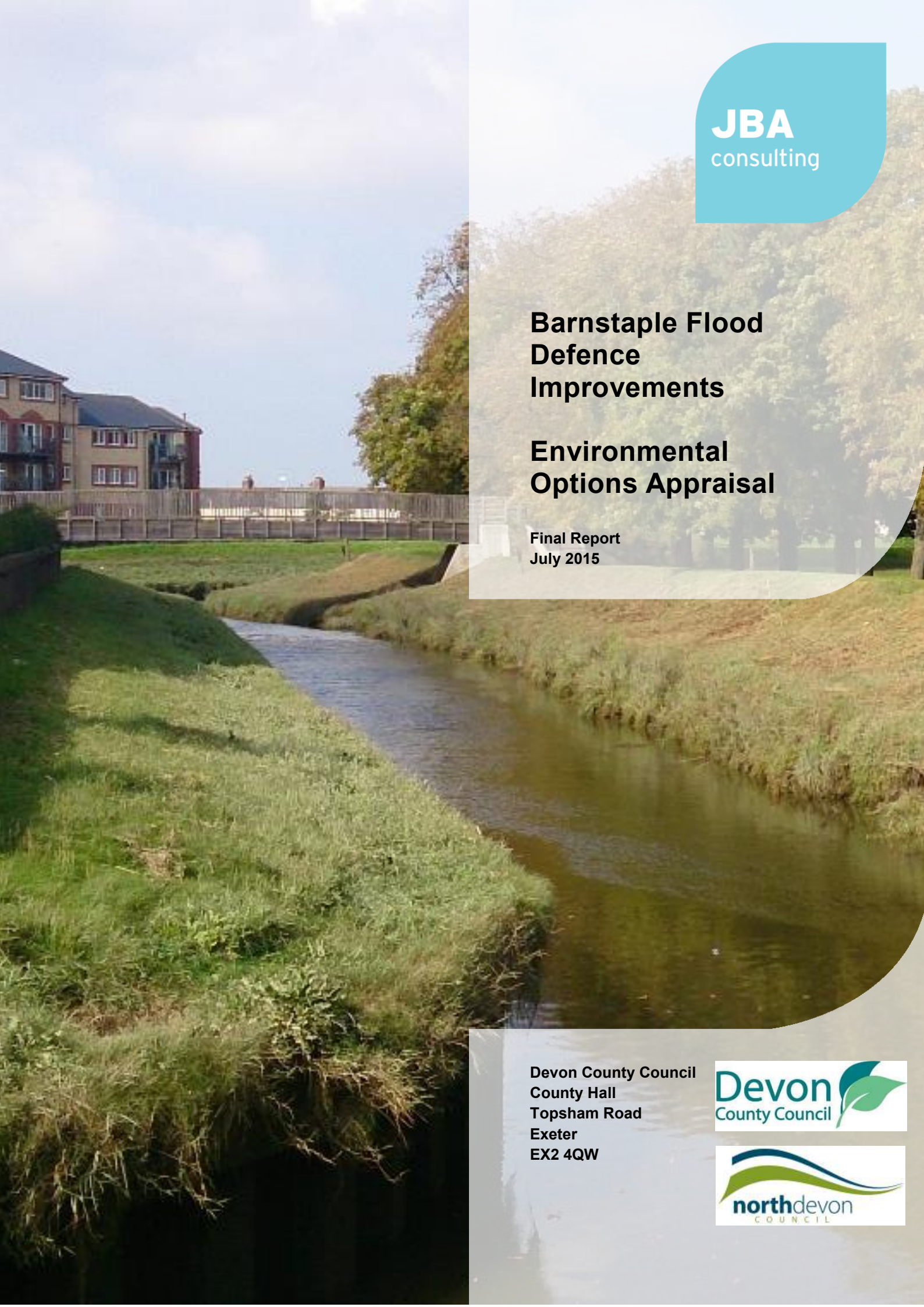

JBA consulting

Barnstaple Flood Defence Improvements

Environmental Options Appraisal

Final Report
July 2015

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Final v4.0	Updates to flood cell F	John Galt

Contract

This report describes work commissioned by Devon County Council. Rachel Drabble and David Revill of JBA Consulting carried out this work.

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Purpose

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Executive summary

The purpose of this environmental scoping study report is to identify potential significant environmental risks and opportunities associated with the flood risk management (FRM) options for the Barnstaple areas as identified by Devon County Council (DCC) and North Devon Council (NDC). The report provides a summary description of the local baseline environment and identifies notable environmental features in the study area that have the potential to be affected by the proposed FRM options. Information has been obtained through a desk study exercise undertaken using readily available data sources and from consultation with relevant organisations. This information was then used to appraise the potential environmental benefits and impacts associated with the FRM options.

Potential solutions to address future flood risk in Barnstaple have been developed, with a focus on six flood cells (zones A to F) that extend from Bradiford Water in the north past the Longbridge in the centre of Barnstaple and includes the River Yeo, a major tributary of the Taw which flows through Pilton, and to the south to Newport and Rock Park. A number of FRM options have been identified for different sections of the flood cells. The project options are currently at an initial concept stage, and therefore a high-level appraisal of the potential environmental risks and opportunities has been undertaken to inform the development.

A high-level qualitative appraisal of the flood risk management options was undertaken to identify potential significant environmental risks and opportunities. The outcomes of this process have been summarised in an appraisal table, which identifies the environmental features that have the potential to be affected by each of the project options and the potential significance of the effects identified. This report also outlines the potential scope of the environmental surveys and studies that would be required as part of the subsequent environmental assessment process should the project be taken forward to through the consenting process.

Flood cell A's options could encroach onto the Bradiford Reserve and therefore permanently damage its habitat features. The southern end of the proposed embankment borders the Taw-Torridge Estuary Site of Special Scientific Interest (SSSI) and Key Network Features, potentially causing damage to the SSSI. Construction of the embankment will also produce a risk to the notable and protected species that have been observed in the reserve. Construction also has the potential to release contaminating materials to surface water, into the sensitive River Taw, conflicting with Water Framework Directive (WFD) objectives.

In flood cell B, increasing the height of the defences along Rolle Quay, the parapet and barriers on Rolle Street bridge may have temporary adverse effect during construction on the setting of Castle Mount and the Boathouse. The conservation area is also at risk from a degradation of its setting during construction, however significant permanent effects on historic environment are unlikely as the nature of the defence is unlikely to change significantly. There is a large risk that piling through Pilton Park will have a significant adverse effect on biodiversity, as Pilton Park is a Key Network Site and Biodiversity Action Plan (BAP) habitat is present in the River Yeo in this location. Piling is likely to remove vegetation around the edge of the park, reducing its habitat connectivity potential. Piling may also have a permanent and temporary adverse effect on the setting of the conservation area and listed buildings within the vicinity of Pilton Park. Re-routing the River Yeo would have a significant negative effect on biodiversity, as BAP habitat and Key Network Features will be permanently lost through infilling of the river channel. The change in hydromorphology and ecology of the river may conflict with the River Yeo's WFD objectives, and also may result in a change to the hydromorphology and ecology downstream and into the River Taw. This option may also exacerbate coastal squeeze by reducing the amount of coastal saltmarsh habitat.

Increasing the standard of flood defences in flood cell C along Castle Quay and raising the existing defences may have significant negative effect on the historic environment, including that of Castle Mount scheduled monument, the listed buildings and conservation area along the river front. Archaeological monuments are also present along the river front, those unobserved may be at risk of damage during construction.

Replacing existing defences for flood cell D to meet design standard is unlikely to have effects on designated sites, for example the Taw-Torridge SSSI, due to the large distance. There is a Key Network Site along the defence line which could be permanently lost, along with notable species that have been observed in the region, such as the common frog. There are no historic features within the vicinity of the defence line, therefore effects on Barnstaple's historic environment are not anticipated.

In flood cell E, improving the defence standard for all of Rock Park may cause a permanent adverse effect on BAP habitat in the river, if the defences were to extend into the river channel. Rock Park is a Key Network Site, so construction in this area could cause loss of habitat important for connectivity and therefore have a permanent negative effect on biodiversity. Improving the defences along the River Taw frontage also has the potential to affect the setting of Newport conservation area, possibly affecting views to the river. This construction along the Taw could also release contaminating materials into the River Taw, conflicting with its WFD objectives. New walls at Coney Gut are not likely to have a significant effect on the environment, as there are relatively few biodiversity features in the area and it is of a small scale.

Doing nothing within all flood zones has the potential to have a positive effect on biodiversity through increased opportunity for habitat creation. However, there are significant negative effects possible to the historic environment and local population and community through increased risk of flooding.

The construction programme should take the local community and economy into consideration as it could provide disruption, thus having a temporary negative effect. These options are also likely to lead to a range of environmental benefits. The new defences would increase protection for people and property in Barnstaple and could reduce flood risk to sensitive historic sites such as listed buildings in the town centre. The defences would reduce the impacts of sea level rise caused by climate change on these aspects and would also make a positive contribution to the local economy by reducing the risk of flooding to the town.

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Abbreviations

AONB ..... Area of Outstanding Natural Beauty
AQMA ..... Air Quality Management Area
BAP ..... Biodiversity Action Plan
CFMP ..... Catchment Flood Management Plan
DBRC ..... Devon Biodiversity Records Centre
DCC ..... Devon County Council
EcIA ..... Ecological Impact Assessment
EIA ..... Environmental Impact Assessment
EPS ..... European Protected Species
FRM ..... Flood Risk Management
GEP ..... Good Ecological Potential
GVZ ..... Groundwater Vulnerability Zone
HAP ..... Habitat Action Plan
HER ..... Historic Environment Record
HMWB ..... Heavily Modified Water Body
LCT ..... Landscape Character Type
LNR ..... Local Nature Reserve
LVIA ..... Landscape and Visual Impact Assessment
MMO ..... Marine Management Organisation
NCA ..... National Character Area
NERC ..... Natural Environment and Rural Communities Act 2006
NDC ..... North Devon Council
NIA ..... Nature Improvement Area
NVZ ..... Nitrate Vulnerable Zone
PEA ..... Preliminary Ecological Appraisal
PRoW ..... Public Right of Way
RBMP ..... River Basin Management Plan
SAC ..... Special Area of Conservation
SAP ..... Species Action Plan
SPA ..... Special Protection Area
SSSI ..... Site of Special Scientific Interest
TRIP ..... Taw River Improvement Project
UNESCO ..... United Nations Educational, Scientific and Cultural Organization
W&CA ..... Wildlife and Countryside Act 1981
WFD ..... Water Framework Directive

1 Introduction

1.1 Purpose of this report

The purpose of this environmental scoping study report is to identify potential significant environmental risks and opportunities associated with the flood risk management (FRM) options for Barnstaple as identified by Devon County Council (DCC) and North Devon Council (NDC). The report provides a summary description of the local baseline environment and identifies notable environmental features in the study area that have the potential to be affected by the proposed FRM options. Information has been obtained through a desk study exercise undertaken using readily available data sources and from consultation with relevant organisations.

This report also outlines the potential scope of the environmental surveys and studies that would be required as part of the subsequent environmental assessment process should any of the FRM options be taken forward to through the detailed design and consenting process, together with the likely planning and environmental consenting requirements of relevance.

- Describes the existing key baseline environmental conditions of the study area;
- Identifies the potential significant environmental risks associated with each of the FRM options;
- Sets out further environmental assessment work required should FRM options be taken forward; and
- Identifies the organisations that would need to be consulted with to inform the appraisal process.

This commission does not include the preparation of any formal Environmental Impact Assessment (EIA) or carrying out any environmental site surveys. All information used in this review has been obtained from a desk study exercise incorporating readily available online data sources, a literature review and through information provided by DCC.

1.2 Project description

Potential solutions to address future flood risk in Barnstaple have been developed, with a focus on six flood cells (zones A to F) that extend from Bradiford Water in the north past the Longbridge in the centre of Barnstaple and includes the River Yeo, a major tributary of the Taw which flows through Pilton, and to the south to Newport and Rock Park (Figure 1-1).

The focus of this environmental scoping study is a series of flood defence concept options identified for the flood zones. No assessment has been undertaken for flood cell F as previously proposed flood defences are due to be constructed soon.

