most sensitive fish are those that have a swim bladder that is also used in hearing such as the Clupidae (herring) species.

There is very little data available for lamprey of any species with respect to hearing, and no audiograms are understood to exist that would provide an indication as to their sensitivity to noise, or indeed a confirmation as to whether they are able to detect sound at all (Popper, 2005)[9]. In common with cephalopods, lamprey have statolith organs, and so it is thought that they may also have a sensitivity to low frequency sound (Lenhardt and

[7] Environment Agency (2014) Bristol Avon Fish Monitoring, Environmental Monitoring , Wessex
[8] Popper et al., 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.
[9] Popper A N (2005) A review of hearing by Sturgeon and Lamprey. Submitted to the U.S. Army Corps of Engineers, Portland District, August 12, 2005, Available at: http://www.nwpapp

Sismour, 1995)[10], or particle velocity rather than sound pressure as species of 'hearing generalist' fish. Due to the general apparent lack of sensitivity to sound of lamprey, and the lack of both detailed information on lamprey hearing or appropriate criteria to assess them by (with respect to particle velocity), they have not been considered further.

4.1.2 Intertidal habitat loss

For the most part the frontage to be defended already has existing flood defences, with built-up areas behind them which would prevent any landward retreat of intertidal habitats even without this Strategy. Any loss of intertidal habitat along most of the frontage would not therefore be the result of this Strategy.

Improving the standard of flood defences could, depending on how they are constructed, potentially result of further loss of intertidal habitat due to (for example) increased defence footprint. At this point, there has been no detailed design of defences and therefore it is not possible to quantify what (if any) loss of mudflat would result from defence construction.

Detriment mitigation devised since the original draft of this HRA was produced includes a new embankment proposed at Bower Ashton. At this location there is an undeveloped area of grassland behind the proposed embankment; theoretically, without the embankment the river banks could erode over time, allowing the intertidal mudflat in this location to retreat inland and thus be preserved in extent notwithstanding sea level rise.

At Bower Ashton there is the potential for a negative impact on estuarine geomorphology as a result of the Strategy constructing a new flood defence and causing coastal squeeze. At this location there is an undeveloped area of grassland behind the proposed embankment; although this is not an entirely naturalised area due to the presence of the channelised River Avon and water infrastructure (e.g. culverted watercourses), theoretically, without the embankment the river banks could erode over time, allowing the intertidal mudflat in this location to retreat inland and thus be preserved in extent notwithstanding sea level rise.

The Severn Estuary Shoreline Management Plan (SMP) Review (2010) provides an assessment of the risks associated with coastal processes and presents a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner. The SMP policy for the area (policy unit BRIS5) is Hold the Line (HTL) which is "to provide some level of coastal defence, keeping the position of the defence approximately where it is at the moment". In terms of coastal squeeze, it is considered the Strategy is in conformity with the Severn Estuary SMP, despite the construction of the earth embankment at Bower Ashton. The adopted SMP and its policies have been accepted by key consultees (Bristol City Council, Environment Agency and Natural England). Despite the SMP stating that HTL for this policy unit is the best environmental option, it is acknowledged that this does not mean that there are no environmental effects at all and therefore any habitat loss as a result of coastal squeeze will be mitigated/compensated before this embankment is constructed.

The Bower Ashton embankment's alignment would also be setback at a level above high tide. This means it would not directly encroach into the intertidal zone at the time of construction in the first epoch, and the landward transgression of intertidal habitats, assuming the gradient of the river bank permits transgression, would not be impeded until sometime later on in the Strategy. It is anticipated that the intertidal habitats would be monitored at regular intervals following the implementation of the Strategy to verify the conclusions of the Environmental Statement (or identify the need for additional mitigation). The method and frequency of this monitoring will be determined at EIA stage.

In total, the direct footprint loss for estuarine habitats associated with the Strategy is estimated to be 2218 m^2. This is based on 2218 m length of defences and a maximum 1 m encroachment out from current defences. This estimate includes the Netham detriment works and at this stage there is uncertainty as to whether these works will lead to encroachment in order to raise defence heights; should the footprint not be increased at Netham the maximum estuarine land take will reduce to an estimated 1268m^2 (0.127 ha).

It is acknowledged that the River Avon intertidal mud in the Strategy area is outside any European site, but could be used by larval lamprey (ammocoetes) associated with the Severn Estuary SAC, or by non-breeding birds associated with the Severn Estuary SPA (at least occasionally in small numbers).

[10] Lenhardt M L, Sismour E (1995) Hearing in the sea lamprey (Petromyzon marinus) and the long nose gar (Lepisosteus spatula). The Association for Research in Otolaryngology, Abstract: 259.

Ammocoetes are blind, wormlike animals that burrow into silt. With respect to juvenile ammocoete nursery areas, optimal habitat can be defined by[11]:

- Several square metres of stable, consolidated fine sediment;
- Presence of shade;
- Relatively shallow water depth, generally <50cm;
- Low water velocity;
- Presence of organic detritus; and
- Delivery of well oxygenated water.

A continuous stream of water passes in through the mouth and out through the gills while the ammocoete remains static in the mud. After approximately three years, the ammocoete will metamorphose and migrate to the sea. Unlike salmon smolts, the timing of juvenile migration in lamprey is protracted and poorly documented. However, lamprey macrophthalmia and ammocoetes are not strong swimmers, attaining maximum individual speeds of less than 1 m s^{-1}, and sustained speeds of less than 0.5 m s^{-1}. As such, their migration is generally believed to be primarily passive[12], with the ammocoetes distributed throughout the water column[13] and most downstream movement due to washout during spates.[14].

Since ammocoetes have a preference for fairly shallow water, but do require the continuous presence of some water in order to filter feed and not die of hypoxia, the shallow water at the lower edge of the intertidal zone may constitute valuable habitat. Such habitat will gradually disappear as sea levels rise and water depths increase, without any ability for the habitat to migrate inland and thus preserve the shallow edges. However, given the small amount of intertidal mudflat in this area, it is unlikely that creating the embankment at Bower Ashton will radically affect the ability of the Bristol Avon to support ammocoetes.

During the winter period the Somerset Levels & Moors may be subject to freezing conditions which can mean that birds move out to coastal areas such as the extensive mudflats and associated high-tide roosts of the Severn Estuary SPA/Ramsar site. While passage and wintering birds associated with this SPA/Ramsar site may sometimes then use the mudflats in the tidal River Avon around Bristol, the amount of intertidal mudflat available (generally a maximum 20m wide strip and often much less) inherently limits the value of these mudflats compared to those within the Severn Estuary SPA/Ramsar site itself and only a small proportion of the total SPA/Ramsar population is likely to utilise these mudflats at any time.

