

Bristol City Council

**River Avon Flood Risk
Management Strategy**

**Strategic Environmental Assessment
Addendum**

Issue | 22 January 2021

This report takes into account the particular instructions and requirements of our client.


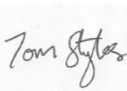


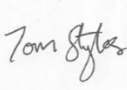


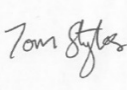
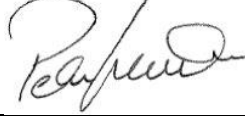

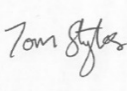

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1 Introduction

Bristol City Council (BCC) has commissioned Ove Arup and Partners Ltd. (Arup) to undertake an update to the Strategic Environmental Assessment (SEA): AECOM Environmental Report¹ previously prepared by AECOM on the River Avon Tidal Flood Risk Management Strategy (“the Strategy”).

As with any city located close to rivers and the sea, Bristol has experienced many flood events in its past and has a long history of interaction with the River Avon, the Severn Estuary and other waterbodies in the region. The city centre is largely developed around these key waterbodies and over the years has experienced increasing flood events that have been caused by increased river/fluvial flows during storm events and also through surges of water via the Severn Estuary creating a tidal food up the river system. In recent years, communities across the UK have experienced increased levels of flooding causing disruption, damage to infrastructure and danger to life. Increasing sea levels and storm events caused by climate change mean the risk of flooding is increasing. The impact would be felt across the West of England due to Bristol’s regional importance for employment, transport, recreation, tourism and economic growth.

Bristol City Council is working with the Environment Agency and key stakeholders to create a vital long-term strategy to protect the city from increased flood events, supported by Arup. The Strategy includes the provision of flood defence infrastructure to manage the risk from River Avon flooding to the centre of Bristol with placemaking to seek opportunities for inclusive growth, quality of life, environment and resilience.

Arup has undertaken a review of the Strategy and an update to the flood risk modelling to include fluvial flood risk alongside the tidal flood risk previously included by AECOM. This acknowledges the interaction between both tidal and fluvial flows in Bristol and the need for flood defences given the potential for flood events resulting from exception flows in both or either of these systems.

This report considers the changes to the Strategy as a result of the flood risk modelling undertaken by Arup on the preferred approach and provides an update to the AECOM Environmental Report to review the environmental impacts to align with the amended River Avon Flood Risk Management Strategy (“the amended Strategy”). This report also considers whether any further assessments are required following the proposed changes to the Strategy.

This SEA Addendum does not supersede the AECOM Environmental Report, with the exception of the Cultural Heritage section following an update to the baseline information, but instead follows on to consider how these changes as a consequence of the amended Strategy impact on the original SEA outcomes with reference to each topic area and should be read in conjunction with the original AECOM Environmental Report and supporting documents. Consultation with key stakeholders and the general public is a key procedural requirement of the SEA

¹ AECOM (2017) Strategic Environmental Assessment: AECOM Environmental Report. River Avon Tidal Flood Risk Management Strategy, Bristol City Council.

Regulations and these documents will be used for further consultation and engagement in advance of adoption by Bristol City Council and endorsement by the Environment Agency.

The AECOM Environmental Report includes the following supporting documents that should be read in conjunction with the SEA Addendum (See Figure 1 - Scope of updates and reporting):

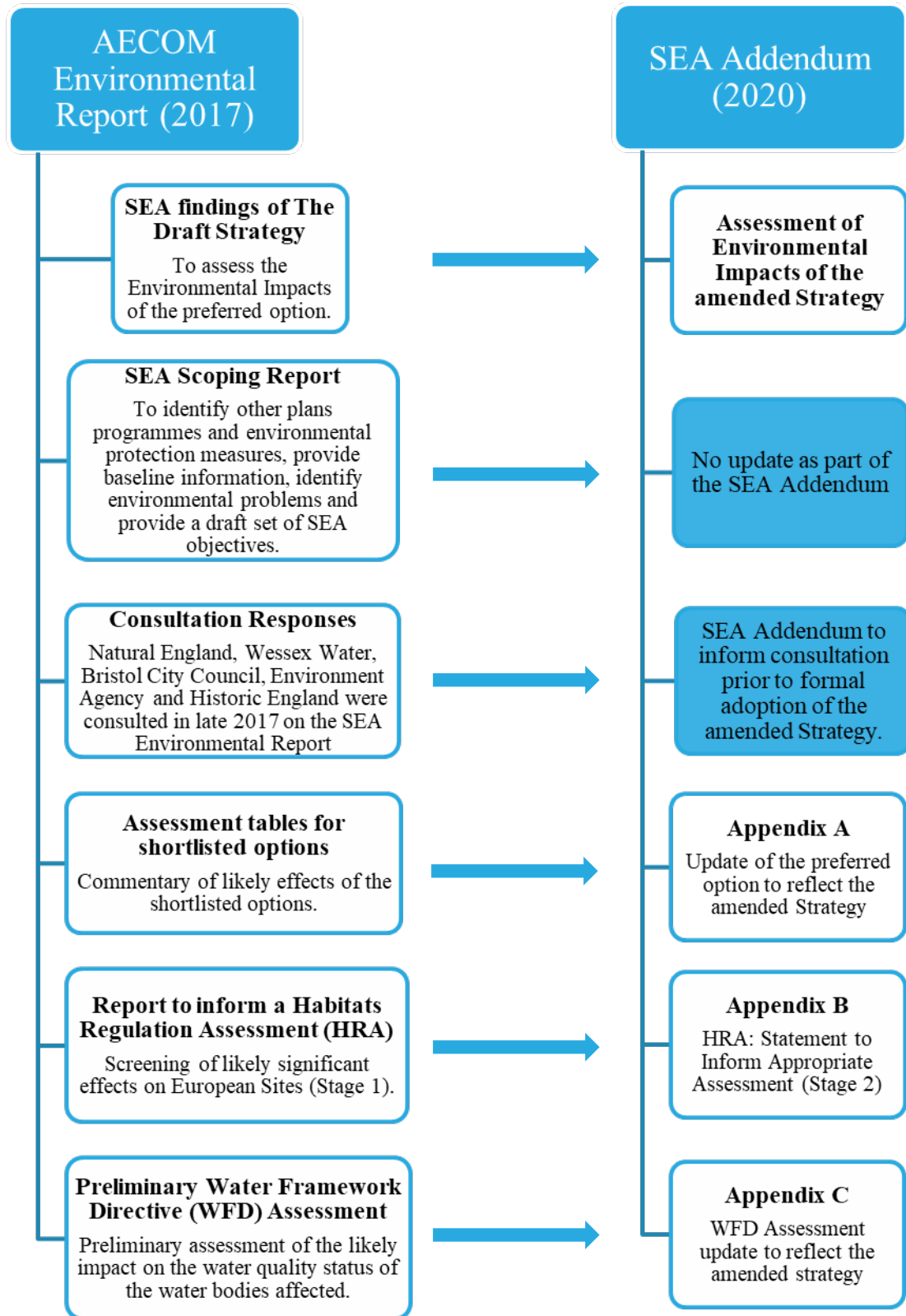
- SEA Scoping Report;
- Consultation Responses;
- Assessment tables for shortlisted options;
- Report to inform a Habitats Regulation Assessment (HRA); and
- Preliminary Water Framework Directive (WFD) Assessment.

The AECOM supporting documents remain relevant to the amended Strategy and a proportionate approach has been undertaken within the SEA Addendum to highlight the key differences to that previously reported within the AECOM Environmental Report.

The following reports undertaken by AECOM are also included for reference and should be read in conjunction with this addendum:

- Baseline Mapping (Activity 9A);
- Options Identification and Environmental Appraisal (Activity 9B); and
- Pre-Scoping Report (Activity 9C).

Figure 1 - Scope of updates and reporting



2 Scope of Work and Approach

Following submission of the AECOM Environmental Report in 2017², BCC has commissioned Arup to provide an update on the Strategy given the need to consider fluvial inputs combined alongside tidal flows to understand broader implications on the core areas of Bristol and the need for flood defences and detriment mitigation measures.

This report outlines the amended Strategy and highlights the key differences to that previously reported within the AECOM Environmental Report and the revisions / additions made as a result of the updated flood risk modelling in the context of SEA. An update of the environmental findings within the AECOM Environmental Report has been undertaken to consider the amendments to the proposed height, lengths and location of the flood defence strategy. The report also includes the assessment of new flood defences and detriment mitigation measures required to accommodate areas identified at risk of flooding within the updated model that considers both tidal and fluvial flows. It is important to note that flood defences and detriment mitigation measures 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.

The focus of this report is on how the identified amendments to the flood defence design influence the environmental findings within the AECOM Environmental Report, with reference to each environmental topic area presented within the assessment of the preferred option. This includes a review of the changes to environmental effects and the recommendations reported and follows on from the work already undertaken, with the exception of the Cultural Heritage chapter that replaces the chapter within the AECOM Environmental Report. This has been undertaken in line with the River Avon Heritage Assessment³ commissioned by BCC. This SEA addendum also reviews the need for further assessment and recommendations regarding the implementation of the amended Strategy.

As part of the update to the flood defence design, an update to the HRA and WFD elements of the assessment are also required and can be found in the appendices to this report. These two assessments supersede the assessments undertaken as part of the AECOM Environmental Report and relate to the amended Strategy produced by Arup.

It has been agreed through discussions with BCC and the Environment Agency (EA) that the baseline information provided within the suite of AECOM documents remains valid and that no updates will be made to the baseline information for the purpose of this work. It has also been agreed that this report should follow the same approach undertaken by AECOM to maintain consistency of reporting. Finally, this report acknowledges the work undertaken by AECOM that considers the reasonable and feasible alternatives associated with the original Strategy but does not review or amend this process. Instead, this report considers the environmental implications as a result of the amendments to the preferred

² AECOM (2017) Strategic Environmental Assessment: AECOM Environmental Report. River Avon Tidal Flood Risk Management Strategy, Bristol City Council.

³ River Avon Heritage Assessment (2018) City Design Group, Bristol City Council [draft].

option, as reported in the AECOM Environmental Report (Option D1), following the updated flood risk modelling.

3 Background

The AECOM Environmental Report was commissioned to support the development of Bristol City Council's River Avon Tidal Flood Risk Management Strategy and presents the key findings of the environmental assessment of options. It was acknowledged in the AECOM Environmental Report:

“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 on the city's attractiveness and economic performance. Climate change predictions have the potential to constrain the scale and form of development in central Bristol today.

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 Plan⁴.”

The Project Board made up of representatives of BCC and EA chose to commission a voluntary SEA to identify significant positive and negative effects, and ensure the environment was appropriately accounted for within the decision making process. An SEA was therefore undertaken by AECOM in line with 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).