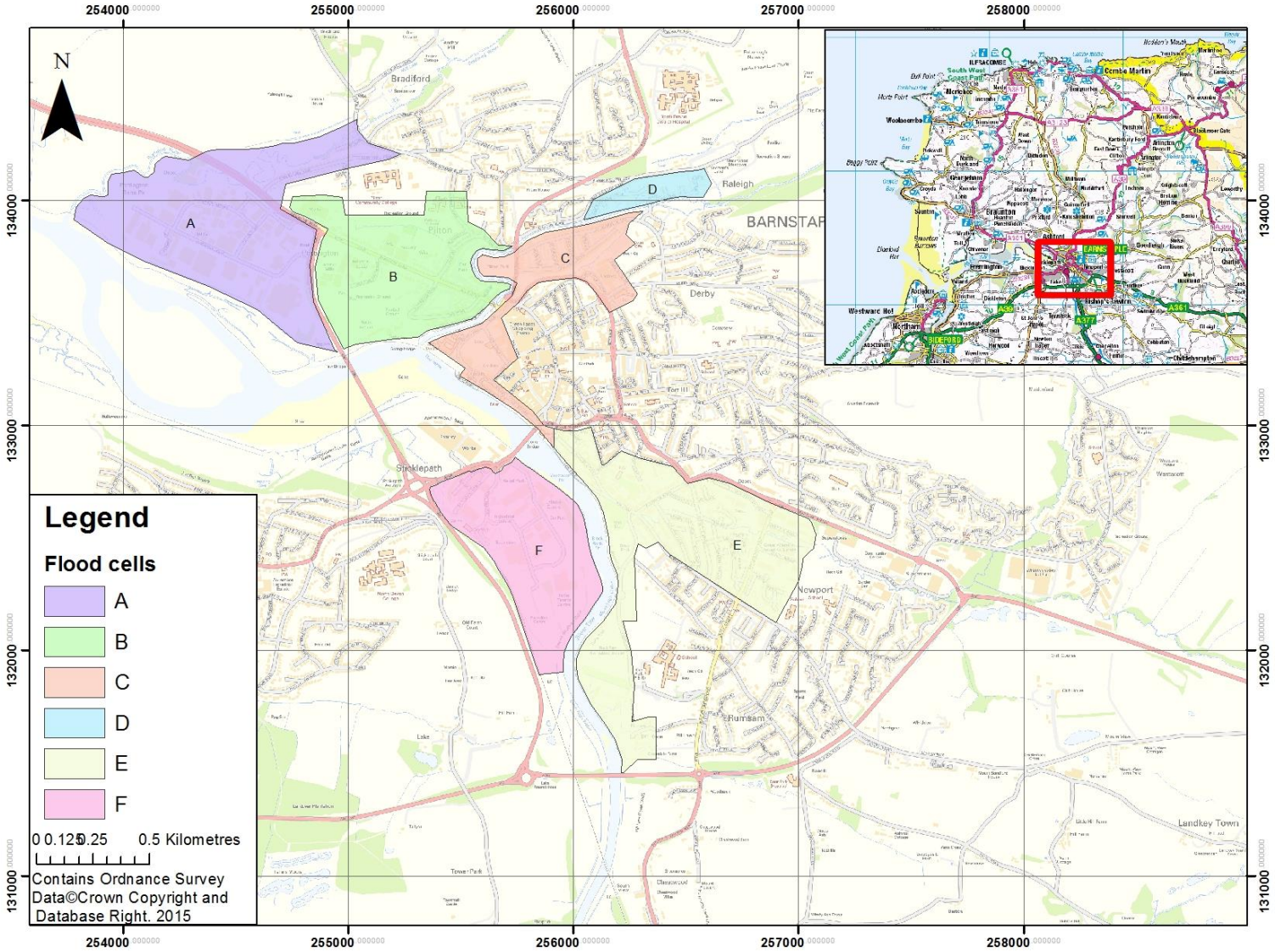

Figure 1-1: Flood cell location

1.3 Study area

Barnstaple is the main town of North Devon and is situated on the tidal stretch of the River Taw, with substantial parts of the town at risk of flooding from the rivers Taw and Yeo, Coney Gut and Bradiford Water and their associated tributaries. Approximately a quarter of the built up area of Barnstaple is at risk of flooding (NDC and Torridge District Council, 2014).

The study area for this scoping study focused on the flood cells, as shown in Figure 1-1, together with an extended search area of 500m around each flood cell. The exception to this search area was biodiversity, where the search area was extended to 2km to take into account the potential connectivity with wildlife sites and ecological features in the wider environs and potential for mobile species.

1.4 Sources of information

A desk study was carried out to obtain baseline environmental information on key environmental features that have the potential to be affected by the proposed flood defence concept options.

Where available, information has been collected in relation to the following topic areas:

- Biodiversity and nature conservation
- Historic environment
- Water environment
- Landscape and visual amenity
- Land contamination
- Population and local community.

The following online information sources were searched for relevant information:

- Multi-Agency Geographic Information for the Countryside (MAGIC)(https://magic.defra.gov.uk/)
- English Heritage, Heritage Gateway (https://www.heritagegateway.org.uk/gateway/)
- Ancient Monuments https://ancientmonuments.uk/)
- Archaeology data service (https://archaeologydataservice.ac.uk/)
- Joint Nature Conservation Committee (JNCC) (https://jncc.gov.uk/)
- North Devon Council Planning Services website (https://www.northdevon.gov.uk/planning-and-building-control/)
- Environment Agency - What's in your backyard?
- Natural England (https://www.gov.uk/government/organisations/natural-england).

A literature review was also undertaken to obtain published information of relevance to the project. The following are the key documents used:

- North Devon Local Plan – Adopted July 2006 (NDC, 2006)
- North Devon and Torridge Local Plan: Publication Draft (NDC and Torridge District Council, 2014)
- River Basin Management Plan South West River Basin District (Environment Agency, 2009)
- North Devon Catchment Flood Management Plan (Environment Agency, 2012)
- Barnstaple Conservation Area Character Appraisal (NDC, 2008b)

- Joint Landscape Character Assessment for North Devon and Torridge Districts (Land Use Consultants, 2010).

Consultation was also undertaken with the following organisations to obtain information of relevance to this project:

- Devon Biodiversity Records Centre
- Devon County Council – Historic Environment Service.

1.5 Appraisal of environmental potential risks

A high-level qualitative appraisal of the flood risk management options was undertaken to identify potential significant environmental impacts (positive and negative). The outcomes of this process have been summarised in a series of appraisal tables (see Section 4).

2 Project options

A number of FRM options that have been identified for different sections of the flood cells. The project options are currently at an initial concept stage, and therefore a high-level appraisal of the potential environmental risks and opportunities has been undertaken to inform the development. A 'do nothing' option has also been assessed for each flood cell. 'Do nothing' means that the defence would receive no further intervention or maintenance, from which the defences will deteriorate. The options are described below:

Flood cell A:

- Raising of A361 and cycle track on an embankment towards Pilton Community College
- Raised embankment / land raising around edge of Bradiford Reserve
- Property level flood protection (PLP) in Meadow Road
- Repair existing tidal defence.

Flood cell B:

- Raising of A361 and cycle track on an embankment towards Pilton Community College
- Increased standard/height of flood wall along Rolle Quay
- Increased parapet on Rolle Street bridge
- Barriers/gates across Rolle Street bridge
- Piling around existing course of Taw through Pilton Park
- Re-routing of Yeo along A39 Pilton causeway
- Repair and maintenance to existing tidal defence.

Flood cell C:

- Re-routing of Yeo along A39 Pilton causeway
- Raise Raleigh Road protection standard with flood relief culverts below Raleigh Road bridge to meet the A39 bridge
- Increased standard of defences along Castle Quay
- Raise existing tidal defence.

Flood cell D:

- Replace the existing defences accordingly over time to meet required design standard and Standard of Protection (SoP).

Flood cell E:

- Improve defence SoP along Taw frontage to Ladies Mile parking circle at Rock Park and along Taw to southern end of Rock Park.
- Improve defence SoP along Taw frontage to Ladies Mile parking circle at Rock Park and overtime allow defences along Taw to southern end of Rock Park to deteriorate and allow storage in Rock Park.
- New fluvial defences (walls) along southern bank of Coney Gut watercourse.
- New defences around Pill House and substation.
- Removal of properties at risk at southern end of Coney Gut watercourse (compulsory purchase).

Flood cell F:

- Previously proposed flood defences are due to start construction soon.

3 Baseline review

This chapter provides a summary of the protected and notable environmental features present in the study area. It includes important flora and fauna, heritage features and aspects of the environment including water quality, landscape character and quality, recreation and amenity value.

3.1 Biodiversity and nature conservation

A desk study search was undertaken to identify the presence of sensitive species and habitats in the study area. This includes a search of Natural England website for designated nature conservation sites. The general study area used to inform this information search was 2km, which was extended to 10km in relation to internationally and nationally designated sites.

3.1.1 Statutory designated sites

There is one European designated site (Special Areas of Conservation (SAC), Special Protection Areas (SPA) or Ramsar sites) within 10km of Barnstaple. This is the Braunton Burrows SAC, which is 6.8km west of the flood cell A. The closest SPA is the Exe Estuary SPA in south Devon, over 50km south east of Barnstaple. This is also the closest Ramsar site. Sites of Special Scientific Interest (SSSI) have also been included in this search.

Braunton Burrows SAC has Annex I habitats that are a primary reason for selection of the site. These include "shifting dunes along the shoreline with *Ammophila arenaria*", "fixed coastal dunes with herbaceous vegetation", dunes with *Salix repens ssp. Argentea* (*Salicion arenariae*) and humid dune slacks (Joint Nature Conservation Committee, undated(a)).

There are 15 SSSIs within 10km of the flood cells (Table 3-1). SSSIs are protected under a range of UK legislation. Section 28G of the Wildlife and Countryside Act 1981 (as amended) states that public bodies (including local authorities) must *'take reasonable steps, consistent with the proper exercise of their functions, to further the conservation and enhancement of SSSIs'*. This protection is extended under the Countryside and Rights of Way Act 2000 (CRoW Act 2000), which places a duty on Government Departments to have regard for the conservation of biodiversity and includes provisions to further the conservation and enhancement of SSSIs. In addition, the Natural Environment and Rural Communities Act (NERC) 2006 states that *'Every public authority must, in exercising its functions, have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity.'*

Table 3-1: SSSIs within 10km of flood cells

SSSI	Closest flood cell	Distance from closest flood cell (km)	Reason for designation
Taw-Torridge Estuary	A and B	0	Overwintering and migratory populations of wading birds. Rare plants grow along its shores.
Bradiford Valley	A	0.5	Ancient sessile oak woodland and associated breeding birds. Additional habitats are provided by an old mill leat, pond, stream and several meadows. The whole site supports a diverse wildlife in close proximity to Barnstaple (Natural England, 1976a).
Park Gate Quarry	E	1.9	The faunas the Lower Carboniferous lithologies display are quite exceptional for their diversity and abundance (Natural England, 1976b).
Fremington Quay Cliffs	A	2.4	Provides stratigraphical evidence for uninterrupted marine sedimentation in North Devon at about the Devonian-Carboniferous boundary (Natural England, 1976c).
Fremington Clay Pit	A	2.9	One of the most important Pleistocene sites in south west England. It provides sections in a series of deposits which demonstrates the only indisputable evidence that glacier ice reached the south west peninsula, most likely during the Wolstonian stage (Natural England, 1976d).

SSSI	Closest flood cell	Distance from closest flood cell (km)	Reason for designation
Plaistow Quarry	D	2.9	The best locality for the Upper Devonian Baggy Beds flora. This flora consists mainly of lycopods and pteridosperms, the latter being the oldest known gymnosperms in Britain. The scarcity of Upper Devonian floras in Britain make this site of national importance, providing one of the few links between the primitive Middle Devonian floras and the more Advanced Lower Carboniferous floras. The site has also yielded invertebrate fauna fossils (Natural England, 1985).
Chapel Hill	A	5.7	The largest population of pennyroyal *Mentha pulegium* known in Devon, a nationally vulnerable plant species (Natural England, 1992).
Caen Valley Bats	A	6.5	Located on the valley slopes of the River Caen, the former stable block buildings at the site are a nationally important summer maternity roost and winter hibernacula for the greater horseshoe bat *Rhinolophus ferrumequinum* (Natural England, 1992).
Arlington	D	6.5	Rich lichen flora with many rare species and also supports a good assemblage of invertebrates, including national rarities. The most important trees are ash *Fraximus excelsior*, oak *Quercus* spp. and beech *Fagus sylvatica*. Lichen of note are *Cetrelia olivetorum* and *Heterodermia obscurata*, the best in south-west England (Natural England, 1988a).
Greenaways and Freshmarsh, Brauton	A	6.7	Herb-rich marshy grasslands and also the rich water-plant communities occurring in the drainage ditches. These habitats have a very restricted distribution in Devon (Natural England, 1988b).
Braunton Burrows	A	6.8	One of the largest dune systems in Britain, with an extensive system of variably-flooded slacks, grassland and scrub, inland of a wide sandy foreshore. There is a variety of habitats for many flowering and lower plants, and for many birds and invertebrates. Several species are nationally rare or vulnerable including Sea Stock *Matthiola sinuate*, Sea Stork's-bill *Erodium maritimum*, Sea Clover *Trifolium aquamosum*, Portland and Sea Spurges *Euphorbia portlandica* and *E. paralis* and White Horehound *Marrubium vulgare* (Natural England, 1976e).
Braunton Swanpool	A	7.0	Reedbed and herb-rich marshy grassland habitats which are rare in North Devon (Natural England, 1988c)
Northam Burrows	A	8.7	Wide range of coastal habitats and rare and local plants. Site also supports many overwintering and migratory birds. In addition, the cobble ridge is an important land-form feature (Natural England, 1988d).
High Down Quarry	E	8.7	World type locality of the aluminium phosphate mineral wavellite, and is the first locality from which the mineral was described and recognised internationally as the 'type-locality' for that mineral. It is also the only known locality in Britain where the rare mineral variscite can be found (Natural England, 1983).
Saunton to Baggy Point Coast	A	9.9	Geological exposures and botanical features particularly maritime heathland, grassland and lichens. One of the most important localities for coastal geomorphology and Pleistocene stratigraphy of south-west England (Natural England, 1986).