However, measures will be devised and presented as part of the detail to support a planning application to ensure no net loss of intertidal habitat.

4.1.3 Habitat fragmentation and blockage of fish passage

Following the production of the first draft of this HRA, it was identified that detriment mitigation (i.e. measures to avoid increased flood risk in some parts of the Strategy area due to new defences in other parts) would be required. In the Netham area (DM5) this included:

- Installing a flap on the Brislington Brook outfall;
- Culverting the open section of the Brislington Brook; and
- Providing over-pumping when the Brislington Brook cannot discharge under gravity.

It is important to note that proposals in these areas are at an early stage of development, and further investigations and design development on a local level will be required to confirm and refine proposals. Nonetheless, depending on their design, all of these features could provide a blockage to eel passage. Given that the SAC is partly designated for its eel populations, and these are known to travel up and down the Bristol Avon, such a blockage would constitute a likely significant effect without the requirement that adequate fish (specifically eel) passage is designed into these features.

[11] Scottish Natural Heritage Commissioned Report No. 027 (ROAME No. F01AC608)
[12] Physiology and Ecology of Fish Migration. Edited by Katsumi Tsukamoto CRC Press 2013 Pages 105–131 Print ISBN: 978-1-4665-9513-2
[13] Moser, M.L., Jackson, A.D., Lucas, M.C. et al. Rev Fish Biol Fisheries (2015) 25: 103. doi:10.1007/s11160-014-9372-8
[14] https://ifm.org.uk/wp-content/uploads/2016/01/River-lamprey-Summary-2008.pdf

5. Mitigation measures to avoid a likely significant effect

5.1 Noise

Wherever piling works will take place beyond or close to the existing flood defence there is the potential for associated noise and vibration to affect fish generally and in particular the ability of migratory fish such as salmon to utilise the river. Detailed construction methods for the proposed Strategy are not known at this stage but where technically feasible, the project will utilise low noise and vibration piling techniques such as pressing or vibro-piling rather than impact/percussive piling.

Where impact piling is required, adverse impacts have been predicted for migrating fish during the migration season, and so a number of additional mitigation measures will need to be adopted to minimise the impacts on migrating salmon (and other SAC fish species) as follows:

- The lowest power levels of impact piling equipment that can undertake the task will be selected;
- No percussive piling will be permitted at dusk and dawn and no piling of any kind will occur between the hours of 6pm and 8am;
- The piling programme will be carefully scheduled to minimise impact piling during the most sensitive time periods;
- Piling will be permitted on the ebb tide only during migration upstream and during the flood tide only for migration downstream;
- Scheduling impact piling to restrict percussive piling to a maximum of *N* hours per day/ per week during the sensitive season (*N* to be determined on the basis of local site conditions, particularly water depth at piling position and confirmed details of the piling equipment to be used).
- Where necessary, low tide working (where percussive piling is only permitted at low tide ± *X* hours (*X* to be determined based on tidal cycles and local site conditions) can also be adopted during the migration season (though this can be very time restrictive in the winter months).

Furthermore, it is recommended that such works should take place outside of the sensitive season for migration. For Atlantic salmon and sea trout this is generally April to June, although the Atlantic salmon migration period for the Bristol Avon can be later in the season (July to October). European eel start migrating upstream into the catchment from mid-February, with juvenile eels migrating when water temperatures are between 13 and 14°C. If it is not possible to avoid conducting works during the sensitive season, underwater noise modelling and measurement can be used to determine the precise nature of any noise barrier created during piling and if necessary enable mitigation to be devised.

As a general precaution however, any ‘in river’ impact piling works should cease if there is evidence of dolphin or porpoise being present at the time of piling.

As planning application(s) are developed, the mitigation measures listed above will need to be developed further, with particular regard to the noise generated by the actual construction methods. These further developed measures will need to be included in an HRA to accompany the planning application. They will then need to be conditioned as part of any planning permission.

5.2 No Net Loss of Intertidal Habitat

As detailed defence design takes place, every opportunity should be taken to minimise net loss of intertidal mudflat to reduce the losses identified in this analysis.

In total, the direct footprint loss for estuarine habitats associated with the Strategy is estimated to be 2218 m^2. This is based on 2218 m length of defences and a maximum 1 m encroachment out from current defences. This estimate includes the Netham detriment works and at this stage there is uncertainty as to whether these works will lead to encroachment in order to raise defence heights; should the footprint not be increased at Netham the maximum estuarine land take will reduce to an estimated 1268m^2 (0.127 ha). Such losses would require compensation in order to maintain habitat balances. It would be the responsibility of BCC to ensure compensatory habitat has been provided, and agreed with the Environment Agency and Natural England, prior to any losses occurring. Whilst recognising the need to potentially compensate as a result of the Strategy, suitable

sites for habitat creation should be identified at a later stage of Strategy development once the total area of habitat loss, both direct loss via encroachment and indirect losses by altering tidal water levels and impedance of habitat "rollback" has been predicted using hydraulic modelling, habitat characterisation and geomorphological appraisal.

The further work for Strategy implementation should include identifying the type of habitat that could be lost as a result of coastal squeeze. At this early stage of design we have assumed a worst case scenario that encroachment will be in the intertidal zone. A targeted, Phase 1 Habitat Survey should be completed at EIA stage to characterise habitats and confirm the type and quality of habitat which has the potential to be impacted directly and indirectly. Alongside ecological work, a geomorphological appraisal would be necessary to confirm whether the estuary's form and adjacent hinterland would permit the rollback of intertidal habitats under rising sea levels i.e. steep river bank gradients may limit the likelihood of rollback.

It would be prudent to ascertain when the habitat losses are likely to occur. A separate modelling exercise is recommended for Strategy implementation during the EIA phase in order to estimate the projected coastal squeeze under the future baseline and with development scenarios. It is not considered possible or appropriate to estimate the potential habitat losses at this stage of the project because more detailed baseline information and design is required than is currently available at the time of writing.

5.3 Fish passage

Measures will need to be included in the detailed design of the flap on the Brislington Brook outfall, the culvert on the open section of the Brislington Brook and the over-pumping when the Brislington Brook cannot discharge under gravity to ensure that fish passage generally and eel/lamprey passage in particular is preserved. There are several standard guides and methodologies for designing such features that will need to be followed during detailed design[15].

Works to Netham Weir sluice gates could also provide opportunity to improve eel passage at this structure, but net positive measures (i.e. those that are not strictly required to avoid a likely significant effect or adverse effect on integrity) more properly belong in the SEA report or other supporting documentation, rather than in the HRA.