3.1 Options Appraisal

The Options Identification and Environmental Appraisal⁵ report undertaken by AECOM sets out a review of a long list of 39 strategic options that each outlined a sequence of measures to be implemented in each epoch of the Strategy (Epoch 1: 2015-2030; Epoch 2: 2030-2065; Epoch 3: 2065-2115). Multiple options were considered and screened at an early stage, over the three Reaches identified by AECOM (Figure 2), to assess their suitability for the Strategy. This resulted in 39 long list options identified through a combinations of the following measures to manage tidal flood risk:

- low defences or crest raising;
- narrow tidal barrier solution;
- property protection and temporary defences;

⁴ Bristol City Council (2011) Local Plan. Available online at: <https://www.bristol.gov.uk/planning-and-building-regulations/local-plan> Accessed April 2020

⁵ AECOM (2017) Activity 9B: Options Identification and Environmental Appraisal, River Avon Flood Risk Management Strategy, Bristol City Council

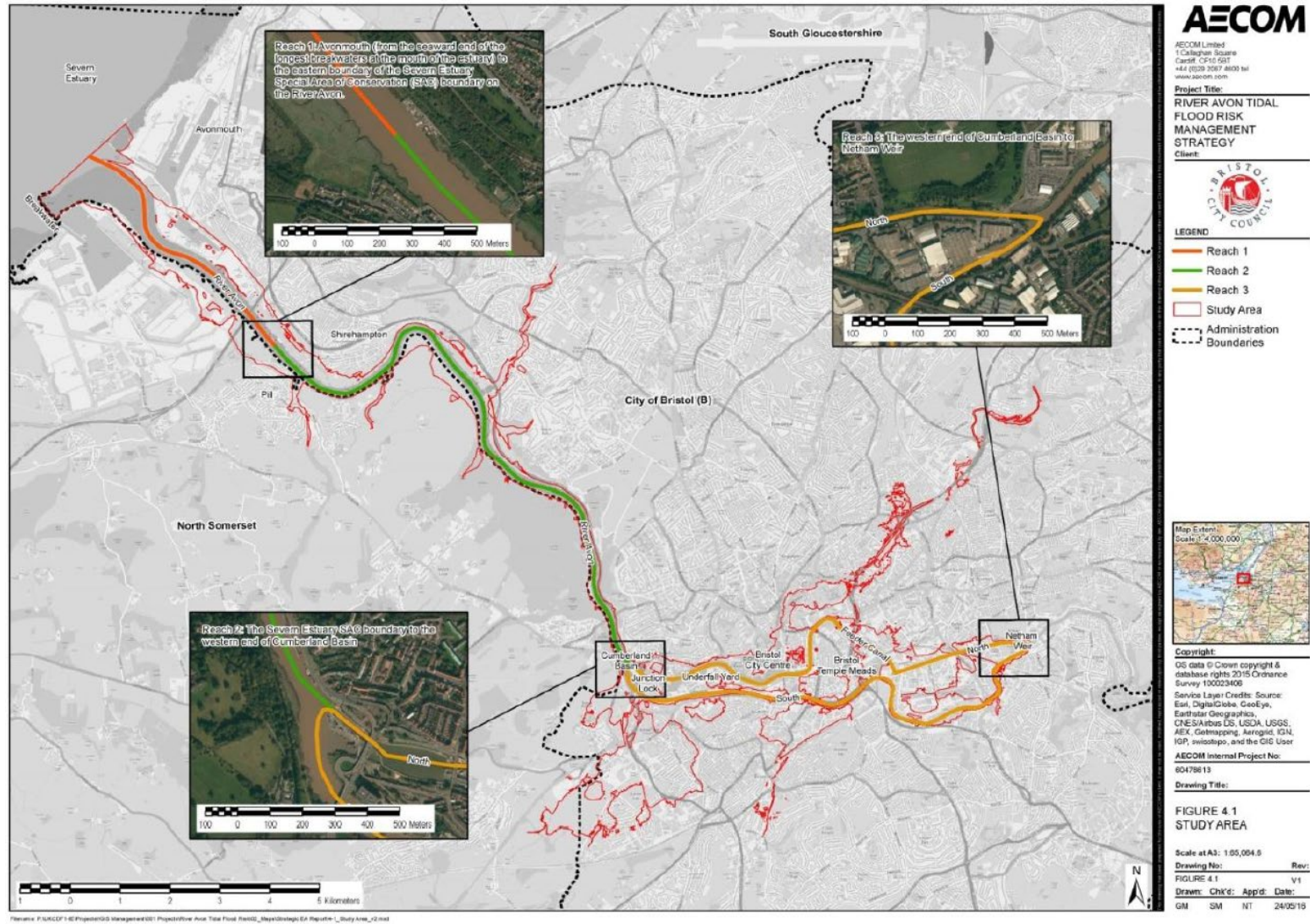
- do minimum;
- high defences or crest raising;
- wide tidal barrier solution; and
- secondary measures to manage the consequences/response to flooding (such as flood forecasting and warnings).

It was found that river front defences were the preferred option when assessed against a range of criteria including in terms of flood risk reduction from fluvial and tidal sources, cost, adaptability and environmental impact. Through the consideration of reasonable and feasible alternatives, a short list of seven remaining options were considered through the AECOM Environmental Report from which the preferred option would be selected. The assessment of the options, presented under the SEA topics and as outlined in the Scoping Report, resulted in the selection of Option D as the preferred option for the strategy. This option consisted of 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.

Option D was refined following the optioneering stage to create Option D1 with further details of defence alignments, design, cost estimates and phasing being developed. The design for Option D1 consisting of approximately 5km of new raised defences within central Bristol (Reach 3 as shown in Figure 2) comprising: Cumberland Road; Commercial Road; Clarence Road; Cattle Market Road; Totterdown; and St. Phillips. These defences would prevent local flooding to the properties and assets situated behind the defences. New defences at additional core areas would also be required as part of Option D1 including Entrance Lock, Netham, Bathurst Dam, and Cumberland Road underpass. These defences would prevent water flowing into the Floating Harbour and flooding properties in central Bristol and would require installation of new tidal stop gates and operating infrastructure at Entrance Lock and Netham as part of the new defences.

Further work undertaken to model the effects of the flood defences found that an increased risk of flooding was evident in four areas: Totterdown, Netham, Bower Ashton and Bedminster. As part of the original Strategy, detriment mitigation measures in each of the four locations were included to resolve the issue.

Figure 2 - Spatial scope of Options Appraisal. Source: SEA Environmental Report, AECOM, 2017



4 Considerations in Fluvial and Tidal Flood Risk Management Design

As part of the work commissioned to Arup by BCC in 2018, hydraulic modelling has identified options to reduce fluvial flood risk. The modelling identified the locations and heights of raised flood defences required, and further work was done to determine the possible reduction in height of these defences that could be achieved if the following measures were employed in combination with raised flood defences. These include:

- **Modifications to Netham Weir:** A best-case scenario was modelled where the weir was able to be lowered to the river-bed level before a flood occurred. However, model results showed that although this would reduce the height requirements of raised flood defences by a maximum of 60mm upstream of the weir, it will lead to a requirement of higher defences downstream of the weir due to a higher flood peak; and
- **Pre-lowering the water level in the Floating Harbour by 0.5m prior to flood events:** The model results showed there would be no reduction to the height of the raised flood defences as the relatively small amount of additional flood storage created in the Floating Harbour is quickly used up early on in the flood before the flood peak arrives.

Hydraulic modelling was also undertaken to determine the reduction in height of raised flood defences that could be achieved if a tidal barrier was constructed in combination with raised flood defences. For this assessment, it was assumed that a 3-gate tidal barrier would be constructed at Nibley in 2065 and that this would coincide with the time when flood defences are raised to provide the required standard of protection to 2125. Results showed there would be no major benefit in operating a tidal barrier during fluvial flood events but there would be significant benefit for tidal events. The results showed that a tidal barrier constructed in 2065 could reduce the height of raised flood defences by about 0.5m from 2065. This reduction in height would reduce to zero at Netham Weir as highest water levels are caused by fluvial floods upstream of here.

Further hydraulic modelling was undertaken to assess the residual risk of a tidal barrier failing during a 1 in 1000-year (0.1% annual chance) flood. This was tested for tidal floods with the tidal barrier failing open and also tested for fluvial floods with the tidal barrier failing closed. The modelling considered failure scenarios where all three tidal barrier gates fail and where two out of the three gates failed. The results showed that the worst case residual risk in 2065 would occur if a tidal barrier were to fail in a closed position during a fluvial flood with all three gates failing. This is because all flow in the river becomes trapped upstream of the tidal barrier until it can overtop it. The residual flood depths in this situation would be over 4m in some areas of Bristol, approximately 2m higher than if a tidal barrier were not constructed. The failure scenario leading to two out of three gates failing would result in substantially lower flood depths in comparison, albeit still large, with flood depths about 0.5m higher than if a tidal barrier was not constructed.

These options have been considered from a flood risk perspective through the use of hydraulic modelling to determine their effectiveness. The outcome of which has concluded that these will not form part of the amended Strategy.

5 Amendments to Option D1

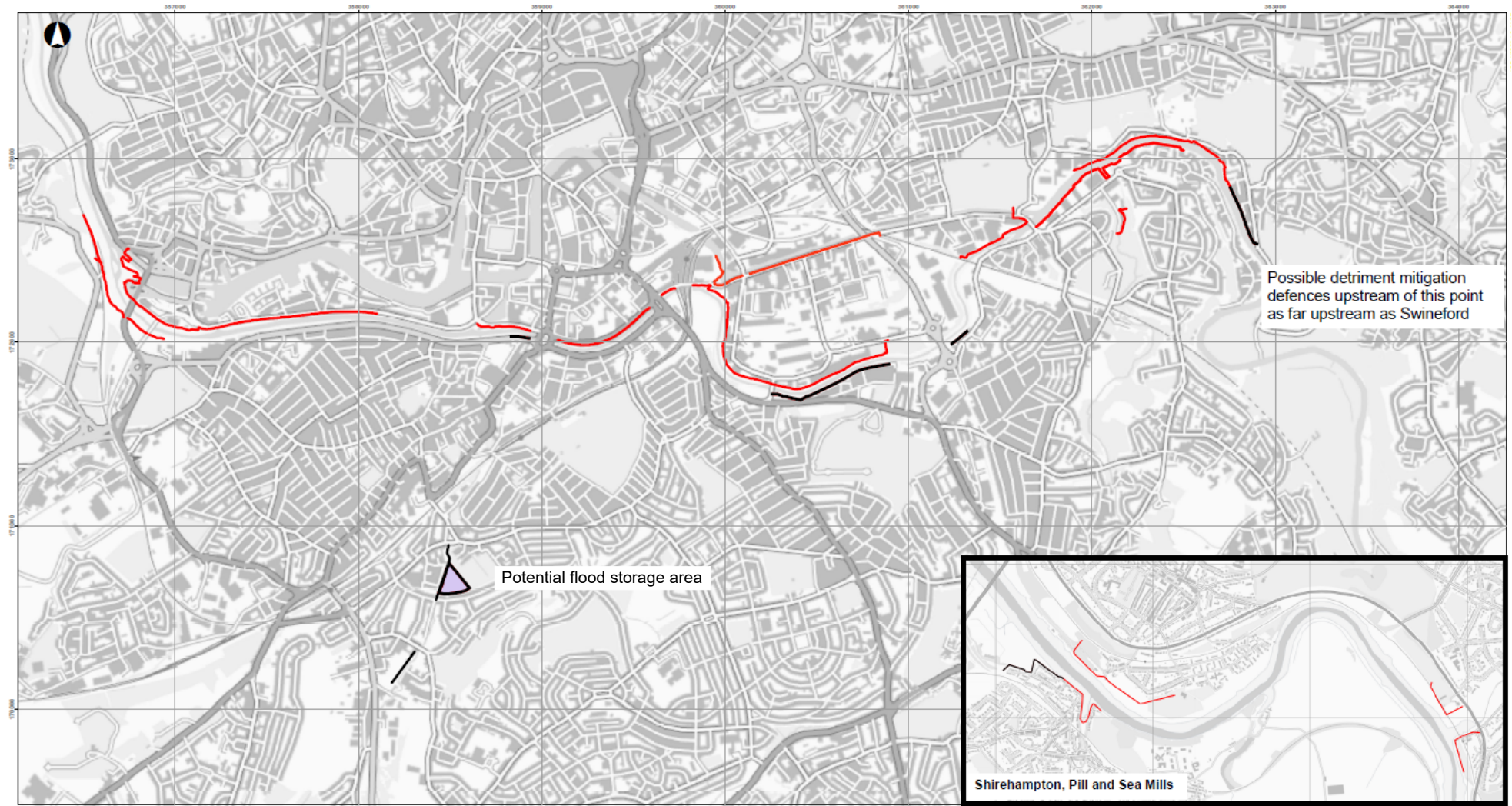
Through the inclusion of both fluvial and tidal flows as part of the amended Strategy produced by Arup a number of amendments have been made to the preferred option presented in the AECOM Environmental Report.