Due to its close proximity to the flood cells, the Taw-Torridge estuary is described in more detail. The Taw-Torridge Estuary SSSI is of major importance for its overwintering and migratory populations of wading birds. In addition, rare plants grow along its shores. The estuary's wide tidal range is reflected by the very large areas of mudflats and sandbanks present (Natural England, 1988). The site regularly supports nationally important numbers of curlew *Numenius arquata*, golder plover *Pluvialis apricaria* and lapwing *Vanellus vanellus*. Other species of waders such as redshank *Tringa tetanus*, dunlin *Calidris alpina* and oystercatcher *Haematopus ostralegus* are also abundant, so that the total number of waders present at any one time can reach over 20,000 (Natural England, 1988). Natural England (2014) states that 95.56% of the SSSI area is in a 'favourable' condition, with the remaining as 'unfavourable no change'. The unit that is unfavourable borders Fremington Quay Cliffs SSSI.

The Taw-Torridge Estuary SSSI Management Plan sets out Natural England's views on how the site's special conservation interest can be conserved and enhanced. The plan (English Nature, 2004) states that proper management of mudflat habitat "requires an understanding of a number of inputs and processes, both natural and anthropogenic, in order to maintain the conservation interest of these areas." The plan also states that management needs to create space to enable landward roll-back to take place in response to sea-level rise. The plan includes a list of operations identified as likely to damage the special interest of the site. Relevant operations identified include the following:

- The destruction, displacement, removal or cutting of any plant or plant remains.
- Drainage (including the use of mole, tile, tunnel or artificial drains.
- Modification of the structure of watercourses, including their banks and beds, as by re-alignment, re-grading and dredging.
- Management of aquatic and bank vegetation for drainage purposes.
- Erection of sea defences or coast protection works.
- Construction, removal or destruction of roads, tracks, walls, fences, hardstands, banks, ditches or other earthworks, or the laying, maintenance or removal of pipelines and cables, above or below ground.
- Erection of permanent or temporary structures, or the undertaking of engineering works, including drilling.
- Use of vehicles likely to damage or disturb features of interest.

Braunton Burrows SAC and SSSI also forms the Core Area of the North Devon United Nations Educational, Scientific and Cultural Organization (UNESCO) biosphere reserve. The Buffer Zone (which includes the Taw-Torridge estuary) surrounds and supports the Core Area and is a continuous area of conservation management where only activities compatible with the conservation objectives can take place. The wider Transition Zone seeks to promote more sustainable use of the environment with human interaction, which includes the whole of North Devon to Lundy Island (Figure 3-1).

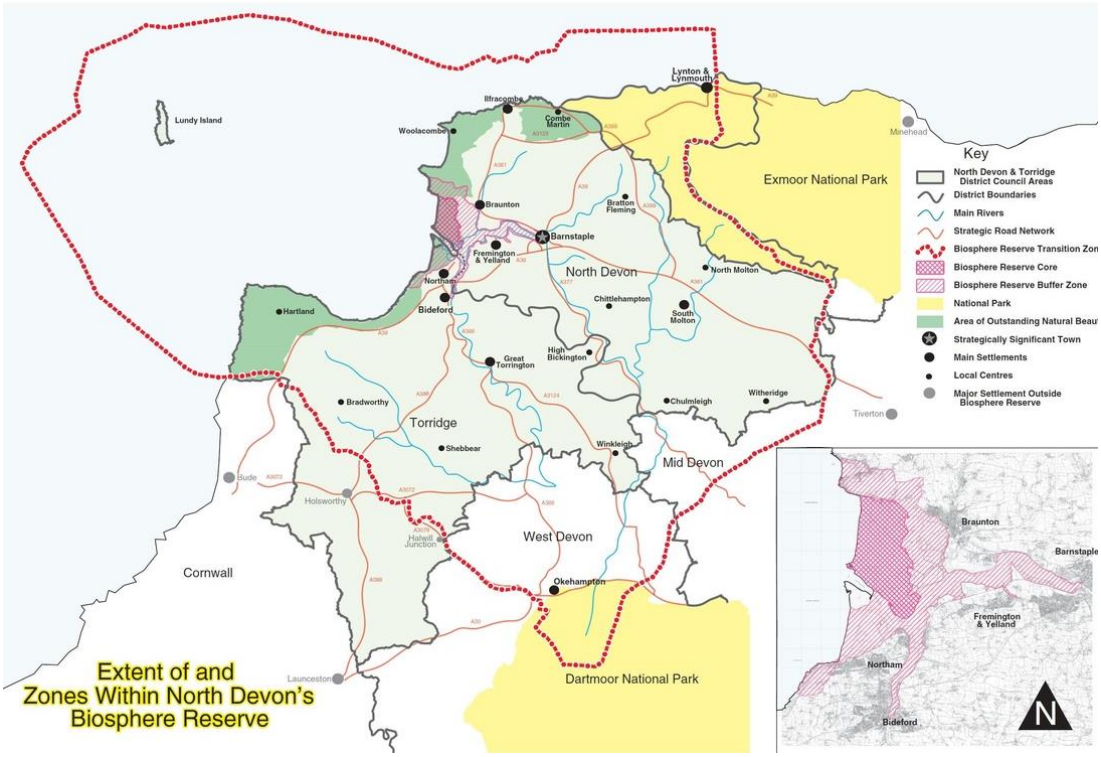

Figure 3-1: North Devon Biosphere Reserve (North Devon Biosphere Reserve Partnership, undated)

The designation of the Taw-Torridge estuary as part of the UNESCO Biosphere Reserve, part of the North Devon Coast Area of Outstanding Natural Beauty (AONB), Heritage Coast, SSSI and an SAC at Braunton Burrows demonstrates the significance of the area as a scientifically and historically important conservation site (North Devon AONB and Biosphere Service, 2010). Although the UNESCO biosphere reserve is for areas with a sustainable approach to natural heritage conservation which involve local communities, it is not a statutory designation as it is not recognised in planning terms the same way as National Parks or AONBs and is not protected explicitly through primary legislation.

3.1.2 Local designated sites

The closest Local Nature Reserve (LNR) to the project area is Yeo Valley Woodland, approximately 500m south east of flood cell D. Yeo Valley Woodland was designated on 15 August 2014, and recognises the importance of the wildlife, geology and public enjoyment of the site (North Devon Council, 2014). The old grasslands on the site are probably the most important feature with regards to conservation and biodiversity (NDC, 2008a).

Fremington LNR is approximately 2.5km from flood cell A. The site includes Leat Meadow and Lovell's Field with wet grassland plants and invertebrates including Marbled White butterfly. Fluctuating water levels in the estuary can affect Lovell's Field with flooding. Four hectares of Lovell's Field is fenced and grazed as part of the coastal floodplain and grazing marsh BAP since 2009 (Natural England, 2013). LNRs are designated statutorily under Section 21 of the National Parks and Access to the Countryside Act 1949, and amended by Schedule 11 of the Natural Environment and Rural Communities Act 2006, by principal load authorities.

The draft Local Plan states that "all development will be expected to provide a net gain in biodiversity." (NDC and Torridge District Council, 2014). Where this cannot be done, NDC will support biodiversity offsetting.

Bradiford Reserve is located behind Pottington Business Park in flood cell A and was created when the A361 bridge was built as a mitigation for the loss of reed-bed habitat. It is managed by the Devon Birdwatching and Preservation Society. Three otter layups are being created in the reserve and there are nesting places for small birds (Devon Birds, 2015).

There are a number of North Devon Key Network Features and North Devon Key Network Sites around Barnstaple, including in the flood cells (Figure 3-2). Key Network Features and Sites are areas of semi-natural habitat that make a significant contribution to the overall movement of species. They include areas of species rich grassland, double hedgerows, ponds and belts of woodland (Devon Wildlife Trust, 2001).

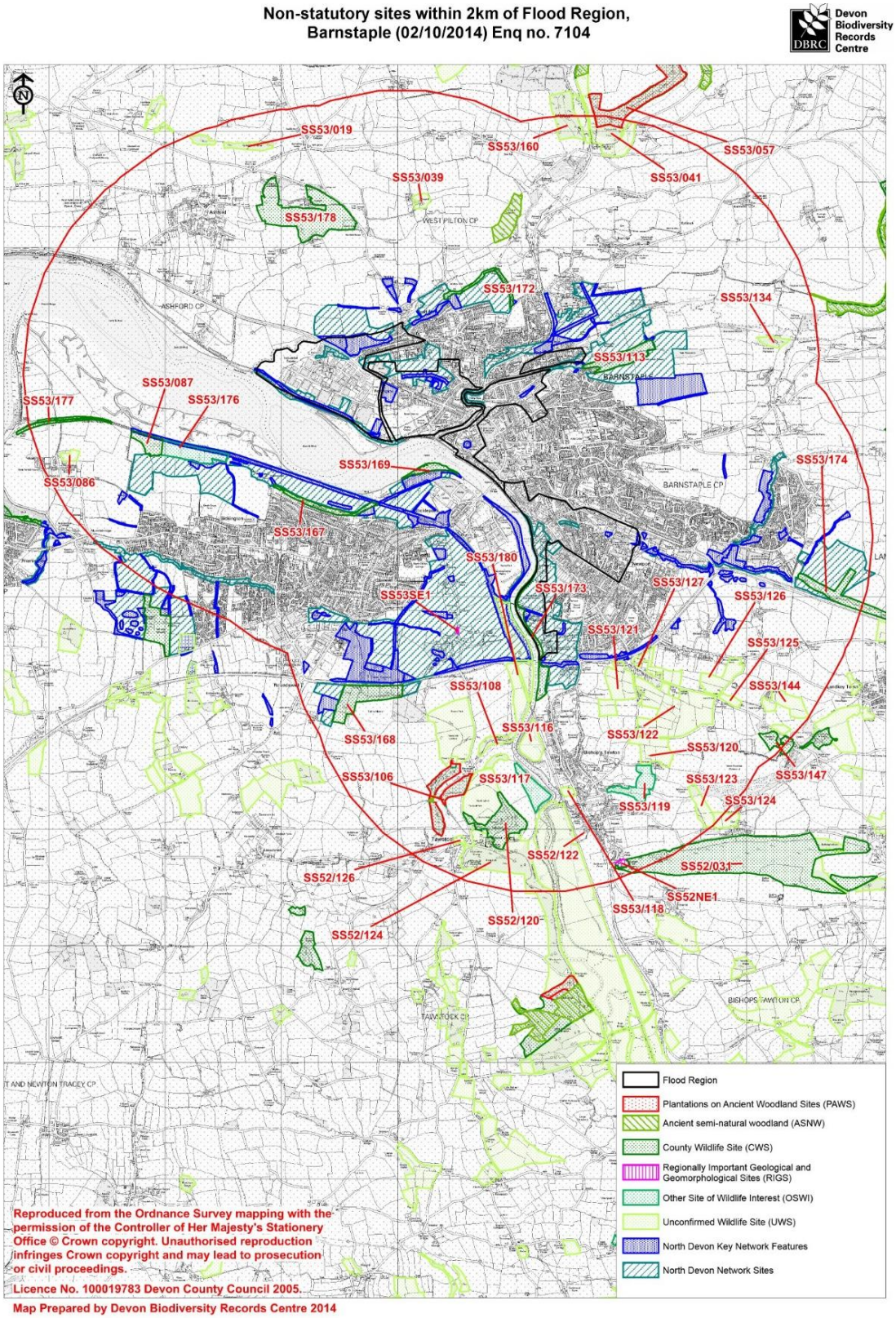

Figure 3-2: Non-statutory sites

3.1.3 Biodiversity Action Plan habitats and species

A search of the MAGIC online database identified a number of Biodiversity Action Plan (BAP) habitats in the study area. These are habitats identified as being the most threatened and requiring priority conservation action under the UK Biodiversity Action Plan (UK BAP).

The Devon BAP identifies 17 Habitat Action Plans (HAPs) and 20 Species Action Plans (SAPs) (NDC, 2006). The North Devon Local Plan (NDC, 2006) states that "development will not generally be permitted where it harms a locally distinctive and important biodiversity habitat as defined in the HAPs, a national, regional or county BAP, the Habitats Regulations or prejudices the functioning and integrity of a biodiversity network." Where development is permitted, any negative effect on biodiversity should be minimised, mitigated and compensated.

Mudflat habitat is present along the Taw estuary up to the approximately 1km upstream from the confluence with the River Yeo. Intertidal substrate foreshore present in the Taw estuary, which includes the confluence with the River Yeo. The types of intertidal substrate foreshore present are: mud, sand and mud, sand, mud and gravel, rock platform and gravel.