[15] http://www.ecrr.org/Publications/tabid/2624/mod/11083/articleType/ArticleView/articleId/3317/Default.aspx
http://www.southampton.ac.uk/engineering/research/projects/fish_passage_upstream_over_gauging_structures.page
http://www.sciencedirect.com/science/article/pii/S092585741630129X

6. Other Plans and Projects

It is a requirement of the Conservation of Habitats & Species Regulations 2010 (as amended) that impacts are not considered wholly in isolation but that any in combination and cumulative effects are identified when the Strategy is considered alongside other projects and plans. In this case, one particularly relevant other project and plan is known: the Shoreline Management Plan for the Severn Estuary.

The Shoreline Management Plan sets coastal defence policy for a wide area including the European designated sites discussed in Section 3. The Shoreline Management Plan has had its own Habitats Regulation Assessment which has been able to conclude either that there will be no adverse effects or that there are "imperative reasons of overriding public interest" (IROPI) and that any adverse effects can be compensated for.

Other relevant plans and strategies in the area include the Severn Estuary Strategy, Bristol City Council Local Plan, and Bristol Central Area Plan. These are discussed in turn below:

- The Severn Estuary Strategy: The TFRMS is likely to work in combination with The Severn Estuary Strategy to reduce the level of flood risk and coastal erosion across the wider region. There is likely to be positive effects for biodiversity, population, health and material assets, soil and water through the delivery of these strategies, and some potential adverse impacts such as coastal squeeze and encroachment impacts on key habitats.
- Bristol City Council Local Plan: The TFRMS complements and supports Bristol City's Local Plan, as there are flood risk issues which exist in some parts of the city which are proposed for future housing delivery, including the city centre.
- Bristol Central Area Plan: The TFRMS is supportive of the Plan's aspirations. Further work should be carried out during EIA work to ensure that any adverse impacts of the delivery of the Strategy are mitigated so that the objectives of the Central area plan are not compromised.

Therefore, provided any defences in the Severn Estuary take appropriate precautions with regard to timing or works and noise mitigation, there would be no in combination effect.

7. Conclusion

Provided the precautionary measures outlined in Section 5 are followed in devising the details of the Strategy and subsequent planning applications, it can be concluded that the Strategy, at this preliminary study level, will not result in a likely significant effect on any European sites either alone or in combination with other projects and plans. No Appropriate Assessment of the preferred option would therefore be required.

This conclusion will need to be reviewed for the HRA(s) of the planning applications, once the precautionary measures outlined in Section 5 have been further developed and incorporated into the Strategy and its construction methodology, in order to confirm the conclusion of no likely significant effect.

Appendix E: Preliminary Water Framework Directive (WFD) Assessment

The following information provides introduction to the Outline Preliminary WFD Assessment for the River Avon Flood Risk Management Strategy.The Water Framework Directive (WFD) aims to protect and enhance the quality of the water environment across all European Union (EU) member states. It takes a holistic approach to the sustainable management of water by considering the interactions between surface water, groundwater and water-dependent ecosystems.

Under the WFD, surface water body status is classified on the basis of chemical or ecological status or potential, with groundwater bodies classified on the basis of qualitative and quantitative status. The term 'ecological potential' is used as it may be impossible for the water body to achieve good ecological status because of modification for a specific use, such as navigation or flood protection.

River Basin Management Plans (RBMP) are produced for River Basin Districts (RBD), of which the study area lies within the Severn RBD area. Each RBMP produced by EU member states have objectives that water bodies within the RBD must achieve good ecological status or good ecological potential by 2021 or 2027.

To ensure compliance with the WFD, decision makers must consider whether proposals for new developments have the potential to:
• cause a deterioration of a water body from its current status or potential; and/or
• prevent future attainment of good status or potential where not already achieved.

In addition Article 4.9 of the WFD requires that the scheme is consistent with the objectives of other EU environmental legislation. Compliance will be achieved through the undertaking of the Habitats Risk Assessment.
Temporary impacts are not considered to result in deterioration in WFD status; additionally maintenance activities associated with on-going defences are not considered to require WFD assessment at this time. Additional maintenance works defined in future scope or works will require a screening exercise.
Impacts are not considered to constitute deterioration of status of the water body if it:
• is only impacted for a short time period (European Commission guidance does not define 'a short time period' and as such it is assumed as those effects that would not persist for more than half of a RBMP cycle period (less than 3 years));
• recovers within a short time period; and/or
• recovers without the need for any restorative measures.
The River Avon Tidal flood Management Strategy has selected the following preferred option for flood risk management:
- Low Defences during 2015-2030 (Epoch 1) (Entrance Lock, Netham, Bathurst Dam, Totterdown),
- Low Defence with maintenance and additional defences in new locations if required from 2030 to 2065 (Epoch 2) (Cumberland Road and Cumberland Road East, Commercial Road, Clarence Road, Cattle Market Road),
- Upgrade to High Defences from 2065 to 2115 (Epoch 3).

Low Defences
The implementation of Low Defences involves identifying low spots in the existing defences and then raising the existing defence levels or constructing new floodwalls or similar defences (e.g. embankments) in these locations. Low defences represent an adaptive approach to sea level rise and would be constructed with a shorter term design life than high defences.

The potential impacts and mitigation measures to be employed would be similar to those for High defences.

High Defences

The implementation of High Defences involves identifying low spots in the existing defences and then raising the defence crest levels or constructing new floodwalls or similar defences (i.e. embankments) in these locations.

The piling involved for any high defences has the potential to intercept groundwater levels, however there are currently no groundwater SPZ in the scheme area, and no groundwater abstractions close to the River Avon that would be likely to be affected and as such impact to groundwater is scoped out of this WFD assessment. This statement should be reassessed in the future as new groundwater abstraction licences could be granted near the River Avon, within the Triassic Groundwater body that could potentially be impacted by piling.

If the proposed raised or new defence is set back from river water body, then it will not alter the morphological regime or the water quality, and therefore would not require WFD assessment. The impact of flood waters being contained within the water body are considered to be temporary and unlikely to have a significant impact to the water body due to its low frequency. A separate modelling exercise, as part of a review of potential coastal squeeze implications, is recommended to quantify this at a later stage of the Project. Please refer to the HRA and SEA for more information on coastal squeeze. The replacement or raising of existing lock gates would be unlikely to cause any change or deterioration to WFD objectives as the works will be undertaken within the existing footprint of the defence or landwards and would not impact the waterbody.