The amended Strategy has reviewed the preferred option through technical assessments and maintains the core approach of the preferred option (Option D1) through construction of Low and High defences, however the time periods in which they are implemented have been amended into the following two Epochs as outlined in Table 1 and presented through Figure 3. The Low defences will be constructed to a 1 in 200 year standard of protection for 2065. The upgraded High defences will provide a 1 in 200 year standard of protection for 2125.

Table 1 – Defences implemented by Epoch

AECOM Strategy 2017	Amended Strategy 2020 (Arup)
Epoch 1 (Low defences) – 2015-2030	
Epoch 2 (Low defences) – 2030 to 2065	Epoch 1 (Low defences) – 2024 to 2065
Epoch 3 (High defences) – 2065 to 2115	Epoch 2 (High defences) – 2065 to 2125

Figure 3 – Timescales of flood defences



Key

River Avon raised flood defences proposed in 2020s. Most to be raised in 2060s

Defences built in 2060s



Note:

- All designs subject to development
- Some defences involve raising of existing structures rather than construction of new

5.1 Update to preferred option

The general principle of the preferred option is to construct raised defences including embankments, walls, and ground raising, with ramps and occasionally gates to provide access as required. Following the updated hydraulic modelling for the amended Strategy the preferred option reported in the AECOM Environmental Report has been updated to include the following changes to the flood defences within Reach 3:

- New road raising at Cumberland Basin Road where it meets the Portway by a maximum of 1.1m and the installation of a floodgate across the road;
- New reinforced concrete wall along Cumberland Basin Road to the Entrance Lock (a reduced length to that previously proposed);
- New replacement of downstream lock gates at Entrance Lock (as opposed to the replacement of the upstream lock gates as per AECOM's proposal);
- New flood defences in front of existing defences around the western extent of Entrance Lock ("the knuckle") requiring piling;
- Additional increase of height of the lock gates (Brunel Dam) at South Entrance Lock by approximately 3.5m and raising the existing footbridge. Unlike other areas, amendments to South Entrance Lock is also only proposed to occur once rather than as an adaptive approach;
- Amendment to increase the height of flood defences previously proposed along the south-west extent of Spike Island;
- Amendment to increase the height and length of proposed earthwork flood defences at Bower Ashton previously proposed as detriment mitigation;
- Amendment to increase the height and length of proposed defences along Cumberland Road – these will include remedial works to areas identified by Bristol City Council;
- Amendment to increase the height of proposed floodgate across the existing heritage railway and Chocolate Path adjacent to Cumberland Road. Works will also include remedial works to the structure of the railway and Chocolate Path to safeguard the use;
- Amendment to increase the height of proposed flood defences along Commercial Road;
- Amendment to increase the height of Bathurst Dam by approximately 2.3m through mass concrete. Unlike other areas, amendments to Bathurst Dam is also only proposed to occur once rather than as an adaptive approach;
- Amendment to increase the height and length of proposed flood defences along Clarence Road. The entire defence will require contiguous piling;
- Amendment to increase the height and alignment of proposed flood defences along Cattle Market Road;

- Amendment to increase the height and alignment of proposed flood defences along the northern side of the River Avon at St Philips Marsh requiring contiguous piling;
- Amendment of defences along the greenway on the southern side of the River Avon at St Philips Marsh to provide a continuous defence with no reliance on existing structures and path widening;
- Amendment to increase the height of proposed flood defences through Netham. A new floodgate is proposed across the Feeder Canal; and
- New flood defences along Feeder Road, including a flood gate across the road.

Defence Finish

In some location within the amended Strategy, the raised defences have the potential to negatively impact the landscape and visual character of the area. Typical flood defences during Epoch 1 (2025-2065) will consist of parapets, typically 0.9 to 1.5m above general ground level, although these will vary at each location and further work is required to fully assess the level of significance. High defences, proposed in Epoch 2 (2065-2125), will protect against the increased tidal and fluvial flows and will require defences to be increased in height by approximately 0.6m. Precautionary allowances of climate change associated with the national planning policy framework would require approximately further 0.3m to be added to defence levels.

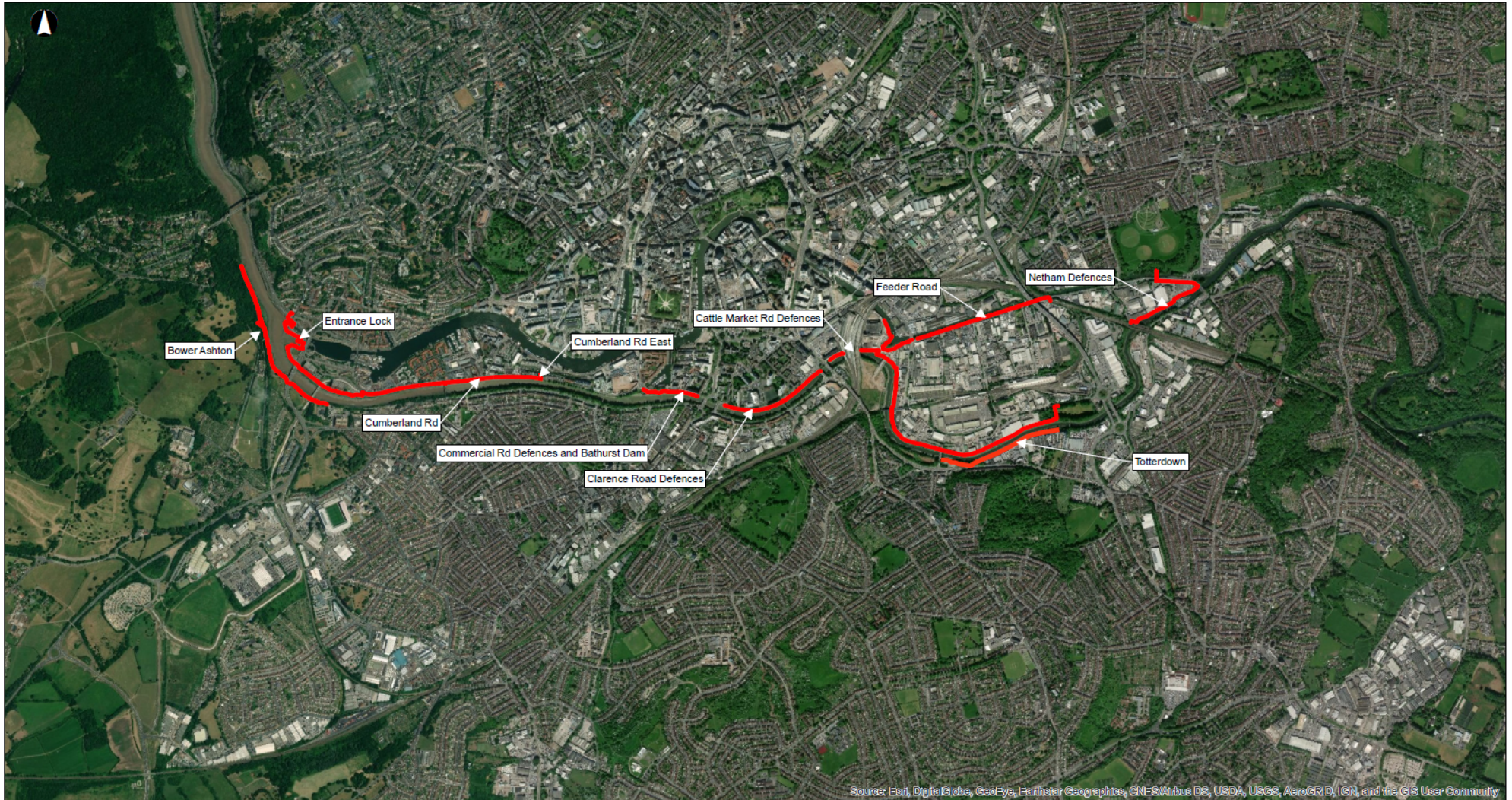
Typically, as per the AECOM Environmental Report, the defences will be finished with masonry cladding or an alternative finish that is suitable for the local landscape. In addition, approaches such as terracing, raising defences using reinforced glass panels and local road raising will reduce the visual impact of the defences. Where possible, other landscaping opportunities will be integrated.

BCC have an aspiration to ensure that raised flood defences built as a result of this Strategy become integrated into wider multi-functional public realm infrastructure. A Placemaking Opportunities report⁶ has been produced that considers the potential for the flood defence design to be integrated within the creation of meaningful public spaces, providing an opportunity to re-think the role and synergies between grey and green infrastructure in urban environments.

The SEA Addendum acknowledges the opportunities highlighted within the Placemaking Opportunities Report through the relevant SEA topic chapters, however it must be recognised that assessment of environmental implications is based on typical flood defence measures in locations identified through the amended Strategy. The report considers the potential for such placemaking opportunities to be implemented to mitigate adverse effects but does not directly assess the measures highlighted within the Placemaking Opportunities Report.

⁶ Arup (2020) Placemaking Opportunities Report, River Avon Flood Risk Management Strategy, Bristol City Council.