Coastal and floodplain grazing marsh is present on the west bank of the River Taw upstream of the Long Bridge and on the north bank of the River Yeo on the eastern edge of Barnstaple. The Taw-Torridge estuary is the only area in Devon other than the Exe estuary where saltmarsh with inter-tidal reeds and areas of coastal grazing exist (Devon Biodiversity Partnership, 2009).

Estuaries have been identified as a key habitat in the Devon BAP (Devon Biodiversity Partnership, 2009). Associated key species include:

- Triangular club-rush
- Dwarf spike-rush
- Eel grasses (*Zostera spp*.)
- *Ophelia bicornis* (polychaete worm)
- *Gammarus chevreuxi* (crustacean)
- *Laomedia angulate* (hydroid)
- *Hartluabella gelatinosa* (hydroid)

The Devon BAP states that several fish such as sea bass use Devon's estuaries as nursery or spawning grounds and salmon pass through on their journey up the river to spawn. The mild climate of the south west provides an important refuge destination for many thousands of waders and wildfowl if conditions elsewhere in Britain become severe (Devon Biodiversity Partnership, 2009). The Taw-Torridge estuary has a relatively high freshwater influence. The BAP has highlighted the following pressures on estuaries in Devon:

- Shoreline developments
- Water quality
- Coastal squeeze
- Bait digging
- Potential over-exploitation of shellfisheries
- Changes in sediment type and distribution
- Invasion of non-native species
- Inappropriate grazing of stock
- Lack of maintenance of river banks
- Lack of knowledge.

3.1.4 Protected and notable species

The Devon Biodiversity Records Centre (DBRC) provided a total of 467 records for protected and notable species within 2km of the flood cells (Figure 3-3). There were 19 Schedule one birds of the Wildlife and Countryside Act 1981 (W&CA) found (Table 3-2). There were also 245 records for non-schedule 1 bird species within 2 km of the flood cells.

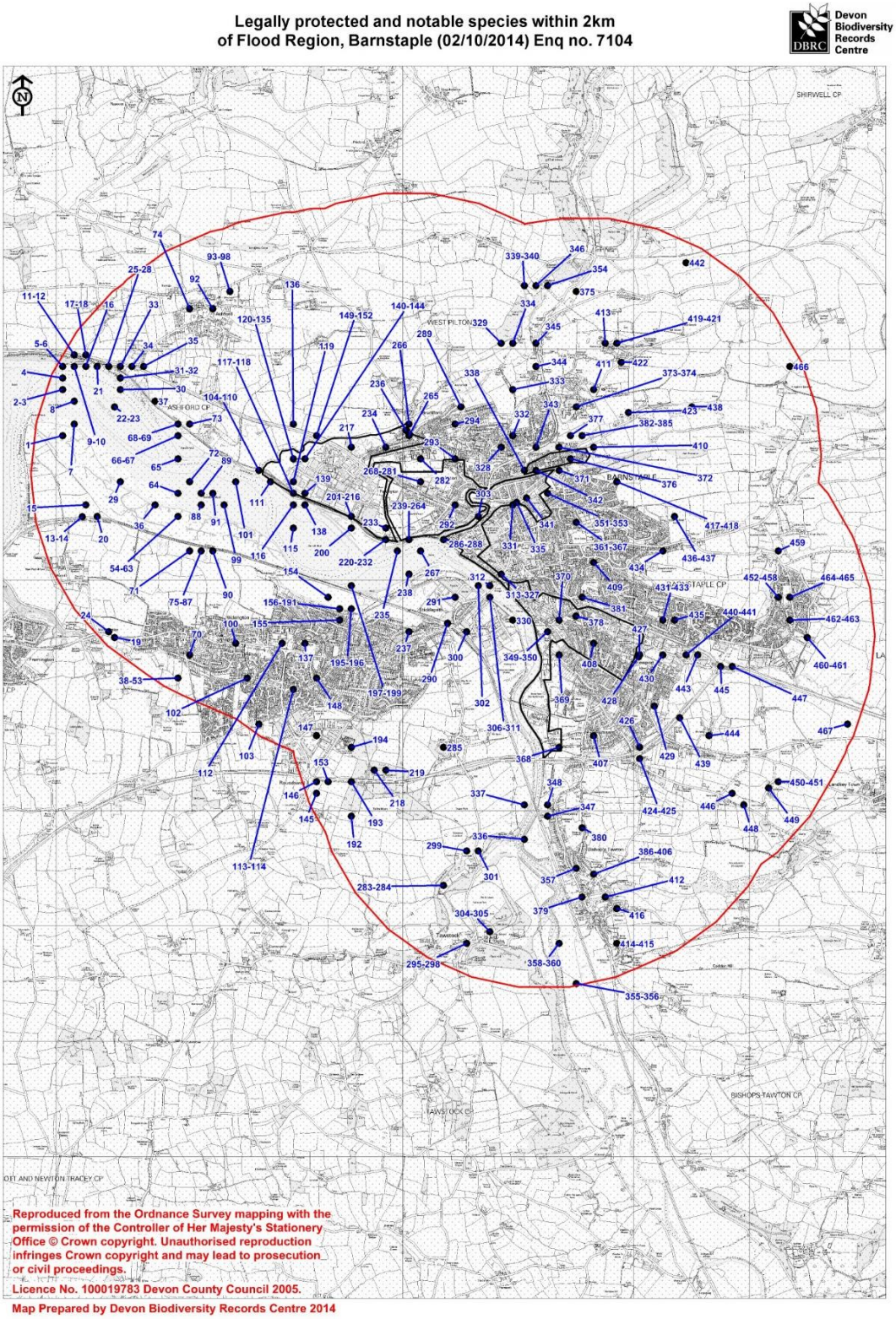

Figure 3-3: Protected and notable species

Table 3-2: Schedule 1 bird species recorded within 2km

Scientific Name	Common Name	Legal Status
Alcedo atthis	Common Kingfisher	W&CA Sch 1
Anas acuta	Northern Pintail	W&CA Sch 1b
Bucephala clangula	Common Goldeneye	W&CA Sch 1b
Fringilla montifringilla	Brambling	W&CA Sch 1
Gavia immer	Great Northern Diver	W&CA Sch 1
Limosa limosa	Black-tailed Godwit	W&CA Sch 1
Larus melanocephalus	Mediterranean Gull	W&CA Sch 1
Milvus milvus	Red Kite	W&CA Sch 1, 9
Numenius phaeopus	Whimbrel	W&CA Sch 1
Pandion haliaetus	Osprey	W&CA Sch 1
Platalea leucorodia	Eurasian Spoonbill	W&CA Sch 1
Philomachus pugnax	Ruff	W&CA Sch 1
Phoenicurus ochruros	Black Redstart	W&CA Sch 1
Regulus ignicapilla	Firecrest	W&CA Sch 1
Tringa nebularia	Greenshank	W&CA Sch 1
Tringa ochropus	Green Sandpiper	W&CA Sch 1
Turdus iliacus	Redwing	W&CA Sch 1
Turdus pilaris	Fieldfare	W&CA Sch 1
Tyto alba	Barn Owl	W&CA Sch 1, 9

There are 44 records of bat species within 2km of the flood cells. Bat species are also European Protected Species (EPS). These are identified by the EU Habitats Directive as the most seriously threatened in Europe. Table 3-3 contains the species of bats recorded.

Table 3-3: Bat species recorded within 2km

Scientific Name	Common Name	Legal Status
Chiroptera	Bats	EPS, W&CA Sch 5, 6
Myotis	Bats	EPS, W&CA Sch 5, 6
Myotis daubentonii	Daubenton's Bat	EPS, W&CA Sch 5, 6
Plecotus	Long-eared Bat species	EPS, W&CA Sch 5, 6
Myotis nattereri	Natterer's Bat	EPS, W&CA Sch 5, 6
Pipistrellus	Pipistrelle Bat species	EPS, W&CA Sch 5, 6
Pipistrellus pygmaeus	Soprano Pipistrelle	EPS, W&CA Sch 5, 6
Pipistrellus pipistrellus	Common Pipistrelle	EPS, W&CA Sch 5, 6
Nyctalus noctula	Noctule Bat	EPS, W&CA Sch 5, 6
Plecotus auritus	Brown Long-eared Bat	EPS, W&CA Sch 5, 6
Rhinolophus ferrumequinum	Greater Horseshoe Bat	EPS, W&CA Sch 5, 6
Rhinolophus hipposideros	Lesser Horseshore Bat	EPS, W&CA Sch 5, 6

The tables below contain summaries of other protected species found within 2km of the project area.

Table 3-4: Other Mammal Species recorded within 2km

Scientific Name	Common Name	Legal Status
Erinaceus europaeus	West European Hedgehog	W&CA Sch 6
Lutra lutra	European Otter	EPS, W&CA Sch 5
Meles meles	Eurasian Badger	W&CA Sch 6, Protection of Badgers Act 1992
Muscardinus avellanarius	Hazel Dormouse	EPS, W&CA Sch 5
Sorex araneus	Eurasian Common Shrew	EPS, W&CA Sch 6
Sorex minutus	Eurasian Pygmy Shrew	W&CA Sch 6

Table 3-5: Reptile and Amphibian Species recorded within 2km

Scientific Name	Common Name	Legal Status
Anguis fragilis	Slow Worm	W&CA Sch 5
Bufo bufo	Common Toad	W&CA Sch 5
Lissotriton	Newt species	W&CA Sch 5
Lissotriton vulgaris	Smooth Newt	W&CA Sch 5
Natrix natrix	Grass Snake	W&CA Sch 5
Rana temporaria	Common Frog	EPS, W&CA Sch 5
Vipera berus	Adder	W&CA Sch 5
Zootoca vivipara	Common Lizard	W&CA Sch 5

Table 3-6: Invertebrate Species recorded within 2km

Scientific Name	Common Name	Legal Status
Boloria euphrosyne	Pearl-Bordered Fritillary	W&CA Sch 5

The Taw and Torridge rivers provide a 'national stronghold' for otters (Devon Biodiversity Partnership, 2009).

The second largest population of Greater Horseshoe Bats in the UK is found around Braunton. In order to protect the important foraging and commuting routes for these bats, a 4km Bat Sustenance Zone has been set up around Caen Valley Bats SSSI (NDC, 2006). The flood cells are not within this zone.

The flood cells are not within a Great Crested Newt Consultation Zone (DCC, 2012).

3.2 Historic environment

Historic features within close proximity to the project have the potential to be impacted by the project either due to direct impacts on the fabric of the structure or due to changes to its setting. A search of English Heritage, NDC and other online databases (Section 1.4) was undertaken to identify these sites, including for designated sites such as Scheduled Monuments and listed buildings and for local historic sites and features.

Barnstaple has been a commercial centre for North Devon for about 1000 years. King Athelstan ruled in the early part of the 10th Century, is reported to have referred to Barnstaple as a defended burh along with 'Pilturn' (NDC, 2008b). Towns struck in the town in the late 10th to early 11th Centuries provide the earliest record of the town name as 'Beardastapol', which is likely to mean Bearda's market or pool, while the town is also recorded in the Domesday Book (1086) as 'Barnestaple' (NDC, 2008b).

In Norman and Medieval times the river was without embankments and flowed in a shallower channel which was much wider than it is today. In 1557 the Mayor and Burgesses of Barnstaple petitioned successfully for a royal charter, having claimed that flooding had resulted in ruining the town, and therefore a new 'wharf' (a now obsolete meaning of the word 'embankment') that extended up the river beyond the Long Bridge was being constructed to contain the River Taw at a cost of £300.

A new quay is recorded to have been built in 1600 on The Strand, known as the New Work, involving further reclamation works to create the Great Quay and Little Quay (NDC, 2008b). The main pottery sites were located in the North Walk / Tuly Street areas and Litchdon Street. Any further evidence of potteries at North Walk / Tuly Street is only likely to survive below ground archaeological deposits (NDC, 2008b).

The town was approached from the north via a substantial causeway called Pilton Bridge, originally built in the 12th Century. From the south the town was approached from the south bank of the River Taw via an equally substantial bridge, the Long Bridge (Grade I Listed), dating mainly from the 13th Century, but since widened in 1834 and again in 1965 (NDC, 2008b). Buildings such as the Parish Church of St Peter and St Paul (Grade II*) and St Anne's Chapel (Grade I) were built using the local sandstone in the 14th Century (NDC, 2008b).

3.2.1 Scheduled monuments

The Castle Mount is a scheduled monument within flood cell C (Figure 3-4). There are no other scheduled monuments within 500m of the flood cells. The Castle Mount was probably built around 1068, and was an earthwork motte and bailey castle constructed at the western end of town at the confluence of the Rivers Taw and Yeo (NDC, 2008b). By the 14th Century, much of the castle had disappeared, with just the raised mound remaining, much as it is today (NDC, 2008b).