Detriment Measures

Numerical modelling has found that implementation of the Strategy's main defences, which have been assessed for WFD, would lead to an increased risk of flooding (detriment) in three areas - Netham, Bower Ashton and Bedminster, and therefore detriment mitigation works have been included in The Strategy to resolve the issue. Proposals in these areas are at an early stage of development, and further investigations, design and WFD assessment will be required to confirm and refine proposals. The following information highlights where WFD assessment will be required for these measures:

DM1 Bower Ashton

This proposal involves the raising of the existing bank. It is not considered that this measure would require WFD assessment.

DM2 Totterdown

This involves raising of private defences which have recently been constructed. It is not considered that this measure would require WFD assessment.

DM3 Bedminster

Detriment Mitigation in the form of Property Level Protection is proposed to be installed into approximately seven properties. It is not considered that this measure would require WFD assessment.

DM4 Netham

This involves raising the existing sheet piled defence to prevent overtopping to a height of 10.4 m. This may need a WFD assessment for the River Avon and potentially the Bristol Floating Harbour.

DM5 Netham

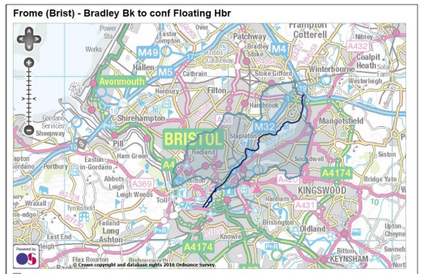
This measure involves the following:

- Flap the Brislington Brook outfall;
- Culvert the open section of Brislington Brook or raise defences around it;
- Provide overpumping when Brislington Brook cannot discharge under gravity; and
- Property Level Protection measures will be installed to a small number of properties.

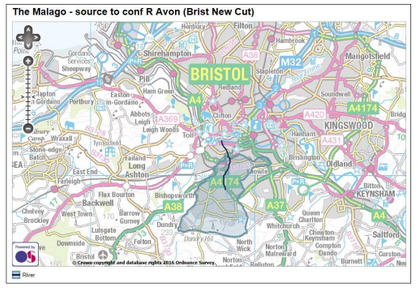
Location, watercourse and NGR (insert two NGRs if linear site)	Outline description of preferred option if known or type of options being considered if preferred option is yet to be defined	Water bodies screened in and why	Waterbodies screened out and why	Baseline data for those waterbodies screened in (From 2015 data provided in EA Catchment Management Tool)	3.1 Preliminary assessment of deterioration	3.2. Assessment of cumulative effects	3.3. Sensitive/critical habitats check	Is the water at Good Ecological Status (GES)/Good Ecological Potential (GEP)	If water body not at GES or GEP will the proposed works prevent GES/GEP being achieved?	3.4 Will the scheme impact on the ability to deliver proposed water body measures? Why/why not?	Mitigation measures to limit impact of scheme	3.5 Can scheme deliver improvement measures to GES/GEP? Why/why not?	Conclusions
Bristol Avon (E:354934 N:175281)	The prefered option would be to install Low defences until 2065 and upgdrade to High Defences during the period 2065 -2115.	Bristol Avon GB530905415405 Work in water body is proposed in preferred option		Bristol Avon Waterbody ID: GB530905415405 Type: Transitional Water Current Status or potential: Moderate (2015) Objective: Good (2021) Hydromorphological designation and use: heavily modified for the use of flood protection , navigation, ports and harbours. Reasons for failing (if failing): N/A Length/area of water body: none provided in catchment tool Protected Areas: Eutrophic sensitive areas, Nitrate vulnerable zones, Horseshoe Bend SSSI, Severn Estuary Ramsar, SAC, Avon Gorge SSSI, Avon Gorge Woodlands SAC Protected Area Objectives: Mitigation measures in place and those not implemented: N/a Ecological: Moderate Biological - High (macroalgae) Hydromorphological Elements: supports-good Hydrological Regime: supports-good Specific Pollutants: High (Iron) Supporting Elements (Surface Water): Moderate (2015) Objectives: Good (2021) Mitigation Measures Assessment: Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment	*Will the scheme cause deterioration to any of the WFD elements at the water body level on a non temporary basis? Need to understand the length/area of water body and how it will be affected by the proposed works.* A potential impact from new piled walls and piling on the hydrological regime cannot be ruled out.	*Consider existing pressures, recent schemes, local knowledge and other planned schemes. Provide details of the sources of information to provide a justification for the conclusion made.* Sheet piling is likely to cause temporary impacts as a result of noise and vibration and scour during construction that could disturb sensitive ecological species and may need mitigation. Piling may mobilise sediment into the water column through piling activities in potentially contaminated areas, further investigation will be required to quantify any mitigation requirements.	*Although the extent of a scheme may be minimal it may fall on critical or sensitive habitats or species in the water body. If the proposed scheme is on habitats that are critical to the individual biological quality elements or on a particularly sensitive habitat then further investigation is required. Critical habitats could be those of unique importance or offering a rare combination of features that are critical to the ecological health of the water body. Sensitive habitats are those which are sensitive to change e.g. internationally designated sites for nature conservation.* The new piled walls are likely to result in a loss of priority habitat of intertidal zone and mudflats. Further WFD assessment will be required, and mitigation to ensure no net loss.	Moderate - Good by 2021	Works are unlikely to prevent good status being achieved for the water body, however further WFD assessment and proposal of mitigation measures will be required for potential localised impacts identified	The scheme will not restrict the ability to deliver waterbody improvements. The scheme is an investment opportunity that could be used to improve aquatic habitats.	Mitigation will be required for loss of habitat. Construction method statements should be used to plan and minimise non-temporary impacts during sheet piling construction. A code of construction practice should be adopted to minimise temporary impacts on waterbodies from mobilisation of contaminated sediments	Overall the nature and scale of the scheme is unlikely to have a significant impact or influence on progress towards WFD GEP, due to the nature and timescales of the project	The scheme is low in impacts in WFD terms, and is designed to improve flood defence for wider social benefits. Further WFD assessment and mitigation will be required to address loss in priority habitats and to identify other mitigation measures required to ensure no non-temporary impacts on status of water body. Suitable mitigation and/or compensation may be required within the water body and this should be planned in close consultation with Natural England, the Environment Agency and other key stakeholders.
Frome (Bristol) (E:361839 N:176158)			Frome (Brist) - Bradley Bk to conf Floating Hbr GB109053027840 Scoped out as no intended development in this water body	Frome (Brist) - Bradley Bk to conf Floating Hbr Waterbody ID: GB109053027840 Type: River Current Status or potential: Moderate (2015) Objective: Good (2027) Hydromorphological designation and use: heavily modified Reasons for failing (if failing): N/A Length/area of water body: 11.75 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2021): Good Biological - High (Fish, Invertebrates, Macrophytes) Hydromorphological Elements: Not-high Hydrological Regime: Supports-good Physico-Chemical Elements: Good High (Ammonia, Dissolved Oxygen, pH, temperature), Good (Phosphate) Specific Pollutants: High (Copper, Zinc), Moderate (Triclosan) Objective (2021): Good Supporting Elements (Surface Water): Moderate - Objective (2021): Good Mitigation Measures Assessment: Moderate or less - Objective (2021): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: Good (Cadmium and its compounds, Di(2-ethylhexyl)phthalate, Nonylphenol, Tributyltin compounds) Priority substances: Good (Lead, Nickel and their compounds)								
The Malago - source to conf R Avon (Bris New Cut) (E:358425 N:170630)			The Malago - source to conf R Avon (Brist New Cut) GB109053021970 Scoped out as no intended development in this water body (developments on the other side of the river)	The Malago - source to conf R Avon (Brist New Cut) Waterbody ID: GB109053021970 Type: River Current Status or potential: Moderate (2014) Objective: Good (2027) Hydromorphological designation and use: heavily modified Reasons for failing (if failing): N/A Length/area of water body: 3.47 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Moderate (Invertebrates) Hydromorphological Elements: Supports good Hydrological Regime: Supports-good Mitigation Measures Assessment: Moderate or less - Objective (2027): Good Physico-Chemical Elements: Moderate High (Ammonia, pH, temperature), Good (Dissolved Oxygen), Moderate (Phosphate) Specific Pollutants: High (Triclosan) Supporting Elements (Surface Water): Moderate - Objective (2027): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment								
Trym - source to conf R Avon (Brist) (E:356310 N:178667)			Trym - source to conf R Avon (Brist) GB109053027530 Scoped out as no intended development in this water body	Trym - source to conf R Avon (Brist) Waterbody ID: GB109053027530 Type: River Current Status or potential: Moderate (2015) Objective: Good (2027) Hydromorphological designation and use: heavily modified Reasons for failing (if failing): N/A Length/area of water body: 7.88 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Bad - Moderate (Invertebrates), Bad (Fish). Objective (2027): Moderate Hydromorphological Elements: supports Good Hydrological Regime: Supports-good Physico-Chemical Elements: Moderate - Objective (2021): Good High (Ammonia, Dissolved Oxygen, pH, temperature), Moderate (Phosphate) Specific Pollutants: High (Triclosan) Supporting Elements (Surface Water): Moderate - Objective (2027): Good Mitigation Measures Assessment: Moderate or less - Objective (2027): Good Chemical: Good (2015) Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment								