Figure 4 - Extent of flood defences



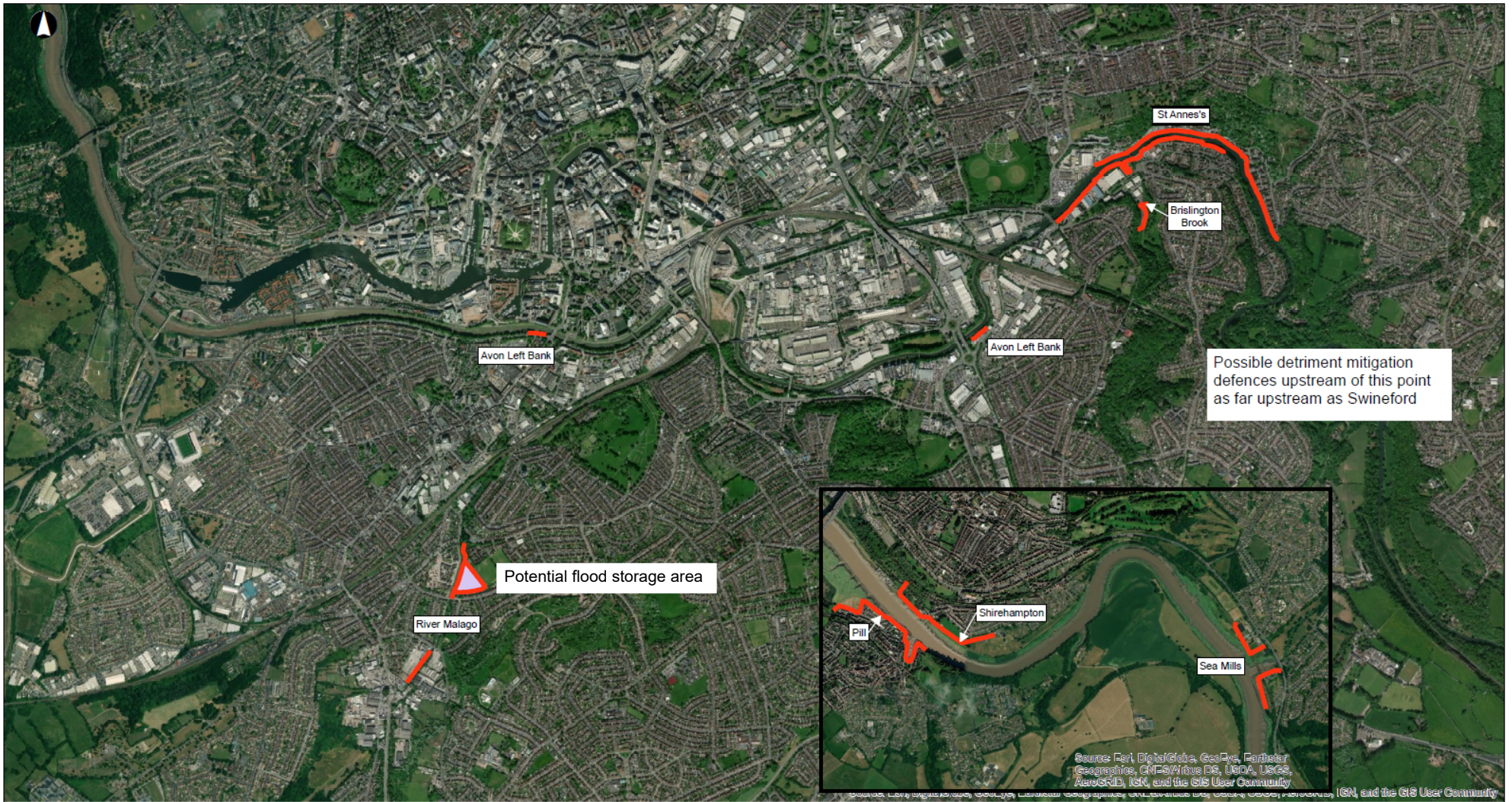
5.2 Detriment Mitigation

In addition to the construction of phased defences in the core areas, the scheme also includes measures to prevent detriment (an increase in flood risk) to other areas. These detriment mitigation measures include works:

- downstream of Bristol in Shirehampton, Pill and Sea Mills (Reach 2);
- on the banks of the Avon itself near the Malago and St Philip's Causeway (Reach 3);
- on the north and south banks at St Anne's (Reach 3);
- towards the downstream end of Brislington Brook (Reach 3); and
- on the Malago to allow Marksbury Open Space to flood (Reach 3).

A number of areas have been identified further upstream than St Anne's that may require the implementation of detriment mitigation measures as a result of the Strategy. Due to the reduced modelling certainty and information available regarding these areas at this time, the extents, height and form of these defences has not been determined. An allowance has been made within the amended Strategy for pricing but are not included within the amended SEA Addendum. Further investigations and design development on a local level will be required to confirm and refine proposals to reduce environmental impacts and identify opportunities for enhancement.

Figure 5 - Extent of detriment mitigation



6 Assessment of Environmental Impacts of the Amended Strategy

This section provides an environmental review of the amended Strategy and reports any additional or altered environmental effects that may result from the revision of the AECOM design as presented in the preferred option, and consideration of whether these changes affect the overall conclusions in the AECOM SEA Report on temporary and permanent effects. As per the AECOM Environmental Report, the environmental effects reported have been made in comparison to the operation of the existing flood defences in Bristol reflecting the “do-minimum” approach outlined in the AECOM Options Identification and Environmental Appraisal.

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

6.1 Biodiversity, flora and fauna

The aim of this section is to present an assessment of the changes brought forward through the amended Strategy in terms of ‘biodiversity, flora and fauna’.

Construction

Defences

Designated Sites

The amended HRA: Statement to Inform Appropriate Assessment (SIAA) contained in Appendix B has concluded at Stage 2 Appropriate Assessment that without mitigation and/or avoidance measures the proposed works could give rise to a **potential adverse effect** on the integrity of the European Sites during construction as a result of new or amended flood defences. Through increased defences, adverse effects could arise on Avon Gorge Woodlands Special Area of Conservation (SAC), Severn Estuary Special Protection Area (SPA), Severn Estuary SAC, Severn Estuary Ramsar and North Somerset and Mendip Bats SAC.

The amended embankment raising at Bower Ashton that has resulted in an increased length are now considered as key flood defences in the strategy. The increased length of these defences to that reported in the AECOM Environmental Report are likely to have an increased impact on the Avon Gorge Woodlands SAC, Avon Gorge SSSI, Avon New Cut LNR and also Leigh Woods NNR. Ashton Court SSSI, whilst offset from the construction works, should also be assessed for impact at later design stages.

Further survey work would be required to understand the impact on the designated sites and the necessary avoidance and/or mitigation measures likely to be required. This is covered in further detail within Appendix C – HRA: SIAA, in

relation to European sites. However, survey work may be required in other designated sites where qualifying features may be impacted. Without mitigation and/or avoidance measures, impacts on designated sites has the potential to result in **significant negative effects**.

Intertidal Habitat Loss

As reported in the AECOM Environmental Report, as the Strategy is refined further, and detailed defence design takes place, every opportunity should be taken to minimise net loss of intertidal saltmarsh and mudflats 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 that must commit to no net loss approach of intertidal habitat Biodiversity Net Gain. The loss of coastal habitats may require creation/enhancement of intertidal habitats of a greater area than the area lost. This will take account of any increased coastal squeeze or habitat loss that may result from new defences and also from any increased coastal defence footprint. Coastal saltmarsh is a priority habitat (Section 41, NERC Act 2006) and a material consideration at planning. Later design stages should account for the requirements of mitigation and/or compensatory habitat cost, including potentially land purchase and/or habitat management, including managed re-alignment. It may be appropriate, through consultation, to contribute to a wider strategic approach across the region for mitigation and/or compensatory measures.

Estuarine Ecology

As reported in the AECOM Environmental Report, 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 Cumberland Basin, Cumberland Road, Commerical Road, Clarence Road, Cattle Market Road, Bathurst Dam and Netham) 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.

Consideration must be given, as outlined in Appendix C – HRA: SIAA, to construction impacts on qualifying features of the assessed SPA, SAC and Ramsar sites, in relation to qualifying habitats, fish, bats and bird species. Mitigation measures outlined in the HRA must be considered during construction on estuarine ecology, including the potential for construction phasing.

Detriment Mitigation

The new areas of detriment mitigation measures including Shirehampton, Pill and Sea Mills, as well as works near St. Philips Causeway, works in association with the River Malago, and works at St Anne's may have a **temporary negative effect** on designated sites and estuarine ecology during construction due to habitat loss, degradation, disturbance (including visual, noise and vibration effects), habitat severance, and/or species mortality/injury.

Potential negative impacts from defence proposals could also arise on statutorily designated sites, namely Lamplighters Marsh LNR, Avon Cut LNR, Avon Valley Woodland LNR, Severn Estuary SSSI and Bickely Wood SSSI. The latter SSSI is

potentially offset from the construction works, however impacts and any potential mitigation should be considered.

Detriment mitigation measures at Shirehampton, Pill and Sea Mills area likely to also result in direct impacts on designated sites (Severn Estuary SAC, Severn Estuary Ramsar and Severn Estuary SPA, including potentially North Somerset and Mendip Bats SAC) through habitat loss, habitat degradation, disturbance, habitat severance, and potentially species mortality and/or injury. Avoidance and/or mitigation measures need to be considered during construction to reduce negative impacts, without mitigation and/or avoidance measures the proposed works could give rise to a potential adverse effect on the integrity of the European Sites. Consideration is to be given to both the wintering and migratory periods of SPA and Ramsar feature birds, in line with appropriate guidance⁷. Consultation is advised with statutory bodies to assess impacts on all designated sites to ensure the design approach and any suggested mitigation is acceptable.

Any loss of habitat from detriment mitigation, or any habitat loss/degradation across the scheme, must be also considered in the commitment to achieving Biodiversity Net Gain. This Strategy will be developed in consultation with Bristol City Council's Ecological and Climate Emergency officers, to ensure the Strategy aligns with the One City Strategies and Plans, and to maximise Biodiversity Net Gain. Furthermore, where possible, the Strategy will work with neighbouring authorities, the Environment Agency, the Avon Catchment Partnership, and other organisations to seek opportunities to incorporate natural flood management, amongst other measures, as delivered partly through Biodiversity Net Gain.

Detriment mitigation may also result in coastal squeeze; this is considered further in the technical note on coastal squeeze⁸.

Construction (and operational) impacts, from defence and detriment mitigation, must also consider impact on protected species and habitats, and further survey and consultation with a suitably qualified ecologist is required in order to assess impacts and provide suitable mitigation and licencing, as required. Opportunities for enhancement will be explored to deliver ecological benefits to a range of habitats, species and designated sites. An Extended Phase 1 Habitat survey will be initially required, and which will be updated throughout the life of the project as necessary. The ecological survey and future assessment should consider priority species and habitats (Natural Environment and Rural Communities Act 2006 (NERC Act)), protected and notable species, invasive and non-native species, and statutory and non-statutory designated sites, including Sites of Nature Conservation Interest (SNCI), noting that the River Avon is a SNCI and in part a Wildlife Corridor (including for bats). Pre-construction surveys, including for any potential ground investigations, should consider impacts to places of rest for otter, as well as any other European Protected Species, including bats and their roosts. Baseline ecological survey should be supplemented with a desk study search from

⁷ Joint Nature Conservation Committee, 2016. 'The status of UK SPAs in the 2000s: the Third Network Review' http://jncc.defra.gov.uk/pdf/UKSPA3_Chapters1-8.pdf

⁸ Arup (2020) Coastal Habitat Loss Technical Note, River Avon Flood Risk Management Strategy, Bristol City Council.

the Local Records Centre (BRERC). Ecological assessment should accord with local policy, e.g. Policy DM19: Development and Nature Conservation in the Local Plan⁹.

Operation

Defences

Whilst operational impacts are not anticipated on migratory fish, it is advised that consultation is undertaken with the EA to ascertain whether amendments to the lock gates will result in consideration of the Eel Regulations (2009) and the Salmon and Freshwater Fisheries Act (1975). Under these pieces of legislation there may be a requirement for the installation of fish and eel passes.

Consideration should also be given in the design process on the impact of operational defence works on other designated sites, both statutory and non-statutory, as outlined under construction impacts.

The amended embankments at Bower Ashton have the potential to result in increased negative impacts on estuarine geomorphology due to the increased length of defences in the amended Strategy and the potential for coastal squeeze. The increased length of embankments would act as a barrier to intertidal mudflat retreat. Coastal squeeze is considered further in the supporting technical note. Furthermore, loss of any SAC (or other European Site) habitat would require reinstatement and/or other mitigation measures, which are likely to require management and monitoring during operation to ensure successful establishment.

Detriment Mitigation

Detriment mitigation around Shirehampton and Pill has the potential to result in **permanent negative effects** on European Sites, as outlined in the HRA: SIAA, consideration should be given to habitat loss and any mitigation and/or compensatory measure, including ongoing monitoring and management.