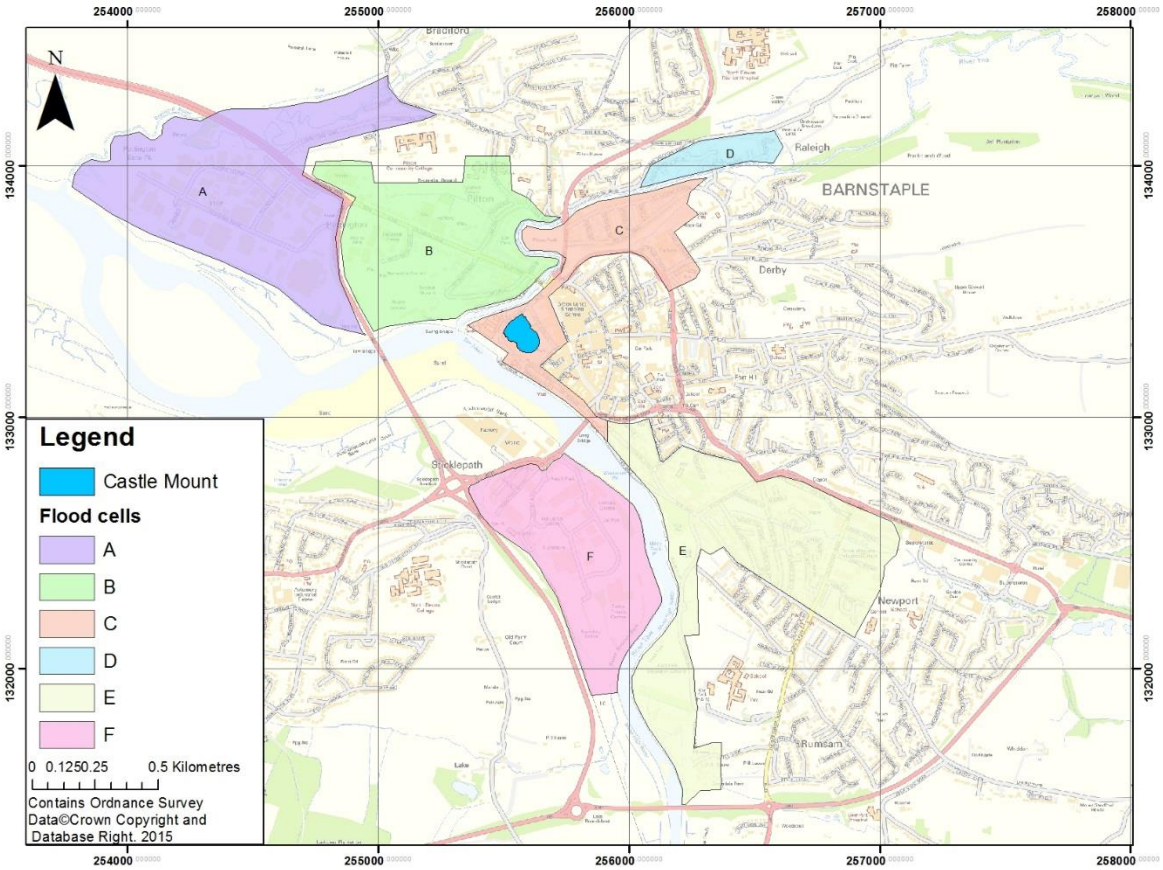

Figure 3-4: Location of Castle Mount scheduled monument

3.2.2 Listed buildings

There are 84 listed buildings within the flood cells and a further 28 within 500m of the flood cells (Figure 3-5). One feature includes the Long Bridge, which is Grade I. Many of the listed buildings are along the bank of the River Taw, including the Grade I listed St Anne's walk, which is now the Heritage Centre. Castle Quay, with 12 bollards from and including the steps to slipway at the civic centre end are listed (Grade II). The majority of listed buildings are within the centre of Barnstaple, with listed buildings located in flood cells C and E, with three listed buildings in flood cell A.

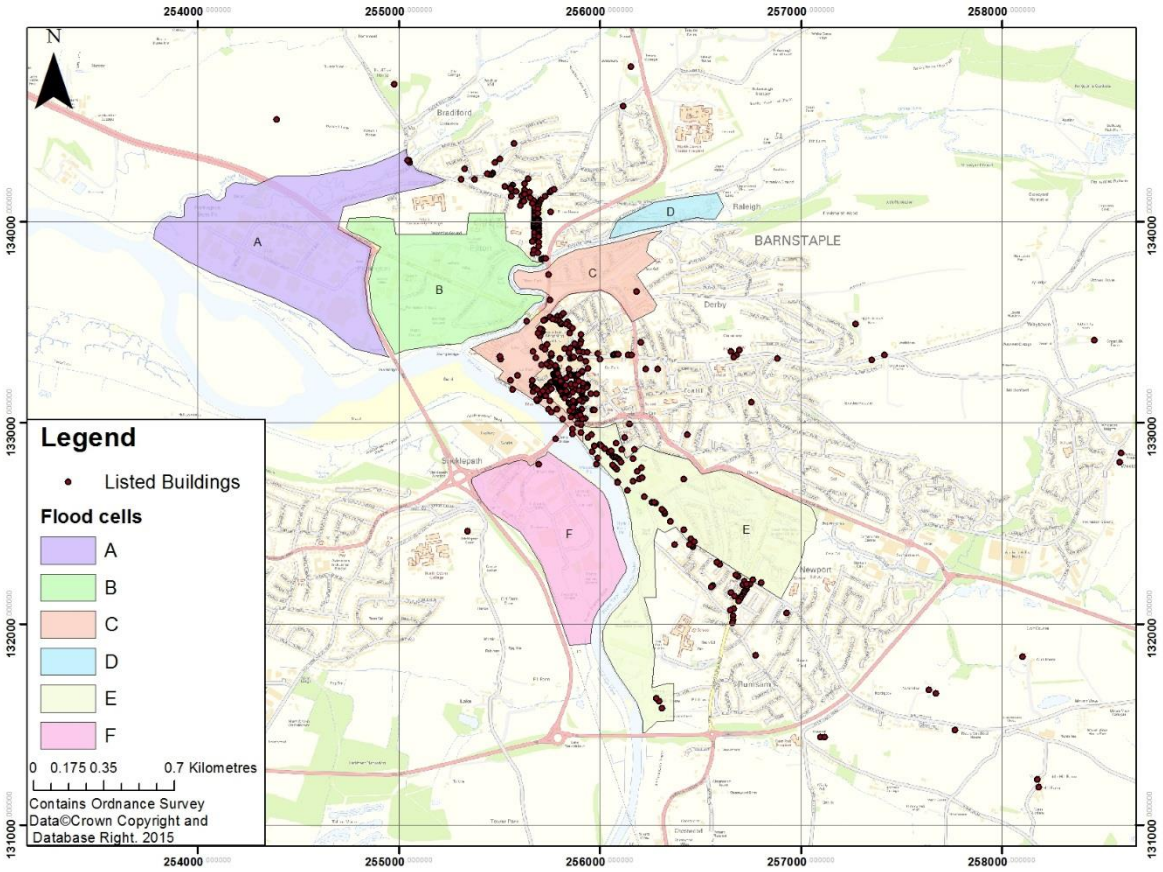

Figure 3-5: Listed Buildings within 500m of flood cells

3.2.3 Conservation areas

Barnstaple has a large conservation area of about 30 hectares, which includes a large number of listed buildings and the Castle Mount Scheduled Monument. The town also has a number of smaller conservation areas outside the town centre covering Pilton, Newport, Rumsam, Ebberley Lawn and Lake (Figure 3-6), which also contain a number of listed buildings.

Barnstaple Town Centre conservation area has 234 listed buildings, of which six are Grade I (NDC, 2008b). The town took on its modern appearance with the construction of the Relief Road (1986) and the Green Lanes Shopping Centre (1989/90), which lost a number of historic features and therefore contributed to the loss of some of the town's historic character (NDC, 2008b).

As well as the medieval archaeological deposits with the town there are a few examples of existing medieval buildings in the conservation area, which include:

- 39 High Street, dating from 14th or early 15th Century.
- St Anne's Chapel, dating from the early 14th Century
- Parish Church of St Peter and St Paul, dating from the early 14th Century.

Damage caused by what is thought to have been a tsunami in 1607, the great flood of Bristol Channel, may explain why there are very few remaining structures surviving in Barnstaple from before the early 17th Century (NDC, 2008b).

Barnstaple is unusual in retaining its boundary walls and back street cottages built of cob, which is fairly common in rural Devon but unusual in an urban setting (NDC, 2008b).

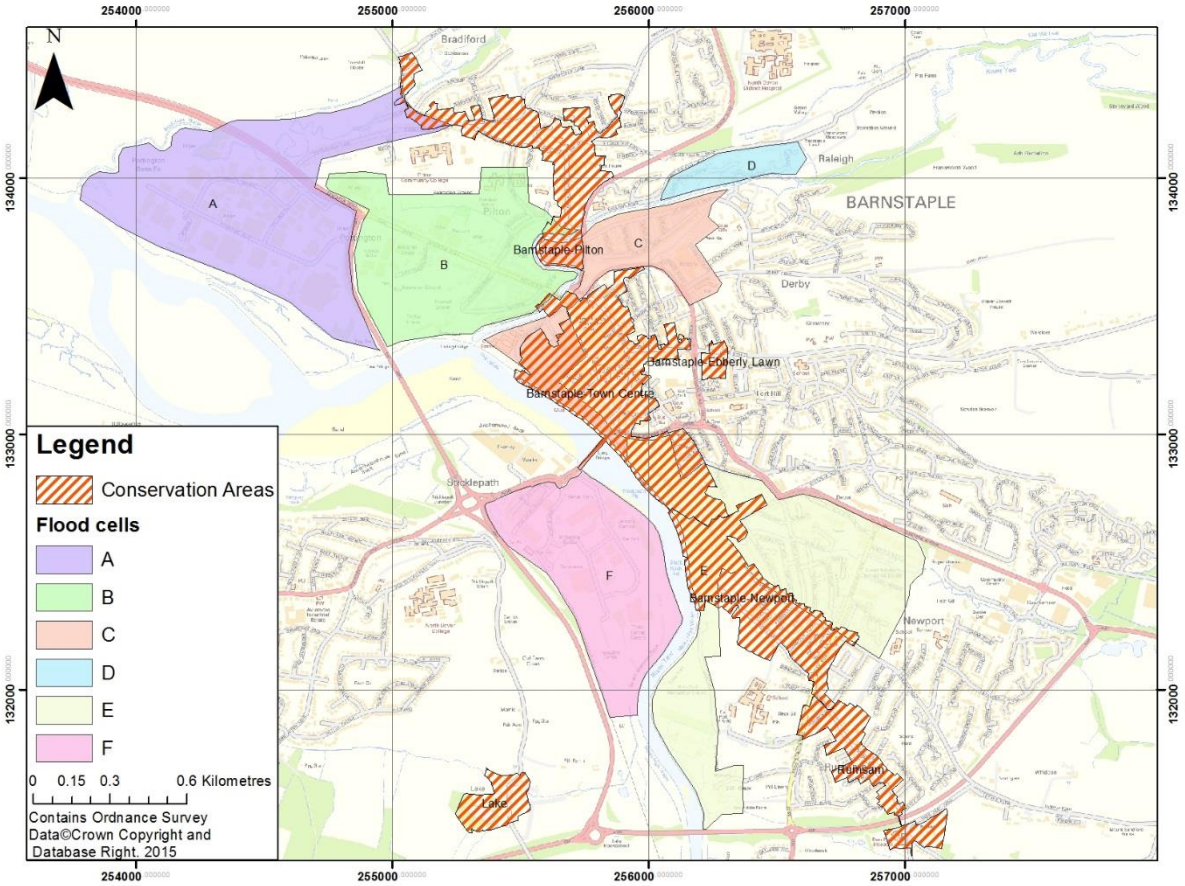

Figure 3-6: Barnstaple conservation areas

There are many development pressures on Barnstaple. One of the main pressures is commercial, but also flooding. Character appraisal of Barnstaple's conservation area states that there may be an increased demand for upgraded flood defences in the future, and this "may have a considerable impact on the character and appearance of the town, especially along the riverside. Equally a failure to prepare for flood events of increased severity and frequency may result in damage to the historic environment of the town" (NDC, 2008b).

The Newport conservation area is partially within flood cell E and has an area of 18ha, which is approximately half the size of the Barnstaple Town Centre conservation area. Newport conservation area has 46 Grade II listed buildings (NDC, 2009a). Newport has many good examples of Georgian and Regency architecture, and has a retained a distinct character and appearance from Barnstaple.

There are good views of the River Taw from the riverside path at the western edge of Rock Park, and include views of the Longbridge in the distance. A view that is of major significance is that along the railings (Grade II listed) to the northeast of Rock Park (NDC, 2009a). Street furniture within the conservation area is typically of a high quality that shows respect for the historic environment.

Developments on the opposite bank of the River Taw could have a significant effect on the setting of, and views from, the conservation area (NDC, 2009a). The northern parts of the conservation rea are at risk of flooding, having formerly been marshland around Coney Gut. This flood risk may be of a major issue as climate change will increase the regularity and severity of flooding events (NDC, 2009a).