BRISTOL AVON

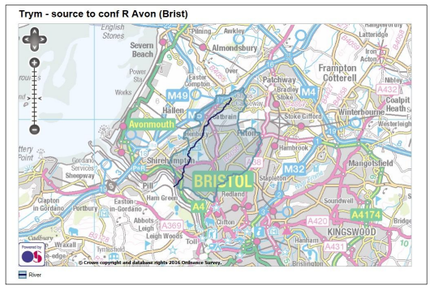
Frome (Brist) - Bradley Bk to conf Floating Hbr

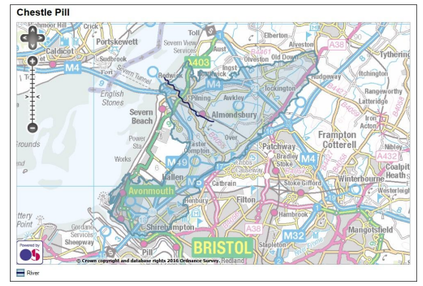


The Malago - source to conf R Avon (Brist New Cut)



Trym - source to conf R Avon (Brist)





Location, watercourse and NGR (insert two NGRs if linear site)	Outline description of preferred option if known or type of options being considered if preferred option is yet to be defined	Water bodies screened in and why	Waterbodies screened out and why	Baseline data for those waterbodies screened in (From 2015 data provided in EA Catchment Management Tool)	3.1 Preliminary assessment of deterioration	3.2. Assessment of cumulative effects	3.3. Sensitive/critical habitats check	Is the water at Good Ecological Status (GES)/Good Ecological Potential (GEP)	If water body not at GES or GEP will the proposed works prevent GES/GEP being achieved?	3.4 Will the scheme impact on the ability to deliver proposed water body measures? Why/why not?	Mitigation measures to limit impact of scheme	3.5 Can scheme deliver improvement measures to GES/GEP? Why/why not?	Conclusions
Chestle Pill (E:355491 N:185213)			Chestle Pill GB109054026650 Scoped out as no intended development in this water body	Chestle Pill Waterbody ID: GB109054026650 Type: River Current Status or potential: Moderate (2015) Objective: Good (2027) Hydromorphological designation and use: artificial Reasons for failing (if failing): N/A Length/area of water body: 4.43 km Protected Areas: none Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Poor - Poor (Fish), Moderate (Invertebrates), Good (Macrophytes and Phytobenthos). Objective (2027): Good Hydromorphological Elements: Supports-good Hydrological Regime: Supports-good Physico-Chemical Elements: Moderate - Objective (2027): Moderate High (Ammonia, pH, temperature), Poor (Dissolved Oxygen, Phosphate) Specific Pollutants: Cycle 2 not assessed Supporting Elements (Surface Water): Moderate - Objective (2021): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2021): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment									
Brislington Bk - source to conf R Avon (Brist) (E:362145 N:171058)			Brislington Bk - source to conf R Avon (Brist) GB109053021980 Scope out for the preferred option for flood risk management. Needs to be scoped in for the detimental measures.	Brislington Brook - source to confluence River Avon (Brist) Waterbody ID: GB109053021980 Type: River Designation: heavily modified Current Status or potential: Overall Water Body - Moderate (2015) Objective: Good (2027) Reasons for failing (if failing): N/A Length/area of water body: 4.045 km Protected Areas:Avon Valley Woodland (LNR), Stockwood Open Space (LNR) Protected Area Objectives: Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Poor - Poor (Invertebrates), Moderate (Macrophytes and Phytobenthos). Objective (2027): Good Hydromorphological Elements: Supports-good Hydrological Regime: Supports-good Physico-Chemical Elements: Moderate - Objective (2027): Good High (Ammonia, pH, temperature, dissolved Oxygen), Poor (Phosphate) Specific Pollutants: Cycle 2 High Triclosan Supporting Elements (Surface Water): Moderate - Objective (2027): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2027): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment									
Bristol Floating Harbour (E:359188 N: 172636)			Bristol Floating Harbour GB70910601 Scope out for the preferred option for flood risk management. Needs to be scoped in for the detimental measures.	Bristol Floating Harbour Waterbody ID: GB70910601 Type: Canal Designation: heavily modified Current Status or potential: Overall Water Body - Moderate (2015) Objective: Good (2027) Reasons for failing (if failing): N/A Length/area of water body: 6.045 km Protected Areas: None Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2027): Good Biological - Not assessed Hydromorphological Elements: Not assessed Hydrological Regime: Not assessed Physico-Chemical Elements: Moderate - Objective (2027): Good High (Ammonia, pH, temperature, Dissolved Oxygen), Moderate (Phosphate) Specific Pollutants: Cycle 2 not assessed Supporting Elements (Surface Water): Moderate - Objective (2027): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2027): Good Chemical: Good Other Pollutants: does not require assessment Priority hazardous substances: does not require assessment Priority substances: does not require assessment									
Severn Lower (E:330553 N: 173336)			Severn Lower GB530905415401 Scoped out as significantly downstream from the flood defence work.	Bristol Floating Harbour Waterbody ID: GB530905415401 Type: Transitional Water Designation: heavily modified for the use of flood protection Current Status or potential: Overall Water Body - Moderate (2015) Objective: Good (2027) Reasons for failing (if failing): N/A Length/area of water body: 6.045 km Protected Areas: Severn Estuary SSSI, SPA and Ramsar, Protected Area Objectives: n/a Mitigation measures in place and those not implemented: N/a Ecological: Moderate - Objective (2021): Good Biological - Moderate - Moderate (Angiosperms), Good (Fish and Invertebrates), High (Phytoplancton). Objective (2021): Good Hydromorphological Elements: Not assessed Hydrological Regime: Not assessed Physico-Chemical Elements: Good - Objective: N/A High (Dissolved Oxygen), Good (Dissolved organic Nitrogen) Specific Pollutants: Cycle 2 High (Arsenic, Copper, iron, Zinc) Supporting Elements (Surface Water): Moderate - Objective (2021): Good Mitigation Measures Assessment: Moderate or Less. Objectives (2021): Good Chemical: Fail. Objective (2021) : Good Other Pollutants: does not require assessment Priority hazardous substances: Fail - Fail (BDPE, Mercury), Good (Benzo(a)pyrene, Cadmium, Hexachlorobenzene, Hexachlorobutadiene, Nonylphenol) Priority substances: Good - Good (Fluoranthene, Lead, Nickel, Trichloromethane)									