The current Severn Estuary Shoreline Management Plan is the same as that assessed by AECOM – SMP2¹⁰. The SMP2 Policy option for the Severn Estuary for all epochs (0-20, 20-50, 50-100 years) is to Hold the Line. Hold the Line is a policy to keep the line of defence in approximately the same location as it is now. Existing defences are maintained, replaced or upgraded along their current alignment. This may or may not include upgrades to counter climate change and sea level rise.

For both defence and detriment mitigation, there is the opportunity to provide specifically designed links between the River Avon New Cut and the Floating Harbour so that otters can cross safely at Bathurst Dam. Further enhancement

⁹ Bristol Local Plan – Site Allocations and Development Management Policies – Adopted July 2014

¹⁰ <https://www.severnestuarycoastalgroup.org.uk/shoreline-management-plan/smp2-action-plan/> Accessed online 21/04/2020.

opportunities, such as allowing animals, including otter, to cross the current and proposed defences and avoid the creation of barriers.

Habitat Regulation Assessment

A Statement to Inform an Appropriate Assessment (SIAA) (Stage 2) has been undertaken to reflect the changes to the amended Strategy and with regards to recent case law¹¹ (Appendix C). This SIAA was completed as part of the HRA process, in compliance with the requirements of the Conservation of Habitats and Species Regulations 2017 (as amended). The SIAA provides an assessment of the potential for effects on European Sites from the implementation of the proposed works, as required by Regulation 63 of the Habitats Regulations. The SIAA follows the consultation process required by Regulation 76 of the Habitats Regulations.

The SIAA undertaken has reported the potential pathway for effects at construction include habitat loss and degradation, habitat severance, disturbance, and species mortality / injury. There are no predicted potential operational effects from the amended Strategy.

As detailed design progresses, and consultation with statutory bodies continues, it is anticipated that baseline survey and supporting information will provide further assessment on the potential for adverse effects to arise. Without further baseline and supporting survey information at this stage, and without avoidance and/or mitigation measures, it is reasonable to conclude there could be **adverse effects** on the integrity of the European Sites.

To allow the competent authority to conclude no adverse effect, further survey and mitigation measures are required. Winter bird surveys and habitat assessments are required, in part, to understand the impact of the proposed works on the Severn Estuary SPA, Ramsar and SAC, and the Avon Gorge Woodlands SAC. Bat surveys are to be undertaken to understand the functional use of the riverine corridor and understand construction impacts on the SAC and bats in general. Any habitat management or reinstatement, with respect to impacts on the European Sites, may require monitoring and further management. Refer to the SIAA for full details.

¹¹ People Over Wind, Case C323/17 European Court of Justice, 12th April 2018.

6.2 Population, human health and material assets

The aim of this section is to present an assessment of the changes brought forward through the amended Strategy in terms of ‘population, human health and material assets’.

Construction

Defences

Construction impacts including impacts arising from increases in dust, noise and disruption from traffic will generally be localised as reported in the AECOM Environmental Report and will impact on those receptors in the vicinity of the proposed flood defences.

Proposed works to amend the vertical alignment of the Cumberland Basin Road and Feeder Road will likely result in increased traffic disruption to that previously reported.

New and amended defences as part of the amended Strategy will result in an increased level of disruption, noise and dust impacts on population and health however these are deemed temporary in nature and localised to nearby receptors, acknowledging that receptors over the two epochs (2024-2065 and 2065-2125) will change over time.

Construction of the defences are likely to result in **temporary negative effects** on this SEA topic as previously reported in the AECOM Environmental Report. It is considered that these impacts are likely to be mitigated through conventional construction practices to minimise disturbance, noise and dust impacts.

Detriment Mitigation

Construction and installation of additional detriment mitigation measures are likely to create potential **temporary negative effects** on localised receptors. These are likely to be minor impacts of a similar scale to that of the AECOM Environmental Report.

Operation

Defences

As reported in the AECOM Environmental Report, a **permanent significant positive effect** is predicted in terms of flood risk protection for material assets, flood risk and health resulting from the level of flood protection provided by the defences. The amended flood defence strategy goes beyond this to incorporate fluvial flood defences providing further permanent significant positive effects to that of the AECOM Environmental Report.

Similarly, it is assumed that the inclusion of fluvial flood defence measures combined with the tidal flood defences will further benefit the physical and psychological health of the local population through a reduction of injuries during flooding events. The amended scheme will have a further **significant positive**

impact on physical and psychological health due to the reduction in flood risk during both Epoch 1 and 2.

As per the AECOM Environmental Report, flood defences through both Epoch 1 and 2 will have a **significant positive impact** on material assets due to the reduction of flood risk from both fluvial and tidal flows.

Detriment Mitigation

As per the AECOM Environmental Report, once operational the areas of detriment mitigation will create **positive effects** through an increased level of protection against flood event for houses requiring protection under the scheme.

The strategy should ensure that material assets such as walkways and residential/commercial areas are not compromised.

6.3 Soil / water

The aim of this section is to present an assessment of the changes brought forward through the amended Strategy in terms of 'soil and water'.

Construction

Defences

As reported in the AECOM Environmental Report, the most significant negative effects will be created through activities relating to the construction of Low defences during Epoch 1 (2024-2065) that will include the necessary piling and foundations for the High defences proposed in Epoch 2 (2065-2125).

The construction activities will have a **temporary negative effect** on water and soil as reported in the AECOM Environmental Report through disturbance of the river bed and release of sediment into the River Avon particularly at locations where the alignment is frontline. Additional areas of impact resulting from new or amended defences in combination with those reported in the AECOM Environmental Report include:

- Cumberland Basin (specifically the “knuckle” adjoining the North and South Entrance Locks);
- Cumberland Road;
- Commerical Road, and
- Netham.

As per the AECOM Environmental Report, it is considered that this can be mitigated through conventional measures such as silt curtains or containment strategies.

Detriment Mitigation

Additional construction activities for detriment mitigation measures where the alignment is frontline such as the detriment mitigation located at St Anne’s and St Philip’s Causeway, may result in a **temporary negative effect** on water and soil through disturbance to the river bed and the release of sediment into the River Avon through activities such as piling. It is considered that this can be mitigated through conventional measures such as silt curtains or containment strategies.

Operation

Defences

The defences included in the amended Strategy will provide increased flood and erosion protection and will further reduce the potential for areas of contaminated land to be exposed maintaining a **permanent positive effect** as reported in the AECOM Environmental Report. Further work to identify the potential for contaminated land is required.

As per the AECOM Environmental Report, the frontage to be defended along the majority of the strategy 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.

Amended earthwork defences proposed at Bower Ashton, previously proposed as detriment mitigation in the original strategy, are required to account for both fluvial and tidal flood events. The amended flood defence would increase the potential for a negative impact on estuarine geomorphology and adds to the potential for coastal squeeze as reported in the AECOM Environmental Report due to the presence of an undeveloped area of grassland behind the proposed embankment.

For purposes of assessment, a worse-case scenario of 0.47ha¹² of estuarine habitat is to be lost on a precautionary basis (2024 works, with additional 0.15ha in 2065 works).

Detriment Mitigation

As per the AECOM Environmental Report, further work to confirm the type and quality of habitat that has the potential to be impacted and a geomorphological appraisal to confirm whether the estuary's form and adjacent hinterland would permit the rollback of intertidal habitats under rising sea level. For further details please see the AECOM Environmental Report.

Outline Preliminary WFD Assessment

An updated Preliminary WFD Assessment has been produced which includes an assessment of all water bodies that could be affected by the implementation of the amended Strategy, including their current water quality status. This can be found within Appendix C.

The additional defences proposed within the amended Strategy has required the following water bodies to be screened into the assessment due to the location of defences:

- Bristol Avon (previously screened in by AECOM);
- Bristol Floating Harbour; and
- Bristol Avon (By Bk to Netham Weir).

The updated 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. 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

¹² Loss of estuarine habitat based on the length of defences / detriment mitigation where encroachment to the riverbank is anticipated, either during construction or operation, assuming an adaptive approach to the defences and a 2m width impacted.

be granted near the River Avon, within the Triassic Groundwater body that could potentially be impacted by piling.

As per the AECOM Environmental Report, if proposed raised or new defences are set back from the water body, then they will not alter the morphological regime or the water quality, and therefore do 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 Preliminary WFD Assessment found that there is potential for impacts on the Bristol Avon water body, as well as the Floating Harbour as the construction of defences in currently undefended areas has the potential to impact the ecological status of the water bodies, as this will likely involve a reduction of aquatic habitat areas, as well as potentially having a negative effect on hydromorphology. The Preliminary WFD Assessment therefore recommends that a full WFD Assessment will be required to evaluate the total combined length and percentage of the water bodies affected to assess the overall significance of the impacts. 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 water body 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).

6.4 Climatic factors

The aim of this section is to present an assessment of the changes brought forward through the amended Strategy in terms of ‘climatic factors’.

Construction

Defences

As reported in the AECOM Environmental Report, the greenhouse gas emissions from the construction activities (HGV and operational plant) and the embodied carbon in the defence measures are not likely to be significant. The amended Strategy requires additional areas of flood defences to protect against fluvial and tidal flood events and a likely increase in greenhouse gas and embodied carbon is expected.

The majority of defences will be ‘futureproof’ to only require piling once, during construction of the Low Defences in Epoch 1 (2024-2065) where possible. The construction of High Defences during Epoch 2 (2065-2125) will mainly consist of the raising of previously constructed Low Defences. This will help control the levels of greenhouse gas production during the construction phase.

Detriment Mitigation

As per the AECOM Environmental Report, despite additional areas of detriment mitigation required to account for both fluvial and tidal flood events this is not deemed to result in a significant increase in greenhouse gas emissions from construction activities and embodied carbon. The effect of the construction of detriment mitigation measures is therefore not likely to be significant.

Operation

Defences

The AECOM Environmental Report acknowledged a positive effect during operation due to the high standard of protection from fluvial and tidal flooding and sea level rise resulting from climate change. The amended Strategy includes additional measures that provides protection from both fluvial and tidal flood events, resulting creating a further **positive effect**.

Detriment Mitigation

As reported in the AECOM Environmental Report, it is not considered that any of the detriment mitigation measures would have any effects on this SEA topic.

6.5 Cultural heritage

The aim of this section is to present an assessment of the amended 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.

This section replaces the previous “*Cultural heritage, including architectural and archaeological heritage*” chapter included in the AECOM Environmental Report to assess against the River Avon Heritage Assessment¹³ undertaken by City Design Group following completion of the AECOM Environmental Report. This section therefore follows a slightly different structure in comparison to other SEA topics.

Assessment Findings

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

It is considered likely that the construction of the defences and detriment mitigation measures will result in a number of temporary effects resulting from changes to the setting of heritage assets from day to day construction activities, as well as permanent adverse effects due to the lasting impact that the construction of the defences will have on the setting and fabric of heritage assets along the River Avon. These likely effects listed below are based on the *vulnerability to change* and grouped by the River Avon Character Areas as defined by the Heritage Assessment undertaken by City Design Group following completion of the AECOM Environmental Report.

The likely operational effects reported below are based on the operational aspects of the flood defences, which due to the nature of the flood defences and detriment mitigation measures are limited. At this strategic assessment level detailed studies of the implications of the scheme on the nature of individual assets’ settings and fabrics have not been made. A high-level assessment of likely effect is used as an indicator of the range and nature of potential impacts which can inform future work during the development of the detailed design.

¹³ River Avon Heritage Assessment (2018) City Design Group, Bristol City Council [draft].