The Pilton conservation area is within Flood Cell C, and has an area of 17.1ha, and has 82 listed buildings, including one Grade I listed building. Pilton's first known written reference is in the Domesday Book, of which less than one per cent of English settlements are (NDC, 2009b).

Views out of Pilton demonstrate its valley location and connection with the River Yeo. Other views include out towards Bradiford Water (NDC, 2009b). As with many other conservation areas, Pilton suffers from development pressure, from new and infill developments (NDC, 2009b).

3.2.4 Historic Environment Record

A request to DCC's Historic Environment Record (HER) centre returned with the presence of many archaeological finds in Barnstaple. A search of the HER Archaeological Monument record found 881 monuments in the flood cells and within 500m. Monuments are classed as 'types', with there being a range present in Barnstaple such as mills (corn, water, woollen, etc.), water wheels, pottery works, standing stone, priory, parish church, brewery and extant buildings, as well as many more.

There are many archaeological finds in and within 500m of the flood cells (Figure 3-7), with many in the centre of Barnstaple, with a few along the Rivers Taw and Yeo (Figure 3-8). There are also 64 records of archaeological activities (i.e. an excavation). Some finds have little known about them, for example a coffin found on the bed for the River Taw, near North Walk, was found in 1876 by men digging for clay (Devon & Dartmoor HER, 2013).

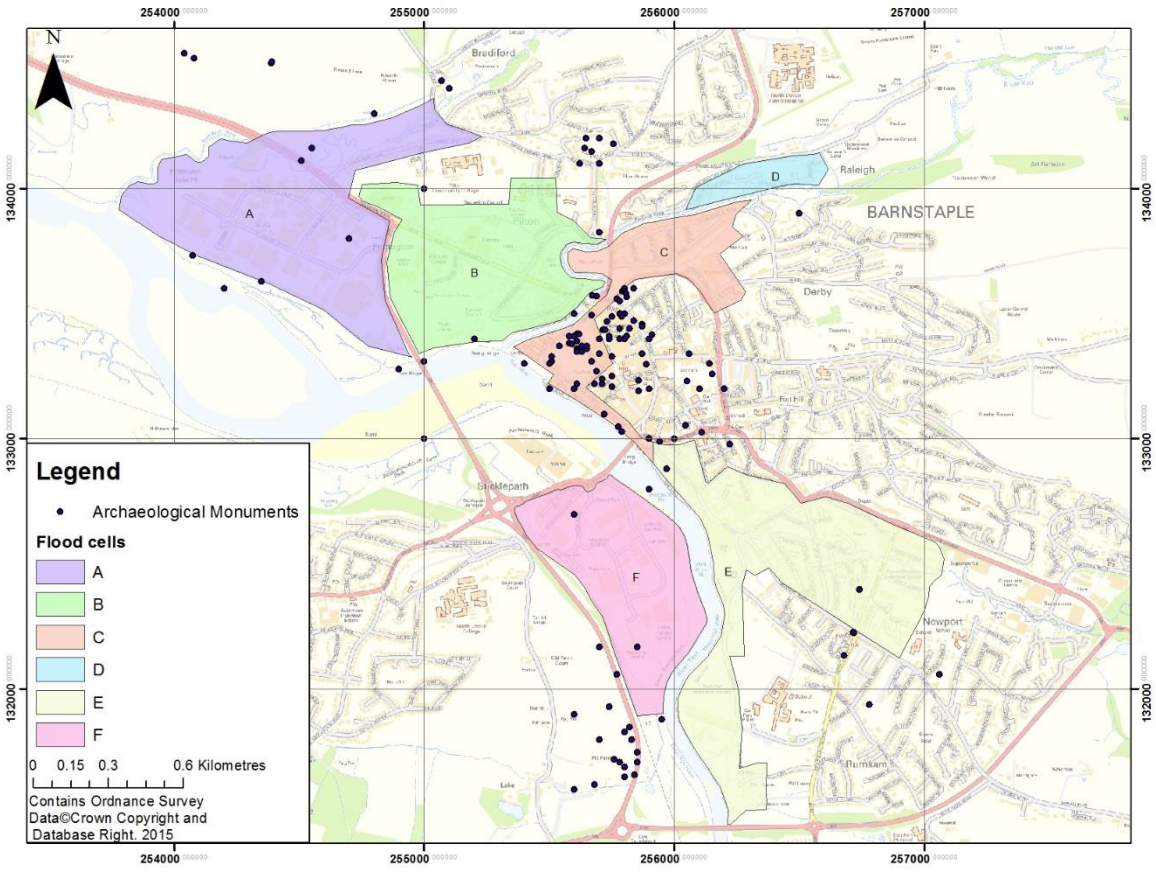

Figure 3-7: Location of Archaeological Monuments

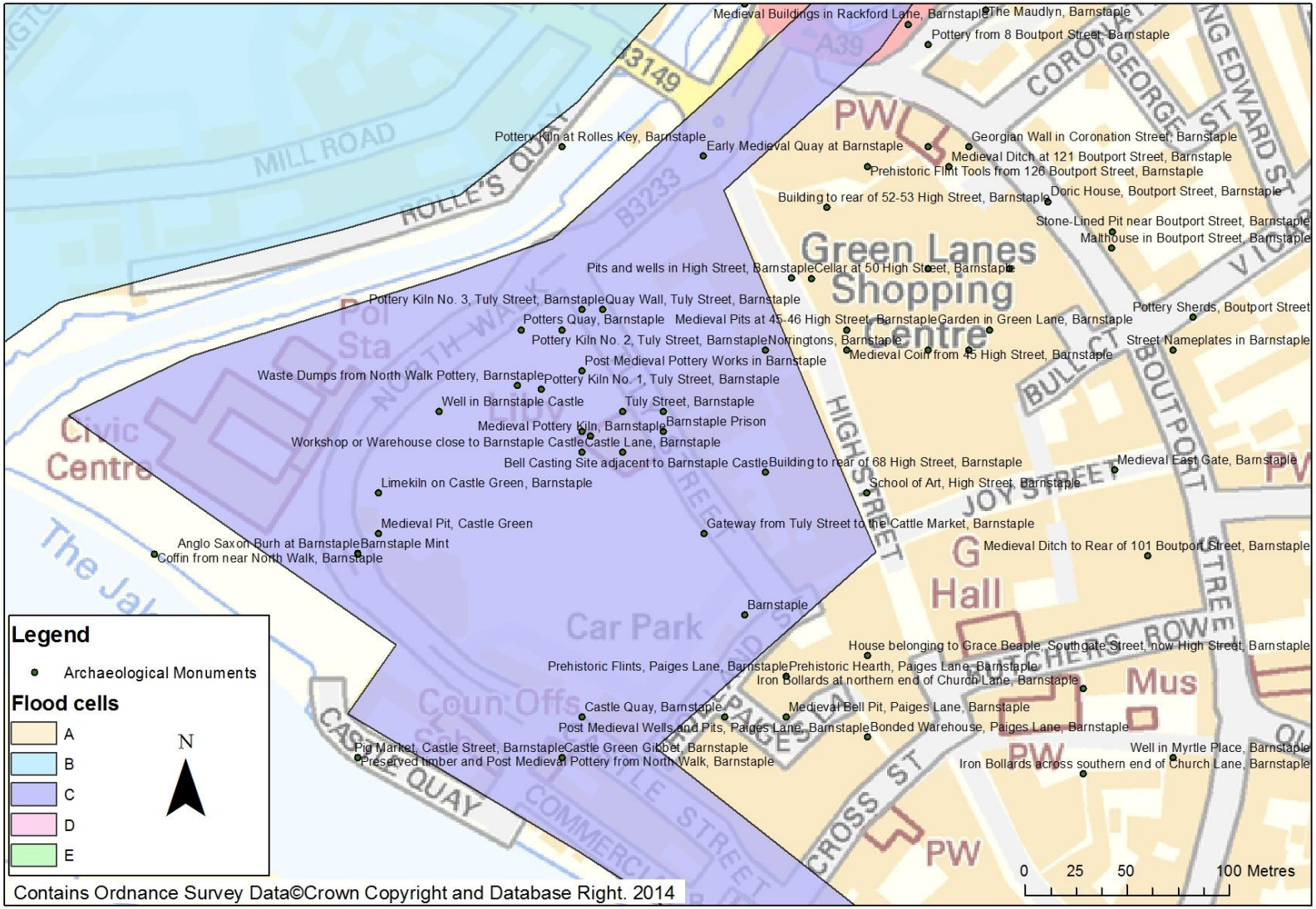

Figure 3-8: Archaeological Monuments in Barnstaple town centre

A search of the archaeology data service (https://archaeologydataservice.ac.uk/) revealed 344 results of excavations undertaken in the Barnstaple area. There is a presence of prehistoric archaeological finds and a stone row about 6km to the west of the town in what is now the estuary. There is potential for the survival of prehistoric land surfaces, palaeoenvironmental deposits and artefacts within the estuary deposits adjacent to the town (NDC, 2008b) (Figure 3-9). There are six results of shipwrecks defined on the Heritage Gateway from Pastscape. The earliest dates from 1541, with the latest from 1882.

When excavating the foundations for a new police station in the inter-war years on the corner of Castle Street and Holland Street (within flood cell C), another medieval structure was found, comprising of a wall with a series of mooring posts which could have formed part of the original Castle Quay (NDC, 2008b).

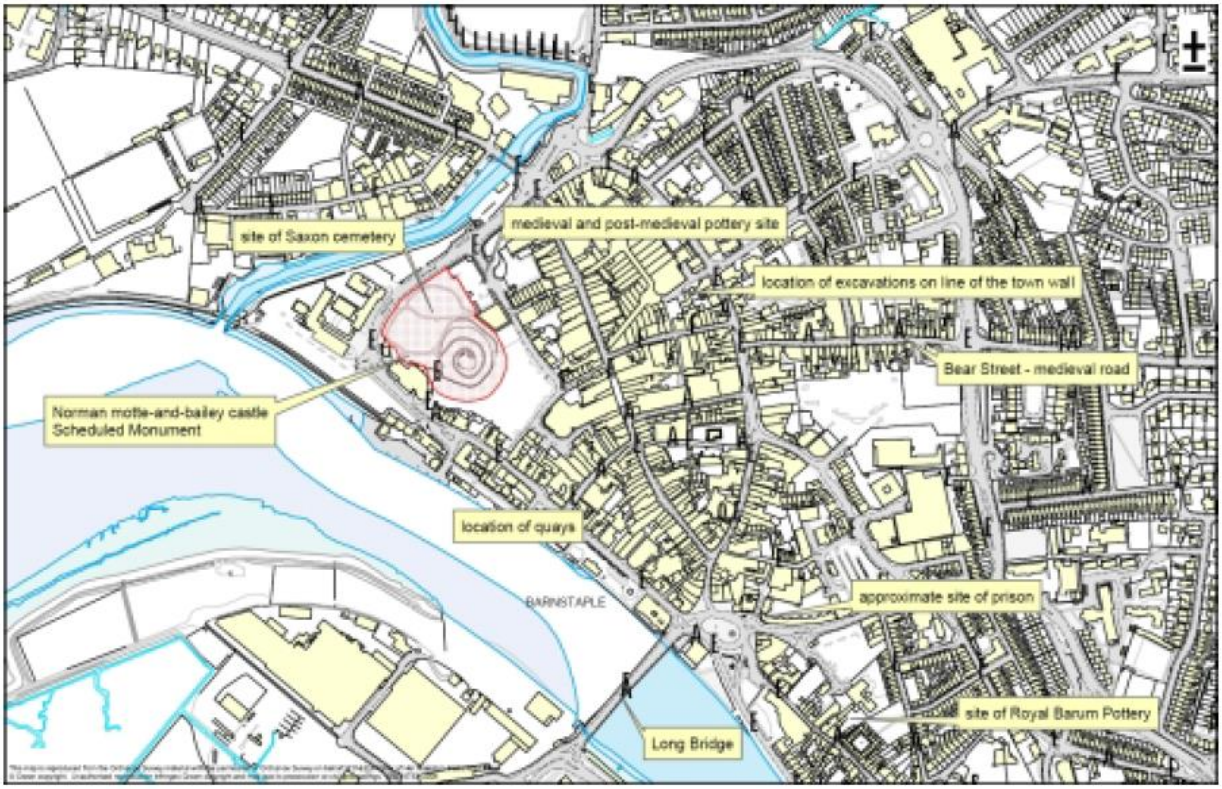

Figure 3-9: Notable archaeological sites in Barnstaple (NDC, 2008b)

3.3 Water environment

3.3.1 Surface water quality

The Taw-Torridge Estuary is a transitional water body (GB540805015500) and is classified within the South West River Basin Management Plan (RBMP) as a heavily modified water body (HMWB) (Environment Agency, 2009). The RBMP identifies the following challenges within the South West region:

- Diffuse pollution from agricultural activities;
- Diffuse and point source pollution from disused mines;
- Point source pollution from water industry sewage works; and
- Physical modification of waterbodies.

The current ecological status of the Taw-Torridge estuary is 'moderate potential' while the chemical quality is 'good'. Since the estuary is a HMWB, it is not able to achieve natural conditions, therefore the ecological status is measured against 'ecological potential' rather than status. It has a target of achieving Good Ecological Potential (GEP) by 2027.