Chestle Pill

© Crown copyright and database rights 2016 Ordnance Survey.

Brislington Bk - source to conf R Avon (Brist)

© Crown copyright and database rights 2017 Ordnance Survey.

Bristol Floating Harbour

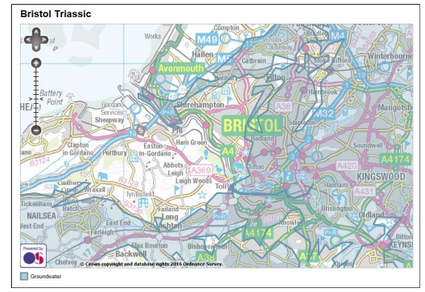
© Crown copyright and database rights 2017 Ordnance Survey.

SEVERN LOWER

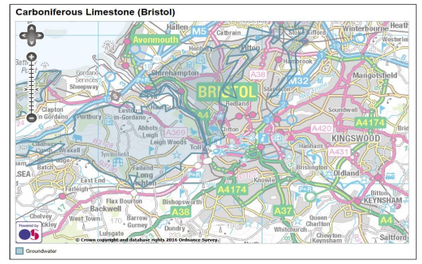
© Crown copyright and database rights 2017 Ordnance Survey.

Location, watercourse and NGR (insert two NGRs if linear site)	Outline description of preferred option if known or type of options being considered if preferred option is yet to be defined	Water bodies screened in and why	Waterbodies screened out and why	Baseline data for those waterbodies screened in (From 2015 data provided in EA Catchment Management Tool)	3.1 Preliminary assessment of deterioration	3.2. Assessment of cumulative effects	3.3. Sensitive/critical habitats check	Is the water at Good Ecological Status (GES)/Good Ecological Potential (GEP)	If water body not at GES or GEP will the proposed works prevent GES/GEP being achieved?	3.4 Will the scheme impact on the ability to deliver proposed water body measures? Why/why not?	Mitigation measures to limit impact of scheme	3.5 Can scheme deliver improvement measures to GES/GEP? Why/why not?	Conclusions
Bristol Triassic (E:347438 N:169605)			Bristol Triassic GB40902G804800 Scoped out as there are currently no receptors in this groundwater body	Bristol Triassic Waterbody ID: GB40902G804800 Type: Groundwater Designation: Secondary A and B Current Status or potential: Overall Water Body - Poor (2015) Objective: Good (2027) Reasons for failing (if failing): natural conditions Length/area of water body: Protected Areas: Drinking Water Protection Area (at Risk), Severn Estuary Ramsar, SAC Protected Area Objectives: Mitigation measures in place and those not implemented: N/a Quantitative - Good Dependent Surface Water Body Status - Good GWDTEs test - Good Saline Intrusion - Good Water Balance - Good Chemical (GW) - Poor Dependent Surface Water Body Status - Good Drinking Water Protected Area - Poor - Objective (2027): Good natural conditions recovery time GWDTEs test - Good Saline Intrusion - Good General Chemical Test - Good Groundwater Supporting Elements: Prevent and Limit Objective: Active Trend Assessment: Upward trend									
Carboniferous Limestone (Bristol) (E:352380 N:173645)			Carboniferous Limestone (Bristol) GB40901G806800 Scoped out as no intended development in this water body	Carboniferous Limestone (Bristol) Waterbody ID: GB40901G806800 Type: Groundwater Designation: Principal and Secondary A Current Status or potential: Overall Water Body - Good (2015) Objective: Good (2021) Reasons for failing (if failing): N/A Length/area of water body: Protected Areas: Drinking Water Protection Area (Probably not at Risk), Avon Gorge SSSI, Avon Gorge Woodlands SAC Protected Area Objectives: none Mitigation measures in place and those not implemented: N/a Quantitative - Good Dependent Surface Water Body Status - Good GWDTEs test - Good Saline Intrusion - Good Water Balance - Good Chemical (GW) - Good Dependent Surface Water Body Status - Good Drinking Water Protected Area - Good GWDTEs test - Good Saline Intrusion - Good General Chemical Test - Good Groundwater Supporting Elements: Prevent and Limit Objective: Active Trend Assessment: No-trend									
Portishead Mercia Mudstone (E:352607 N:176081)			Portishead Mercia Mudstone GB40902G805300 Scoped out as no intended development in this water body	Portishead Mercia Mudstone Waterbody ID: GB40902G805300 Type: Groundwater Designation: Secondary B Current Status or potential: Overall Water Body - Good (2015) Objective: Good (2021) Reasons for failing (if failing): N/A Length/area of water body: Protected Areas: Drinking Water Protection Area (Probably not at Risk) Protected Area Objectives: none Mitigation measures in place and those not implemented: N/a Quantitative - Good Dependent Surface Water Body Status - Good GWDTEs test - Good Saline Intrusion - Good Water Balance - Good Chemical (GW) - Good Dependent Surface Water Body Status - Good Drinking Water Protected Area - Good GWDTEs test - Good Saline Intrusion - Good General Chemical Test - Good Groundwater Supporting Elements: Prevent and Limit Objective: Active Trend Assessment: No-trend									