Construction

Defences

Through the construction of the defences required in the amended Strategy, there are likely to be **temporary and permanent negative effects** on the City Docks, Redcliffe and Avon Valley Conservation Areas. The construction of defences within the Conservation Areas will require more intrusive construction activities during Epoch 1 (2024-2065) in comparison to that of Epoch 2 (2065-2125). All piling will be undertaken in Epoch 1 and will be futureproofed for the raising of defences during Epoch 2.

Due to the historic nature of the River Avon study area, there is also the potential for significant effects due to impacts on archaeological remains. This should be considered fully during the construction process, with mitigation measures developed through discussion with stakeholders and included within a CEMP.

It is considered that the construction of defences is likely to result in **temporary negative effects** resulting from changes to the setting of heritage assets through increases in noise and dust and from temporary changes to views to and from the assets. The following heritage assets are likely to be impacted through day to day construction activities:

- Cumberland Basin - Grade II Cumberland Basin; Grade II* South Entrance Lock; Grade II* Swing Bridge over North Entrance Lock; Grade II* Swing Bridge over South Entrance Lock; Grade II A Bond and B Bond Tobacco Warehouses; Grade II Ashton Avenue Swing Bridge; Grade II* Ashton Court Park and Garden resulting from the construction of earthwork defences at Bower Ashton; and non-designated assets including mooring posts, the remains of Rownham Ferry slipway, former warehouse wharfs, a concrete memorial view point, the Plimsoll Bridge and the Harbour Master's Watch House as identified by the Historic England Screening for Potential Listing report in the Cumberland Basin area¹⁴.
- The Underfall and Junction Locks - Scheduled Monument of Underfall Yard, Bristol Docks; Grade II* Machine Shop; Grade II Former Shipwright's Shop; Grade II Avon Crescent listed terrace of former dock workers houses; and non-designated Heritage Railway and Chocolate Path.
- New Cut West - Grade II Vauxhall bridge; and non-designated assets including the Heritage Railway and Chocolate Path.
- Bathurst Basin - Grade II Bathurst Basin; Grade II Bristol General Hospital; Grade II Old City Gaol; Grade II The Louisiana Public House; Grade II properties along Bathurst Parade; and non-designated heritage assets including the former Cardiff and Channel Steamship Co shed (Marchioness Building), the early 20th century former swing bridge and the 19th century ramped path that provides access to God's Garden. Access must be maintained to preserve the function of these non-designated heritage assets.

¹⁴ Screening for Potential Listing: Cumberland Basin Area (2019) Historic England.

- New Cut East - Grade II Bedminster Bridge; Grade II Langton Street Bridge (colloquially known as the Banana Bridge); Grade II Drinking Fountain; and non-designated heritage assets including the relieving arches supporting the Commercial Road approach to Bedminster Bridge and the steel mooring posts and buttresses along Clarence Road.
- Totterdown - Grade I Temple Meads Railway Station; and non-designated heritage asset of Totterdown Lock.
- Avon Riverside - non-designated heritage assets including Avon Railway Bridge; Sparke Evans Park; Sparke Evans Park Bridge; Totterdown Bridge; Victorian railway Bridge; and a riverside path created by the remains of the former Bath Road now overgrown along the southern bank.
- Netham Lock - Grade II Netham Lock; Grade II Lock Keeper's House; Grade II Warehouse, former premises of Marble Mosaic Company; and non-designated heritage assets including the Netham Weir, the new Brislington Bridge and the Feeder Canal.

It is considered that construction of defences will result in **permanent negative effects**. As these effects are permanent, those relating to the setting of heritage assets would continue to be experienced throughout operation. Opportunities identified in the Placemaking Opportunities Report may reduce permanent setting impacts to that listed below. Physical changes to heritage assets of high value, such as listed buildings, are likely to have a significant impacts although the nature of the effects on the significance of the assets will need further assessment as the designs develop. The effects would result from the changes to the setting or fabric of the following heritage assets, some of which may be significant:

Cumberland Basin

- Grade II Cumberland Basin - raising of Cumberland Basin Road, installation of a floodgate across the road, reinforced concrete wall along Cumberland Basin Road, replacement of downstream lock gates at Entrance Lock and flood defences in front of existing defences around the western extent of Entrance Lock ("the knuckle") requiring piling will likely result in **significant permanent negative effects** on the fabric and setting of the Grade II Cumberland Basin.
- Grade II* South Entrance Lock - amendments to increase the height of the dammed lock gates and the decommissioning of the sluice gates within the Grade II* South Entrance Lock is likely to create **significant permanent negative effects** on the fabric and setting of the heritage asset.
- Grade II* Swing Bridge over South Entrance Lock – amendments to raise the existing footbridge to accommodate the damming up of the lock gates of Grade II* South Entrance Lock to a height required to protect against both tidal and fluvial flood events is likely to result in **significant permanent negative effects** on both the setting and historic fabric of the heritage asset.
- Grade II A Bond and B Bond Tobacco Warehouses – construction of defences along the southern extent of Spike Island is likely to create a **permanent negative effect** resulting from the changes to the setting of the Grade II

heritage assets. The defences are set away from the listed features and will avoid any physical impact. Further opportunities within the placemaking strategy will likely reduce the permanent impact on these heritage assets.

- Grade II Ashton Avenue Swing Bridge - construction of defences along the southern extent of Spike Island is likely to create a **permanent negative effect** on the setting of the Grade II heritage assets. Further detail will be required to understand whether there is likely to be any permanent impact on the fabric of the heritage asset. Further opportunities within the placemaking strategy will likely reduce the permanent impact on these heritage assets.

The Underfall and Junction Locks

It is considered that the upgrading of the Underfall Yard sluice gates and the proposed head wall will require works to assets associated with the Scheduled Monument albeit outside of the boundary of the designation. The Underfall sluices are a vital element of the function of the harbour and may require Scheduled Monument Consent. Works to restore and preserve the use of this feature is likely to result in **permanent positive effects**. Further consideration will be required to understand the impacts in greater detail.

New Cut West

It is considered that remedial works to the Heritage Railway and Chocolate Path to repair the structure of the assets to preserve the use and functionality for pedestrians and cyclists following recent flood events is likely to result in a **permanent positive effect** on the non-designated assets.

Bathurst Basin

It is considered that construction of defences along Commercial Road in proximity to Grade II Bathurst Basin and the raising of Bathurst Dam will likely result in **significant permanent negative effects** associated with the fabric as well as changes to the setting of the heritage asset.

New Cut East

- Grade II Langton Street Bridge – construction of defences adjoining the existing bridge abutment will likely result in a **permanent negative effect** on the setting and fabric of the heritage asset;
- Construction of defences along Commercial Road may result in a **significant permanent negative effect** on the relieving arches depending on the extent of defences. Works should seek to avoid this non-designated heritage asset where possible; and
- Construction of defences along Clarence Road may result in a **significant permanent negative effect** on the steel mooring posts and buttresses. These are non-designated heritage assets but works should seek to avoid the impact and loss of functionality of these heritage assets where possible.

Totterdown

Construction of the defences in proximity of Totterdown Lock may have a lasting effect on the fabric of the heritage asset, however the amended Strategy has the

potential to further reveal the heritage asset and improve visibility resulting in a **permanent positive effect**. This should be explored further at the next design stage.

Avon Riverside

It is considered that constructing of defences may result in **permanent significant negative effects** in the setting and fabric of non-designated assets within the Avon Riverside character area.

Netham Lock

Grade II Netham Lock and Lock Keeper's House - It is considered that construction of defences at Netham will likely have **permanent negative effects** resulting from changes to the setting of Grade II Netham Lock and the adjacent Grade II Lock Keeper's House; and

- Permanent negative effects will also be likely along the non-designated Feeder Canal due to the construction of a flood gate across the canal.

Detriment Mitigation

Through the construction of the detriment mitigation required in the amended Strategy, there are likely to be **temporary and permanent negative effects** on the Redcliffe and Avon Valley Conservation Areas.

It is considered likely that construction of detriment mitigation to the west of Grade II Bedminster Bridge will result in **temporary negative effects** on the setting of the heritage asset.

It is considered that construction of detriment mitigation at St Anne's will have a **temporary negative effect** within Avon Valley Conservation Area. Further review of both designated and non-designated assets along this stretch is required to fully inform the assessment.

It is considered that detriment mitigation works at Sea Mills has the potential to cause **significant permanent negative effects** on "Part of the Roman Settlement of Abonae" listed as a Scheduled Monument. Works to construct an embankment at this location will likely impact on the setting and fabric of the feature and will require Scheduled Monument Consent. Further work should be undertaken to avoid physically impacting the heritage asset where possible. Historic England should be consulted during this process. The detriment mitigation proposed in this area is required in close proximity to the Grade II Harbour Walls of Sea Mills resulting in **temporary negative effects** during construction. Further work is required to determine what permanent impacts are likely in this location.

It is thought that other areas of detriment mitigation are likely to be localised and will not significantly impact on known heritage assets, although previously unrecorded heritage assets could be impacted. Further impacts created during construction of the detriment mitigation measures should be explored in line with an updated Heritage Assessment.

Operation

Defences

From a perspective of protecting and preserving cultural heritage assets, clearly the improved protection from flooding would result in **significant permanent positive effects** as the setting and the fabric of heritage assets would be protected from future flood events. There may also be further opportunities for the strategy to contribute to the enhancement of the existing character, setting and appearance of cultural heritage assets and Conservation Areas, some of which are highlighted within the Placemaking Opportunities Report.

The operation of flood gates across waterways and highways during flood events will have the potential to impact on nearby heritage assets resulting in **temporary negative effects** on the setting and character.

Detriment Mitigation

It is not considered that 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.

As the amended Strategy progresses, work is required to further understand the likely impacts on the setting and fabric of heritage assets and agree the consent required. In the case of physical impacts, Listed Building and/or Scheduled Monument Consent would be required. Consultation with Historic England and the Local Planning Authority (LPA) Conservation and Archaeological Officers will be required to agree a suitable design which minimises adverse effects and gains the necessary consent to undertake the works.

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) are likely to reduce construction impacts but further work to understand the cause of setting impacts are required. The material of flood defences should be considered to mitigate operational impacts on the setting of heritage assets including the use of glass to maintain visibility where necessary.

Further work is also required to understand the potential impact on buried archaeology as well as agree suitable mitigation measures. This could include the requirement for further desk-based research, geophysical survey, paleoenvironmental sampling and/or trial trenching.

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 the original 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. Further design development, including the Placemaking Opportunities Report¹⁵ will seek to reduce these effects on heritage assets affected.

Proposed Monitoring

The following indicators are proposed to monitor the effects of the amended 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; and
- Number and condition of conservation areas, historic parks and gardens.

¹⁵ Arup (2020) Placemaking Opportunities Report, River Avon Flood Risk Management Strategy, Bristol City Council.

6.6 Landscape

The aim of this section is to present an assessment of the changes brought forward through the amended Strategy in terms of landscape character and visual effects.

Construction

Defences

The setting along the River Avon varies significantly within the study area of the amended Strategy, from the wide open estuarine environment at Pill, Shirehampton and Sea Mills, to the setting of the River Avon gorge and the urban historic townscape within the city of Bristol. The scale of the impact is dependent on the setting of the area and the form and scale of any flood defence.

The River Avon at Entrance Lock (near Cumberland Basin) and Cumberland Road falls within the City Docks Conservation Area. It is rich in both long-range panoramic views of specific features, landmarks and distinctive skylines, as well as short-range contained views. The Cumberland Basin area offers high quality views out of the character area including the iconic view of the Avon Gorge and Clifton Suspension Bridge (Grade I listed), as well as views into the city which include elements such as the ss Great Britain and Bristol Cathedral¹⁶.