Seven mitigation measures have been identified for the Taw-Torridge estuary, which are necessary in order for the water body to achieve GEP. None of these mitigation measures are currently in place. These are:

- Indirect / offsite mitigation (offsetting measures).
- Operational and structural changes to locks, sluices, weirs, beach control, etc.
- Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone.
- Managed realignment of flood defence.
- Bank rehabilitation / reprofiling.
- Preserve and, where possible, restore historic aquatic habitats.
- Removal of hard bank reinforcements / revetment, or replacement with soft engineering solution.

Any development proposals that could affect the estuary will need to demonstrate no deterioration in the status of the water body and should work towards helping it achieve its status objectives.

Coney Gut (GB108050019980) is named the Taw estuary in the RBMP, but is defined as a river rather than an estuary. It is classified as a HMWB and has a current GEP of 'good'. Coney Gut has the following mitigation measures, which are all in place:

- Educate landowners on sensitive management practices (urbanisation).
- Appropriate timing (vegetation control).
- Appropriate vegetation control technique.
- Selective vegetation control regime.
- Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone.
- Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works.
- Flood bunds (earth banks, in place of floodwalls).
- Preserve and, where possible, restore historic aquatic habitats.
- Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution.

The River Yeo waterbody (GB108050019990) has an overall status of 'moderate', with an aim of becoming 'good' by 2015. Bradiford Water (GB108050020040) is also listed within the RBMP. This waterbody has an overall status of 'good' and is currently meeting its status objective. Neither of these waterbodies is designated as a HMWB.

The waterbody that enters the Taw to the south of flood cell F is named the Taw Estuary (GB108050014590) is listed within the RBMP. It has a current overall status of 'moderate' and is not designated as a HWMB.

The Environment Agency takes periodic water samples along the River Taw to establish its chemical and biological quality. The closest sampling site to the project area is just upstream of the confluence with the River Yeo, on the border with flood cell C.

There are sustainable drainage systems to reduce flood risk in the area, and improving water quality through the Torridge Nature Improvement Area (NIA) and Taw River Improvement Project (TRIP) (NDC and Torridge District Council, 2014). TRIP involves a £1.8 million worth of restoration work from 2012 to 2015 to improve water quality and help achieve the goals of the Water Framework Directive (WFD) (North Devon Biosphere Reserve Partnership, 2013).

3.3.2 Groundwater quality

The South West RBMP identifies that Barnstaple forms part of the River Taw and North Devon Streams groundwater body (GB40802G801000). Its current quantitative quality and chemical quality is 'good' (Environment Agency, 2009). Pressures on the groundwater body that are

affecting its status include impact of nutrients and hazardous substances and other pollutants, nutrients, abstraction and other artificial flow pressures.

Barnstaple is located in a Nitrate Vulnerable Zone (NVZ). An NVZ is designated where land drains and contributes to the nitrate found in 'polluted' waters. Polluted waters include (Environment Agency, 2014):

- Surface of groundwaters that contain at least 50mg/l nitrate.
- Surface or groundwaters that are likely to contain at least 50mg/l nitrate if no action is taken.
- Waters which are eutrophic, or are likely to become eutrophic if no action is taken.

Barnstaple is also identified as a Groundwater Vulnerability Zone (GVZ) – 'minor aquifer high'.

3.3.3 Water resources

Mains water is provided by South West Water. Approximately 90% of the South West Water region's water supply comes from surface water sources (South West Water, undated).

The River Yeo near Barnstaple was classified as over-abstracted due to agriculture in 2006 by the Environment Agency (Land Use Consultants, 2010). There are significant abstractions from public water supply within the North Devon river basin district (Environment Agency, 2009). Although the area is traditionally known for having abundant water, growth of Barnstaple and Exeter may place pressure on the water resources of the area, especially that of Exmoor (Natural England, 2012).

There are currently 1500 properties at risk from a 1% annual probability river flood in Barnstaple, rising to 2400 properties in 2100 if the current flood defences are kept (Environment Agency, 2012). The Catchment Flood Management Plan (CFMP) for North Devon states that Barnstaple is in an area of "moderate to high flood risk where we can generally take further action to reduce flood risk." (Environment Agency, 2012).

The flood risk in Barnstaple is currently well managed but a high number of people remain at risk from large floods, with the associated damages being high. Further improvements are considered necessary (Environment Agency, 2012)

The CFMP states that the Taw-Torridge estuary environmental benefits outweigh the economic considerations in relation to flood defence. There is an opportunity to improve the environmental status by removing embankments and improving river and floodplain connectivity. Therefore, the policy option for this area is "we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits." (Environment Agency, 2012).

3.4 Landscape and visual amenity

Barnstaple is approximately 8km east of the North Devon AONB and about 14km west of Exmoor National Park. The North Devon AONB covers 171km^2 of mainly coastal landscape from the border with Exmoor National Park, through the mouth of the Taw-Torridge Estuary and beyond to the Cornish Border (Land Use Consultants, 2010). This area is also defined as a Heritage Coast, which designation comes further upstream of the Taw-Torridge estuary and is situated within the North Devon Biosphere Reserve.

The major features of Barnstaple's skyline that are visible from a distance include the Castle Mount and the spire of St Peter's Church. There are several locations around the town from which broad overviews (Figure 3-10) are possible due to Barnstaple's valley setting, including from the top of Sticklepath Hill and North Road near the North Devon District Hospital (NDC, 2008b). The spire of the Parish Church of St Peter and St Paul is able to be viewed from short to long range views, including from the east bank of the River Yeo by the police station on North Walk (NDC, 2008b).

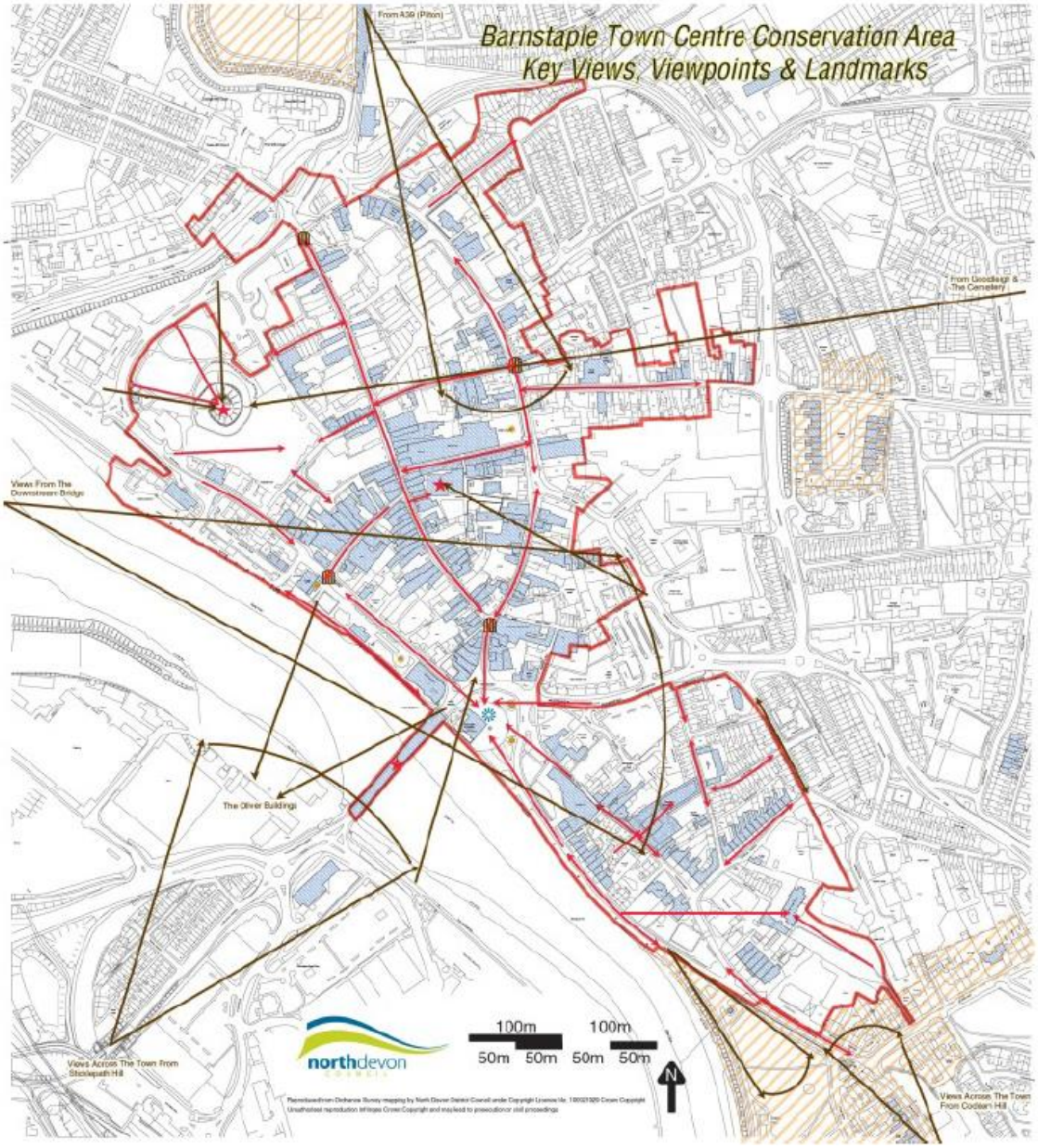

Figure 3-10: Key views, viewpoints and landmarks in Barnstaple (NDC, 2008b)

3.4.1 National Character Areas

National Character Areas divide England into 150 distinct natural areas, defined by a unique combination of landscape, biodiversity, geodiversity and cultural and economic activity. Barnstaple falls with the Exmoor NCA (145). The landscape of predominantly upland plateaux of Devonian sandstones and slates terminating in the north at the Bristol Channel with a spectacular cliff coastline, and terminates in the west at Barnstaple (Natural England, 2012). The Taw-Torridge estuary is a key characteristic of the Exmoor NCA, with its large areas of high quality saltmarsh.

On the south west side of Barnstaple, at the southern tip of flood cell E is the border between the Exmoor NCA and The Culm NCA (149). The Culm NCA extends across north west Devon and north east Cornwall, from Dartmoor to the Atlantic. A key characteristic of the NCA is the enclosed, wooded valleys of the Taw and Torridge, cutting through the ridges with open valley floors.

3.4.2 Landscape Character Types

Barnstaple is in the Estuaries Landscape Character Type (LCT) (Land Use Consultants, 2010). LCTs are Devon wide landscape classifications that were developed in 2006, and are subdivisions of the Devon Character Areas. North Devon's LCTs identifies the special qualities, forces for change and the strategy to protect, manage and plan for the landscape types special qualities for each LCT. Key characteristics of the Estuaries LCT include the broad, sweeping estuary of the Taw-Torridge, with expansive mudflats and sandbanks (Land Use Consultants, 2010). The banks are defined by grazing marsh, arable fields and rough grassland. There is a strong maritime history associated with the textile trade, which includes the Grade I listed Long Bridge in Barnstaple and historic quays along the shore. Another key characteristic is the sewage works located on the north bank of the estuary, with views of nearby development and the airfield at Chivenor, which affects the overarching perceptions of tranquillity and remoteness associated with the estuary. There are many factors affecting landscape character, as follows (Land Use Consultants, 2010):

- Light and noise pollution.
- The estuary is crossed in two locations by the A39 major road corridor, impacting on the landscape's levels of peace and character.
- Noise and air pollution from the A361 running parallel to the northern estuary bank.
- Further growth in popularity of the area leading to increased demand for facilities, infrastructure (including car parks and signage) and higher traffic levels.
- Future growth of Barnstaple, Braunton and Bideford/Northam/Appledore as the main towns.
- Sea level rise and coastal erosion as a result of climate change, resulting in a significant rise in the estuary's water levels and a consequential widening of its channels.
- Future climate change modelling predicting that by 2100, most spring tides will breach the current flood defences protecting settlements and farmland along the estuary fringes.
- Increasing demand for the tidal energy of the estuary to be harnessed as a renewable energy source in response to government targets for climate change mitigation (proposals have already been put forward for this type of scheme).

To protect the open character and expansive views to and from the estuary, the Landscape Character Assessment (Land Use Consultants, 2010) states that it must be ensured that "new development on its fringes is incorporated into its landscape setting."

3.5 Contaminated land

The Barnstaple area has a long history of the pottery industry, due to the presence of glacial clay deposits. In the past, heavy metals were frequently used in the glaze materials of pottery ware, and there is potential for historical pottery sites to be contaminated with these materials (NDC, 2009c). The aims of NDC in dealing with contaminated land are (NDC, 2009c):

1. To protect human health
2. To protect controlled waters
3. To protect the environment
4. To protect designated ecosystems and biodiversity
5. To prevent damage to property
6. To encourage voluntary remediation
7. To encourage re-use of previously developed land.