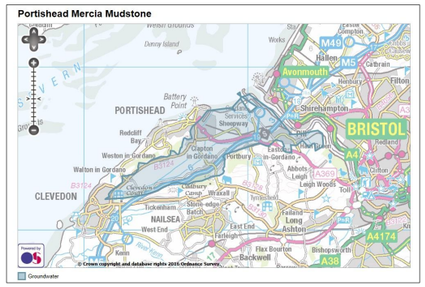
Bristol Triassic



Carboniferous Limestone (Bristol)



Portishead Mercia Mudstone



Water Framework Directive Assessment

Water Body ID	Water Body Type	Water Body Name	River Basin District	Outline Preliminary Assessment Completed
GB530905415405	Transitional Water	Bristol Avon	Severn	Yes
GB109053027840	River	Frome (Brist) - Bradley Bk to conf Floating Hbr	Severn	Screened Out
GB109053021970	River	The Malago - source to conf R Avon (Brist New Cut)	Severn	Screened Out
GB109053027530	River	Trym - source to conf R Avon (Brist)	Severn	Screened Out
GB109054026650	River	Chestle Pill	Severn	Screened Out
GB40902G804800	Groundwater Body	Bristol Triassic	Severn	Screened Out as no receptors
GB40901G806800	Groundwater Body	Carboniferous Limestone (Bristol)	Severn	Screened Out
GB40902G805300	Groundwater Body	Portishead Mercia Mudstone	Severn	Screened Out

Surface Water Assessment Matrix

Effect	Description/criteria	Examples	Outcome
Major beneficial	Impacts that taken on their own or in combination with others have the potential to lead to the improvement in the ecological status or potential of a WFD quality element for the entire waterbody	Creation of significant areas riparian habitats (for example, within a river diversion) which enhance the value of the waterbody.	Increase in status of one or more WFD element giving rise to a predicted rise in status class for that waterbody.
Minor /localised beneficial	Impacts when taken on their own or in combination with others have the potential to lead to a minor localised or temporary improvement that does not affect the overall WFD status of the waterbody or any quality elements	Minor habitat creation measures such as creation of marginal berms up/downstream of a structure.	Localised improvement, no change in status of WFD element
Green (no impact)	No measurable change to any quality elements.	Macrophytes: Clear span bridge which causes light shading Invertebrates: Changes to flow with no likely effect in macroinvertebrate community/contamination in area with highly tolerant invertebrate community (e.g. ASPT <4) Fish: Minor, temporary encroachment.	No change
Yellow - Localised/temporary adverse effect	Impacts when taken on their own or in combination with others have the potential to lead to a minor localised or temporary deterioration that does not affect the overall WFD status of the waterbody or any quality elements. Consideration will be given to habitat creation measures.	Invertebrates: Estimated loss in diversity of invertebrates for e.g. < 100 m of waterbody/or X% of waterbody surface (due to habitat loss, changes to flow etc.) Fish: Localised loss of fish habitat/numbers of fish Macrophytes/phytoplankton: Loss of macrophytes/diatoms due to shading from a bridge or other structure. Temporary loss of invertebrates/macrophytes etc. during channel re-alignment	Localised deterioration, no change in status of WFD element when balanced against mitigation measures embedded in the scheme.
Orange - adverse effect on class of WFD element	Impacts when taken on their own or in combination with others have the potential to lead to the deterioration in the WFD status class of one or more biological quality elements, but not in the overall status of the waterbody. Consideration will be given to habitat creation measures.	Invertebrates: Likely significant drop in invertebrate diversity over e.g. > 300 m or X% of waterbody surface (due to habitat loss/siltation or combination of various impacts etc.) Fish: Obstruction to upstream migration of fish to spawning grounds in a salmonid river therefore affecting fish in whole of WFD waterbody Macrophytes/phytoplankton: Loss of macrophytes/diatoms for a significant length of water due to shading from a long (e.g. > 200 m) culvert or other similar structure	Decrease in status of WFD element when balanced against positive measures embedded in the scheme.
Red – adverse effect on overall WFD class of waterbody	Impacts when taken on their own or in combination with others have the potential to lead to the deterioration in the ecological status or potential of a WFD quality element, which then lead to a deterioration of status/potential of waterbody	Any change in status of an element that leads to an overall deterioration of WFD class of waterbody – this colour is only assigned when the positive benefits from mitigation for that waterbody are outweighed by negative impacts.	Decrease in status of overall WFD waterbody status when balanced against positive measures embedded in the scheme.