The Cumberland Road and Bathurst Basin areas are more enclosed, offering local views across the New Cut and longer views along the river corridor to bridge crossings. From Bedminster in the south, when the trees are not in leaf, views from the slightly elevated Coronation Road are across the New Cut to Spike Island, with the distinctive skyline of Clifton, Clifton Wood and Brandon Hill above.

As reported in the AECOM Environmental Report, construction of defences may result in a temporary negative effect on townscape, impacting on the character of areas requiring flood defences due to the presence of construction sites and construction activity, as well as visual amenity. The amended Strategy would also result in **temporary negative effects** through new and amended flood defences for the protection against both tidal and fluvial flood events. It is likely that the increased level of flood defence would increase the number of receptors impacted through construction.

Detriment Mitigation

It is considered that detriment mitigation works within the areas of St Anne's, Brislington Brook, works adjacent to the Malago, and works further downstream of the River Avon at Shirehampton, Pill and Sea Mills will result in **temporary negative effects** on the landscape/townscape character and visual amenity of the local area due to the presence of construction sites and construction activity.

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<https://www.bristol.gov.uk/documents/20182/33832/City%20Docks%20Conservation%20Area%20Appraisal.pdf/4d991ad0-be4c-40a8-b2f6-4e007bb8e601>

Further work should be undertaken to determine the impacts from other areas of detriment mitigation including works adjacent to the Malago, Brislington Brook and further upstream along the River Avon.

Operation

Defences

During operation, the presence of flood defences as part of the amended Strategy will create the potential for **permanent negative effects** on the local area through the introduction of a physical barrier which is likely to affect views and movement across the river or city. High defences proposed through Epoch 2 (2065-2125) will have the greatest potential for **significant adverse effects** due to the increase in height.

Mitigation measures through careful and considerate design may be possible to reduce these effects including setting back defences from the river, raising/terracing the ground behind to reduce the relative height of the defence, and the use of reinforced glass walls as part of the raised defence measures which would help to retain views and connectivity to the waterfront.

The amended Strategy creates opportunities to improve the areas adjacent to the defences, in terms of aesthetics and functionality. This has the potential to trigger **positive effects** through the inclusion of green infrastructure elements as part of the scheme design, public realm enhancements and a better integration of the scheme into the surrounding context, contributing to the overall townscape quality. Work undertaken as part of the Placemaking Opportunity Report¹⁷ considers the potential for the flood defence design to be integrated within the creation of meaningful public spaces, providing an opportunity to re-think the role and synergies between grey and green infrastructure in urban environments.

Detriment Mitigation

During operation, the presence of detriment mitigation as part of the amended Strategy will create the potential for **permanent negative effects** on the local area through the introduction of a physical barrier to movement and to views across the river or city.

A landscape and visual impact assessment is recommended to inform the design of flood defences and the potential for significant effects. Where adverse effects are reported due to the presence of flood defences, further work is required to mitigate these impacts through design development to avoid or reduce both landscape and visual effects.

Consultation on the amended Strategy is expected and responses should inform the design process as the strategy develops, alongside the placemaking study to seek to reduce adverse effects and for the flood defence design to be integrated within the creation of meaningful public spaces.

¹⁷ Arup (2020) Placemaking Opportunities Report, River Avon Flood Risk Management Strategy, Bristol City Council.

7 Cumulative effects

In assessing the effects of the amended Strategy on the environment, consideration has been given as to how the amended Strategy might interact with the other initiatives outlined in the AECOM Environmental Report and the likelihood of possible cumulative effects on the environment is included below.

The Severn Estuary Shoreline Management Plan¹⁸

The current Severn Estuary Shoreline Management Plan (SMP) is the same as that assessed by AECOM – SMP2. The SMP2 Policy option for the Severn Estuary for all epochs (0-20, 20-50, 50-100 years) is to Hold the Line. The amended Strategy could lead to some minor advancements of the line, beyond that previously reported, through the delivery of new and amended raised defences.

As per the AECOM Environmental Report, there is potential for ‘in combination’ effects to occur through the undertaking of other schemes delivering SMP policies in other parts of the estuary, the combination of which has the potential to lead to additional adverse effects. Further review of the potential for ‘in combination’ effects should be undertaken at the next design stage to fully understand the likely cumulative effects (both adverse and beneficial) and agree suitable compensation or appropriate mitigation measures where necessary.

The Severn Estuary Strategy¹⁹

As per the AECOM Environmental Report, the amended Strategy is designed to complement the The Severn Estuary Strategy to reduce the level of flood risk and coastal erosion across the wider region. There are likely to be positive effects for biodiversity, population, health and material assets, soil and water through the delivery of these strategies. However, there are also potential adverse impacts such as coastal squeeze and encroachment on key habitats that should be assessed in combination across the region.

Bristol City Council Local Plan²⁰

The amended Strategy complements and supports the Bristol City’s Local Plan, as reported in the AECOM Environmental Report. The provision of defences to mitigate against both tidal and fluvial flood events will facilitate greater enablement of development in these areas in the future, further protect heritage assets under threat of flood risk, provide improvements on both physical and psychological health resulting from flood events and will further protect material assets and critical infrastructure from future flood events. For further details, please see the AECOM Environmental Report.

¹⁸ http://sites.cardiff.ac.uk/secg/files/2016/03/SE-SMP2-planning-leaflet_N-Somerset_draft_v1.pdf

¹⁹ <http://www.severnpartnership.org.uk/files/2016/01/Consultation-Draft-2016-Severn-Estuary-Strategy.pdf>

²⁰ Bristol City Council (2011) Local Plan. Available online at: <https://www.bristol.gov.uk/planning-and-building-regulations/local-plan> Accessed April 2020

Bristol Central Area Plan²¹

As per the AECOM Environmental Report, the amended Strategy will work in combination with the delivery of this plan and the amended Strategy itself goes some way to realising the potential opportunities to support the delivery of objectives. The separate Placemaking Opportunities Report also compliments this plan through a review of the landscaping and placemaking opportunities as part of the wider strategy that 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 amended Strategy are mitigated so that the objectives of the Central area plan are not compromised.

Bristol One City Climate Strategy²²

The One City Climate Strategy published in February 2020 is a collaborative approach to addressing the “climate emergency”²³ in Bristol and sets out a strategy and pathway of action on how Bristol can become carbon neutral and climate resilient by 2030. The approach to the One City Climate Strategy looks to achieve co-benefits alongside the declared “ecological emergency” in Bristol, to respond to wider city challenges. A response is being developed separately to the One City Climate Strategy. The amended Strategy would play a major part in protecting the city from increased flood events as a result of sea level rise, amongst other factors. The One City Climate Strategy recognises that this is likely to be in the form of flood defence walls but also acknowledges the need to take opportunities where natural solutions could be implemented to support flood protection, while providing urban cooling, environmental and health and wellbeing benefits. Further work alongside the Placemaking Opportunities Report should be undertaken to collaborate with the objectives of the One City Climate Strategy.

Severn River Basin Management Plan²⁴

The amended Strategy should consider enhancement opportunities to improve the overall status of the water bodies where possible as part of the full WFD

²¹

<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>

²² <https://www.bristolonecity.com/wp-content/uploads/2020/02/one-city-climate-strategy.pdf>
[Accessed April 2020]

²³ <http://www.bristolonecity.com/bristol-agrees-next-steps-to-emergency-climate-action/>
[Accessed April 2020]

²⁴ Measure in the Bristol Avon and North Somerset catchment - Severn river basin district River Basin Management Plan. (Updated 2015) p73. Available at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718336/Severn_RBD_Part_1_river_basin_management_plan.pdf [Online]. Accessed: 01/05/20

assessment. Programme of measures identified by the Environment Agency in the Severn River Basin Management Plan should be referenced and any specific actions identified for the improvement of each water body. It should ensure that there is no conflict between the amended Strategy and the Environment Agency's goals for the water bodies and that the amended Strategy is used as an opportunity to design in enhancements where possible.

8 Conclusions and Recommendations

Following an assessment of the environmental impacts of the amended Strategy for each SEA topic, the following conclusions have been made.

As per the AECOM Environmental Report, the assessment of the amended Strategy was found to have likely **significant positive effects** on the following topics due to the increased flood protection of the area of Bristol and due to the inclusion of both tidal and fluvial flood modelling has further increased these positive effects. These topics include:

- Population, human health and material assets; and
- Cultural heritage, including architectural and archaeological heritage.

The SEA addendum recognises the benefits from the implementation of the flood defences identified and the beneficial effects on people, health, material assets, heritage features and climatic factors. These works are crucial to the preservation of key areas of Bristol that are fundamental to the character and make-up of the city and will protect these areas from flood events arising from both tidal and fluvial flows.

Despite the amended Strategy providing positive effects through increased flood protection from both tidal and fluvial flood events, the SEA Addendum highlights that without suitable mitigation and compensation there is the potential for **negative effects** on the following topics, some of which are likely to be significant.

Biodiversity, flora and fauna

Consideration has been given to the impact of the amended Strategy on European Sites and it has been identified through the Statement to Inform Appropriate Assessment (SIAA) the potential pathway for effects and that without avoidance and/or mitigation measures, it is reasonable to conclude there could be **adverse effects** on the integrity of the European Sites. Further survey work would be required to understand the impact on the designated sites and the necessary avoidance and/or mitigation measures likely to be required.

Appropriate Assessment at detailed design should consider the impact of the works in relation to the Conservation Objectives of the European sites, and also in-combination with other plans and projects. For further details on the effects reported and the recommended mitigation measures, please see Appendix B for details.

The amended Strategy is likely to have further **negative effects** on other statutorily designated sites, namely Severn Estuary SSSI, Avon Cut Local Nature Reserve (LNR), Leigh Woods National Nature Reserve (NNR), Avon Gorge Site of Special Scientific Interest (SSSI) and Ashton Court SSSI. Works within an SAC, SSSI, NNR and/or LNR will require consent from Natural England and engagement with LPA, with clearly defined scope of works and footprint. Specifically, work within the SSSI would need to ensure that the works do not negatively impact the favourable condition of the SSSI. Impacts on non-statutory

designated sites, e.g. priority habitats or locally designated sites, will be required to be evaluated as the design progresses.

As reported in the AECOM Environmental Report, there may be a **temporary negative effect** on estuarine ecology during the construction period particularly in locations where frontline alignments are proposed 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.

The amended Strategy would increase the potential for coastal squeeze. Further work should be undertaken to minimise any loss/degradation of habitat across the scheme. Measures will be devised and presented as part of the detail to support a planning application that will commit to Biodiversity Net Gain in line with the Severn Estuary Shoreline Management Plan.

Cultural heritage

Through a review of the heritage assets detailed within the Heritage Assessment commissioned by BCC, a number of **temporary negative effects** are seen through the construction of the raised defences and detriment mitigation measures. These are likely to arise through the construction programme, resulting from proposed construction activity in proximity of the heritage assets resulting in temporary alteration to their settings.

A number of **permanent negative effects** are also predicted through the construction of the amended Strategy, some of which are likely to be significant, due to the lasting impacts the works are likely to have on the heritage assets highlighted. These permanent negative effects would arise from physical changes to the fabric of some of the listed buildings and from changes to the settings of others. It is clear, however, that from a perspective of protecting and preserving cultural heritage assets, the improved protection from flooding would result in **significant permanent positive effects** as the setting and the fabric of heritage assets would be protected from future flood events. Further design development, including the placemaking strategy, will seek to reduce these effects on heritage assets affected. The amended Strategy also includes the repair and restoration of heritage assets damaged by previous flood events and there will be further opportunities for the strategy to contribute to the enhancement of the existing character, setting and appearance of cultural heritage assets and Conservation Areas.