Risk screening of potential to cause deterioration of current WFD Ecological status

	Transitional Water	Scheme Elements	Preferred Route Alignment based on Front Alignment Option						Overall impact	Further WFD Assessment or Mitigation (to retain or promote good status)
	GB530905415405	Phase (Construction / Operation)	Construction	Construction	Construction	Construction	Operation	Operation		
	Bristol Avon	Identified quantitative impacts	Noise and vibration from piling	Temporary landtake	Pollution due to discharges	Scour	Permanent landtake for new sheet piled wall	Change to hydraulics		
Hydromorphological	**Hydrological Regime:** Quantity and dynamics of water flow	Predicted change to status elements	No measureable change to element	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change anticipated	No measureable change anticipated	No measureable change anticipated	No significant impact anticipated	None Required
	Hydrological Regime: Connection to groundwater bodies		No measureable change to element	No measureable change to element anticipated	Possible minor impact from piling into groundwater at the foreshore locations, where there is the possibility of mobilising contaminated sediments.	Possible minor impact from piling activities in the Foreshore areas.	New piled walls will have possible minor impacts in the connection of groundwater to surface water at Clarence Road, Commercial Road, Cattle Market Road west and Netham area, but it is unlikely that there would be any significant impact at the waterbody scale. Overall, impacts are considered unlikely but cannot be ruled out at this stage as groundwater levels in the areas are not known.	Possible minor loss of groundwater baseflow. However water quality is expected to be dominated by upstream sandstone catchment. Overall, impacts considered unlikely but cannot be ruled out at this stage.	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. Further Site Investigation is proposed at the detailed design stage to make sure that the introduction of a sheet piled wall will not prevent groundwater flow towards the River Avon, or increase risk of groundwater flooding from mounding of groundwater behind the wall. If found to exist suitable mitigation will be incorporated into the design to prevent the build up of groundwater behind the new piled structure.
	River Continuity: Migration of aquatic organisms		Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Works to Netham water sluice gates could provide an opportuniy to improve eel passage at this structure and it would benefit waterbodies upstream of Netham.
	River Continuity: Sediment transport		No measureable change to element	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No significant impact anticipated at waterbody scale	No significant impact anticipated	None Required
	Morphological conditions: River depth and width variation		No measureable change to element	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road. Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Morphological conditions: Estuarine depth variation		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Morphological conditions: Structure and substrate of the river bed		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road. Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No significant impact anticipated at waterbody scale	No significant impact anticipated	None Required
	Morphological conditions: Quantity, structure and substrate of the Estuary bed		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Morphological conditions: Structure of the riparian zone/intertidal zone		No measureable change to element anticipated	There is potential for minor impacts due to changes in local hydraulics and substrate transport at the perimeter of the land take required for construction of river frontage pile walls (Clarence road, Commercial Road, Netham and Cattle Market Road west), but unlikely to be significant at waterbody scale, and likely to recover naturally	No measureable change to element anticipated	There is potential for scour local to works in the foreshore, but this is unlikely to be significant at waterbody scale, and likely to recover naturally	New walls could have the potential for some minor detrimental impacts on the structure of the intertidal zone compared to existing conditions at the Clarence Road, Commercial Road, Cattle Market Road west, and Netham areas. Where new walls are constructed this could result in a loss of intertidal environment, this is unlikely to be significant at the water body scale, however mitigation may be required to ensure no net loss in environment.	No significant impact anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. The potential loss of intertidal environments will need to be quantified and if required mitigation included to ensure no net loss in priority ecological environments.
	Tidal Regime: Freshwater flow		No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated at waterbody scale and therefore no measureable change to element anticipated	No significant impact anticipated	No significant impact anticipated	None Required
	Tidal Regime: Wave exposure		No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated	No significant impact anticipated at waterbody scale and therefore no measureable change to element anticipated	No significant impact anticipated at waterbody scale and therefore no measureable change to element anticipated	No significant impact anticipated	None Required
Biological	**Macroalgae and angiosperms**		Insensitive to impact. No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Benthic invertebrate fauna: Composition		Insensitive to impact. No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Benthic invertebrate fauna: Abundance		Insensitive to impact. No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Fish fauna: Species composition and abundance		Possible temporary effects from piling in foreshore area. Mitigation will be needed depending on methodology and timing.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Fish fauna: Presence of type-specific disturbance sensitive species		Possible temporary effects from piling in foreshore area. Mitigation will be needed depending on methodology and timing.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
	Fish fauna: Age structure of fish communities		Possible temporary effects from piling in foreshore area. Mitigation will be needed depending on methodology and timing.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel, however overall, impacts are considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage.
Critical sensitive habitats/species	**Priority habitats and species:** Various species using mudflats		Possible temporary effects from piling in foreshore area.	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel. This is unlikely to be significant at the water body scale, however mitigation may be required to ensure no net loss in environment.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. The potential loss of intertidal environments will need to be quantified and if required mitigation included to ensure no net loss in priority ecological environments.
	Priority habitats and species: Intertidal mudflat		No measureable change to element anticipated	There is the potential for a minor temporary impact due to the loss of habitat during works on the foreshore and channel. This is unlikely to be significant at the waterbody scale.	No measureable change to element anticipated (impact mitigated through CEMP)	There is potential for scour local to works in the foreshore, affecting the ecological habitats, but this is unlikely to be significant at waterbody scale.	New walls at Clarence Road, Cattle Market road west , Commercial Road and in Netham will result in some loss of habitat on the foreshore and channel. This is unlikely to be significant at the water body scale, however mitigation may be required to ensure no net loss in environment.	No structures in river channel. Therefore no measureable change to element anticipated	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. The potential loss of intertidal environments will need to be quantified and if required mitigation included to ensure no net loss in priority ecological environments.
Physico-chemical elements	**Dissolved Oxygen**		No measureable change to element anticipated	No measureable change to element anticipated	No measureable change to element anticipated (impacts mitigated through CoCP and best practice for design, construction and operations). There is the potential that the scheme could result in the mobilisation of sediment into the water column through piling activities in potentially contaminated areas. Contaminants attached to the mobilised sediments could enter the water column and have the potential to impact water quality within the WFD waterbody, impacts are considered unlikely but cannot be ruled out at this stage	No measureable change to element anticipated (no structures in river channel)	Possible impact on surface water run-off (and therefore water quality) into River Avon. Impacts considered unlikely to be significant at the waterbody scale but cannot be ruled out at this stage.	No measureable change to element anticipated (no structures in river channel)	Potential localised impacts,, but not considered significant to water body.	To be considered further at full WFD assessment stage. Further Site Investigation is proposed at the detailed design stage to clarify the potential for contaminated land in the area of new piling proposed.
	Dissolved Inorganic Nitrogen									
	pH									
	Oxygen balance									
	Acid neutralising capacity									
	Temperature									
	Transparency									
Chemical	**Pollution by all priority hazardous substances identified as being discharged into the water body**									
	Pollution by other priority substances identified as being discharged in significant quantities into the water body									

CEMP: Construction Environmental Management Plan
CoCP: Code of Construction Practice

About AECOM

AECOM (NYSE: ACM) is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries.

As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges.

From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM companies had revenue of approximately US$19 billion during the 12 months ended June 30, 2015.

See how we deliver what others can only imagine at aecom.com and @AECOM.

Contact
AECOM
Portwall Place
Portwall Lane
Bristol, BS1 6NA, United Kingdom
T +44 (0) 117 901 7000
LinkedIn Twitter Facebook Instagram

aecom.com