As the design is developed, it is recommended that the potential for adverse effects on heritage assets is considered at each stage, with efforts taken to reduce significant impacts to those which are otherwise unavoidable. Opportunities to enhance the settings of heritage assets or provide conservation should also be explored. Any works taking place within the designated area of a listed building or scheduled monument will require consent from Historic England (scheduled monuments and listed buildings Grade I and II*) or the LPA (Grade II listed buildings). An assessment of the significance of the heritage asset proportionate to the scale of proposed change would be required to support application for consent, alongside an assessment of the impact of the proposal on that significance, detailed plans and method statements and a strongly evidenced discussion of the justification for the work. Impacts arising from changes to the setting of heritage

assets, alongside impacts on conservation areas and non-designated heritage assets would be covered as part of the future EIA. Mitigation measures are likely to be required, both for impacts to designated and non-designated assets. In the case of buried archaeological remains this would likely involve archaeological recording or monitoring, while impacts to built heritage might require building recording as a minimum.

Similarly, minor effects (not significant) were identified for the following topics, as reported in the AECOM Environmental Report:

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

It is recognised that the SEA Addendum and supporting documents raise a number of negative effects through the implementation of the amended Strategy, some of which are likely to be significant. Further work, alongside existing studies including the placemaking work and public consultation, should be undertaken to further develop the design to minimise the impact on the environment and those effects reported. It is recommended that public consultation and interaction with local stakeholders to jointly develop a “landscape vision” for the Strategy is undertaken to further explore opportunities.

Further information on the *Proposed Mitigation, Potential Enhancement Opportunities* and *Proposed Monitoring* associated with each topic can be found in the Strategic Environmental Assessment (SEA): AECOM Environmental Report²⁵.

Consultation should be undertaken prior to formal adoption of the amended Strategy and should include, but not limited to, the following key stakeholders:

- Environment Agency (EA);
- Historic England (HE); and
- Natural England (NE).

²⁵ AECOM (2017) Strategic Environmental Assessment: AECOM Environmental Report. River Avon Tidal Flood Risk Management Strategy, Bristol City Council.

Appendix A

Assessment table for shortlisted options

Assessment table for shortlisted options - The amended Strategy

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/ MT (2024-2065)	LT (2065-2125)			
Biodiversity, flora and fauna	<p>Epoch 1: Low Defences – are required at Cumberland Basin, Cumberland Road, Bathurst Dam Commercial Road, Clarence Road, Cattle Market Road, Netham, and Feeder Road.</p> <p>Epoch 2: High Defences – all Low Defences will be raised to High Defences and new defences proposed at Totterdown.</p>	<p>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 Cumberland Basin, Cumberland Road, Commerical Road, Clarence Road, Cattle Market Road, Bathurst Dam and Netham. Construction of defences around Shirehampton and Pill are within and near the SPA, SAC and Ramsar site. Works also occur within Avon Gorge Woodlands SAC. Impacts may arise on these designated sites from construction, namely habitat loss, degradation, and/or disturbance or mortality/injury to species of the European Sites.</p> <p>Epoch 2: 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.</p>	✓	✓	<p>Temporary / construction effects</p> <p>Permanent operational effects from habitat loss</p>	Medium	<p>Epoch 1: Low Defences – there is likely to be a significant negative effect on designated sites as the works are adjacent to or within a number of sites designated at local, national or international level.</p> <p>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.</p> <p>Other protected species and habitats are likely to occur within the project, e.g. priority habitats. Invasive species may be present within the construction footprint. Consideration of both these former points will be managed through detailed design and project-level mitigation and aim to remove any negative effect from the project.</p> <p>The proposed works will require consideration of Biodiversity Net Gain, to ensure compliance with policy and the emerging Environment Bill and will consider enhancement opportunities.</p> <p>Epoch 2: High Defences: Refer to Epoch 1.</p>
Population, human health and material assets	<p>Epoch 1: Low Defences – are required at Cumberland Basin, Cumberland Road, Bathurst Dam Commercial Road, Clarence Road, Cattle Market Road, Netham, and Feeder Road.</p> <p>Epoch 2: High Defences – all Low Defences will be raised to High Defences and new defences proposed at Totterdown.</p>	<p>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.</p> <p>Flooding can result in impacts on both physical and psychological health. Once operational, this measure will reduce flood risk from the River Avon and therefore would have a positive impact on these aspects of human health.</p> <p>This measure will have a positive impact on material assets as it will ensure more land will</p>	✓	✓	<p>Temporary construction effects</p> <p>Permanent operational effects</p>	Medium	<p>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.</p> <p>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.</p> <p>Epoch 2: High Defences – this measure will have substantial positive effects on material assets due to the sustained level of protection from flooding provided by High Defences.</p>

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/ MT (2024-2065)	LT (2065-2125)			
		be under protection from flooding and therefore available for development. Epoch 2: High Defences – this measure will have similar positive impacts for material assets and human health (see Epoch 1).					
Soil and water	Epoch 1: Low Defences – are required at Cumberland Basin, Cumberland Road, Bathurst Dam Commercial Road, Clarence Road, Cattle Market Road, Netham, and Feeder Road. Epoch 2: High Defences – all Low Defences will be raised to High Defences and new defences proposed at Totterdown.	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 Cumberland Basin, Cumberland Road, Commercial Road, Clarence Road, Cattle Market Road, Bathurst Dam and Netham. Epoch 2: 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	Medium	Epoch 1: Low Defences – there would be some temporary negative effects associated with the disturbance of soils and leaching. Mitigation measures would be explored to minimise effects as far as practicable. . However, these negative effects can be managed through mitigation which will be discussed by the project design team at a later date. Epoch 2: High Defences – temporary effects associated with upgrading /construction (see Epoch 1).
Climatic factors	Epoch 1: Low Defences – are required at Cumberland Basin, Cumberland Road, Bathurst Dam Commercial Road, Clarence Road, Cattle Market Road, Netham, and Feeder Road. Epoch 2: High Defences – all Low Defences will be raised to High Defences and new defences proposed at Totterdown.	Epoch 1: Low Defences – this measure will be likely to reduce tidal flood risk. However, there would be higher levels of CO2 emissions associated with construction of these defences compared to PLP. Epoch 2: High Defences – this measure will have similar impacts (see Epoch 1).	✓	✓	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 CO2 emissions; however it is not considered to be a significant effect. In the absence of the amended Strategy, extensive repair works are likely to be required as a result of flood events and would give rise to CO2 emissions through construction including the use of plant, equipment and vehicle movements. Epoch 2: High Defences –this measure will have similar effects (see Epoch 1).
Cultural heritage	Epoch 1: Low Defences – are required at Cumberland Basin, Cumberland Road, Bathurst Dam Commercial Road, Clarence Road, Cattle Market Road, Netham, and Feeder Road. Epoch 2: High Defences – all Low Defences will be raised to High Defences and new defences proposed at Totterdown.	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: High Defences – the geographical scope of impacts will be similar to those of Epoch 1 (see Epoch 1).	✓	✓	Temporary & Permanent construction effects Permanent operational effects	Medium	Epoch 1: Low Defences – there are a number of Listed Buildings in proximity to the defences and detriment mitigation measures proposed. This measure would result in negative effects in terms of the setting and fabric of some cultural heritage assets, some of which are likely to be significant. The assets which are likely to be affected are: Cumberland Basin - Grade II Cumberland Basin; Grade II* South Entrance Lock; Grade II* Swing Bridge over North Entrance Lock; Grade II* Swing Bridge over South Entrance Lock; Grade II A Bond and B Bond Tobacco Warehouses; Grade II Ashton Avenue Swing Bridge; Grade II* Ashton Court Park and Garden

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/ MT (2024-2065)	LT (2065-2125)			
							<p>resulting from the construction of earthwork defences at Bower Ashton; and Non-designated assets including mooring posts, the remains of Rownham Ferry slipway, former warehouse wharfs, a concrete memorial view point, the Plimsoll Bridge and the Harbour Master’s Watch House.</p> <p>The Underfall and Junction Locks - Scheduled Monument of Underfall Yard, Bristol Docks; Grade II* Machine Shop; Grade II Former Shipwright’s Shop; Grade II Avon Crescent listed terrace of former dock workers houses; and Non-designated Heritage Railway and Chocolate Path. The amended Strategy includes work to restore and safeguard these assets that have been impacted by previous flood events.</p> <p>New Cut West - Grade II Vauxhall bridge; and Non-designated assets including the Heritage Railway and Chocolate Path.</p> <p>Bathurst Basin - Grade II Bathurst Basin; Grade II Bristol General Hospital; Grade II Old City Gaol; Grade II The Louisiana Public House; Grade II properties along Bathurst Parade; and Non-designated heritage assets including the former Cardiff and Channel Steamship Co shed (Marchioness Building), the early 20th century former swing bridge and the 19th century ramped path that provides access to God’s Garden. Access must be maintained to preserve the function of these non-designated heritage assets.</p> <p>New Cut East - Grade II Bedminster Bridge; Grade II Langton Street Bridge (colloquially known as the Banana Bridge); Grade II Drinking Fountain; and Non-designated heritage assets including the relieving arches supporting the Commercial Road approach to Bedminster Bridge and the steel mooring posts and buttresses along Clarence Road.</p> <p>Totterdown - Grade I Temple Meads Railway Station; and Non-designated heritage asset of Totterdown Lock.</p> <p>Avon Riverside - Non-designated heritage assets including Avon Railway Bridge; Sparke Evans Park; Sparke Evans Park Bridge; Totterdown Bridge; Victorian railway Bridge; and a riverside path created by the remains of the former Bath Road now overgrown along the southern bank.</p> <p>Netham Lock - Grade II Netham Lock; Grade II Lock Keeper’s House; Grade II Warehouse, former premises of Marble Mosaic Company; and Non-designated heritage assets including the Netham Weir, the new Brislington Bridge and the Feeder Canal.</p> <p>Sea Mills - Scheduled Monument “Part of the Roman Settlement of Abonae”; and Grade II Harbour Walls.</p> <p>Epoch 2: High Defences – Further negative effects associated with the raising of defences and construction of detriment mitigation</p>

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/ MT (2024-2065)	LT (2065-2125)			
							<p>measures will be present on a number of heritage assets listed above.</p> <p>On completion, this measure will result in a positive effect on cultural heritage through the increased flood risk protection to heritage assets along the River Avon and associated water bodies. In the absence of flood protection measures, many heritage assets are at risk from increased flood events.</p> <p>Further opportunities to enhance and restore heritage assets during construction will be explored as part of the Strategy.</p>
Landscape	<p>Epoch 1: Low Defences – are required at Cumberland Basin, Cumberland Road, Bathurst Dam Commercial Road, Clarence Road, Cattle Market Road, Netham, and Feeder Road.</p> <p>Epoch 2: High Defences – all Low Defences will be raised to High Defences and new defences proposed at Totterdown.</p>	<p>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.</p> <p>Epoch 2: 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.</p>	✓	✓	<p>Temporary construction effects</p> <p>Permanent operational effects</p>	Medium	<p>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, Redcliffe and Avon Valley. 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.</p> <p>Epoch 2: 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.</p>

Appendix B

Statement to Inform Appropriate Assessment

B1

Appendix C

Preliminary Water Framework Directive (WFD) Assessment

C1