A search of the Environment Agency's *What's in your backyard* website revealed five historic landfill sites, one within flood cell B, one within flood cell E, one within flood cell F and the other two within 500m of Barnstaple on the same bank of the Taw as flood cell F. The Seven Brethren

Bank is the largest landfill in the area, and is within the majority of flood cell F. This landfill last received waste in 1992. The landfill within flood cell B is Wooleway's Site. Seven Brethren Bank is a principal area of redeveloped contaminated land, as approximately 20 commercial properties occupy the site (NDC, 2009c). Park School Railway Cutting is within flood cell E and last received waste in 1982. All sites are likely to be inert, containing waste such as glass, concrete, bricks, tiles, soil and stones.

3.6 Air quality

Air quality in Barnstaple is very good, as shown on the Environment Agency's *What's in your backyard website.* NDC also undertake air quality monitoring in Barnstaple, sampling the amount of nitrogen dioxide present. The annual mean concentrations in 2012 of nitrogen dioxide from 11 sites in Barnstaple ranged from 7.70µg/m^3 to 34.88µg/m^3 (NDC, 2014). There are no 'very busy' roads in North Devon and it is considered unlikely that the Air Quality Standard for carbon monoxide will be breached in North Devon (NDC and Torridge District Council, 2010).

There are no Air Quality Management Areas (AQMA) in Barnstaple. The Western Bypass and Downstream Bridge, which was completed in 2007, reduced a lot of pressure on air quality in Barnstaple.

North Devon residents are responsible for 8.4 tonnes of carbon dioxide emissions in 2007 (NDC and Torridge District Council, 2010). In 2005, the majority came from road transport, with a share of 39%.

3.7 Noise

The Campaign for the Protection of Rural England has identified northern Devon as one of the most tranquil areas in Devon and the UK (NDC and Torridge District Council, 2014). The region is connected by the roads A39, A361 and A377, along with a regional rail line between Barnstaple and Exeter, which detract from the overall tranquillity of the North Devon district, along with new developments (NDC and Torridge District Council, 2010).

The draft Local Plan (NDC and Torridge District Council, 2014) states that it is "particularly important to minimise the impact of noise and vibrations in sensitive locations and buildings such as residential areas, hospitals, schools and areas valued for their tranquillity including Sites of Special Scientific Interest,…and the wider countryside."

3.8 Population and local community

The North Devon and Torridge District areas have an ageing population of 157,500 (NDC and Torridge District Council, 2014) and is projected to increase to a total of 177,300 by 2031 (NDC and Torridge District Council, 2014). Barnstaple itself has a population of just over 25,000 (SERIO and ekosgen, 2014). The Draft Local Plan (NDC and Torridge District Council, 2014) identifies a supply of 16,469 dwellings over the life of the plan, of which Barnstaple and Bideford will accommodate 49%. The total housing requirement for Barnstaple over the period 2011 to 2031 is for approximately 3810 dwellings (NDC and Torridge District Council, 2014).

Approximately 65% of northern Devon's (North Devon and Torridge District) population live in the zone around the Taw-Torridge estuary and in coastal settlements (NDC and Torridge District Council, 2014). North Devon has the tenth highest proportion of second or holiday homes in the country, and therefore is one of the worst areas in the ability to get access to the housing ladder (NDC and Torridge District Council, 2010).

There are major transport assets within the flood cells, particularly the A361 between flood cells A and B and beside flood cell F. The A39 also runs along the border of flood cells C and E. Commercial areas at risk of flooding within the flood cells include Pottington Business Park in flood cell A and Barnstaple town centre, in flood cell C. Much of flood cell A and the north eastern end of flood cell E is used for commercial and/or industry use. Remaining areas within the flood cells are generally residential.

Data received from DCC show there are Public Rights of Way (PRoW) running beside the existing and proposed flood defences (Figure 3-11). The South West Coast Path runs along the landward side of the flood defence along the River Taw in flood cell A. Other PRoW include along the River Taw in flood cell Cs and E in Rock Park and within flood cell F along the river bank. The River Yeo also has a PRoW running along the bank in flood cell D.

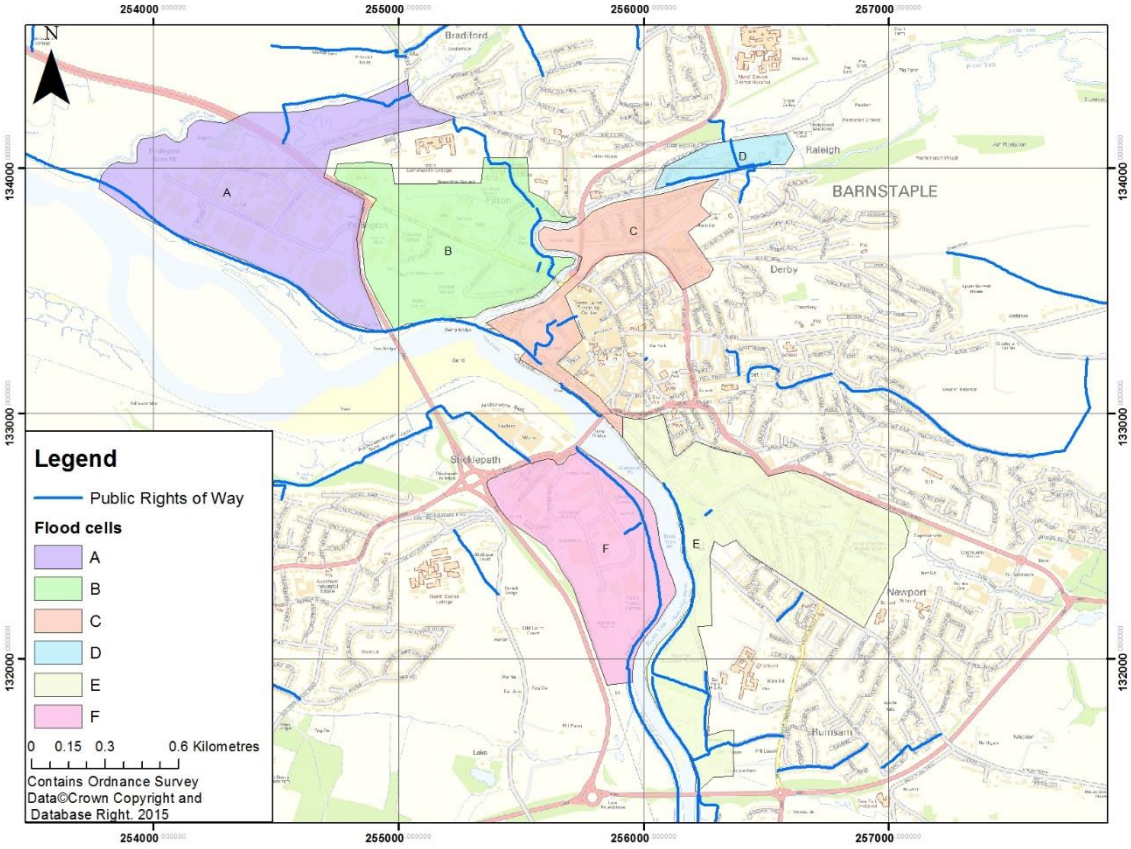

Figure 3-11: PRoW in Barnstaple

3.9 Local economy

North Devon and the Torridge District have a £2.2 billion economy which supports around 7700 business and 66,000 jobs. In 2008 the economy of the area benefited by £376 million from tourist spend, which supported 10,633 related jobs (NDC and Torridge District Council, 2014). Employment is focused in smaller firms, with 91% of businesses employing less than 10 people in 2011. Barnstaple is a key area for employment, retail and services in the northern part of the county. The largest sector is retail, following by health and social work and accommodation and food (NDC and Torridge District Council, 2014).

Barnstaple is the main focus of employment in the area, with Petroc providing the main opportunities for further and higher education within northern Devon (NDC and Torridge District Council, 2014). Petroc is 300m west of flood cell F. Areas for employment within the flood cells include Pottington Business Park, Barnstaple Retail Park and Barnstaple town centre.

4 Impact appraisal

This section describes the outcomes of the environmental appraisal. It summarises of the key potential environmental risks and benefits associated with each of the project options (see Section 2). The results of the appraisal are set out using an appraisal table for each of the flood cells (Table 4-1 to **Error! Reference source not found.**), which considers the potential effects of each option against the environmental baseline.

Table 4-1: Potential key environmental issues in flood cell A associated with flood defence options

		Assessment summary				
Environmental aspect	**Notable feature**	**Raise A361**	**Raise embankment around Bradiford Reserve**	**PLP in Meadow Road**	**Repair existing tidal defences**	**Do nothing**
Biodiversity and nature conservation	Designated sites	This option is 130m from the boundary of the Taw-Torridge Estuary SSSI and BAP habitat and therefore carries a low risk of adversely affecting the special features of the SSSI. This option would, however, include construction on two Key Network Features and potentially a Key Network Site. Therefore, important habitat connectivity features that may serve the SSSI could disappear and have a potential damaging effect on the features of the SSSI. Construction best practice and seasonal constraints would need to be applied during construction to avoid a significant negative effect on the features of the SSSI, key network features and protected species.	The southern end of the embankment borders the Taw-Torridge Estuary SSSI, a Key Network Feature and Key Network Site and the whole length borders Bradiford Reserve. There is a risk that construction of an embankment would result in the permanent loss of an area of SSSI and Bradiford Nature Reserve. Construction best practice and seasonal constraints would need to be applied during construction to avoid a significant effect on the features of the SSSI, Bradiford Reserve and Key Network Sites and Features. This option is unlikely to affect Bradiford Valley SSSI, as it will not change the level of flood risk to the SSSI. There is the opportunity to enhance biodiversity within Bradiford Reserve, such as introducing bat and bird boxes, and creating areas for otters.	PLP in Meadow Road is unlikely to have an effect on any biodiversity features as habitat is not expected to be impacted by PLP measures. PLP also does not provide an opportunity for biodiversity enhancement.	There is potential for a negative effect on the special features of the SSSI that borders the River Taw. Risks arise from potential for habitat loss, damage to rare plants and disturbance to over wintering birds. Also along this front are Key Network Features and Sites, which could be damaged by this option. Construction of sea defences or coastal protection works are prohibited within the SSSI as they could cause damage to the special features of the SSSI. Any loss of habitat within and bordering the SSSI should be kept to an absolute minimum, with construction best practice and seasonal constraints applied to avoid significant negative effect on the features of the SSSI.	Doing nothing could provide benefit to biodiversity by providing more space for important SSSI habitat to migrate to as a result of climate change, thereby reducing coastal squeeze. This would also benefit the BAP habitats present in the river channel. Bradiford Reserve is affected by flooding currently, as it is allowed to flood, therefore no effect is anticipated. However, doing nothing could lead to more flooding of urban areas, such as Pottington Business Park. As such flooding is more likely to increase the risk of contaminants entering the river, for example household waste, chemicals, garden products, pesticides, household cleaners, etc. These could have a pronounced impact on water quality and aquatic ecology. Rivers are a BAP habitat and this option could present a risk to this habitat through potential increased pollution. This option is unlikely to affect Bradiford Valley SSSI as it will not change the flood risk to the SSSI.
	BAP habitat	Although this option is unlikely to undertake construction on BAP habitat, construction of this option has the potential to result in the permanent loss of habitat and could conflict with the objectives of the draft Local Plan, which states that “all development will be expected to provide a net gain in biodiversity.” This loss of	The southern end of the embankment borders mudflat BAP habitat. There is a risk that construction of an embankment would result in the permanent loss of BAP habitat and cause damage and disturbance to a wider area of habitat outside of the proposed embankment, including in the nature reserve.		Repairing existing tidal defence has the potential to risk BAP mudflats within the River Taw during construction. There is a risk to the habitat that the existing defence may have created through construction. Construction risks would need to be carefully managed through the	

Assessment summary						
Environmental aspect	**Notable feature**	**Raise A361**	**Raise embankment around Bradiford Reserve**	**PLP in Meadow Road**	**Repair existing tidal defences**	**Do nothing**
		habitat should be kept to an absolute minimum. There is a risk that construction could lead to a reduction in water quality, which has been identified as a pressure and risk to BAP habitats within the Devon BAP.	Construction activities associated with this option carries the potential to adversely affect the water quality and ecology of the river, as construction materials could be released into the river and construction could encroach into the river channel. Water quality has been identified as a pressure and risk to BAP habitats within the Devon BAP.		application of construction best practice. Repairing existing tidal defence has the potential to risk biodiversity features along the bank of the River Taw during construction. This option would also exacerbate the coastal squeeze pressure that is occurring to BAP habitat, according to the Devon BAP.	
	Notable species	There are protected species found in this area, including wetland bird species associated with the SSSI (Figure 3-3). There is also the potential to affect otter in particular, as they would be affected by removing connecting habitat. Construction best practice and seasonal constraints would need to be applied during construction to avoid a significant negative effect on the protected species. There is potential to benefit otter through creating otter holts and ledges under the raised A361 bridge.	A number of protected bird species have been identified in this area, and this option has the potential to cause damage to the species and their habitat. This includes over wintering birds. As such seasonal constraints may be required during construction. The loss of habitat should be kept to an absolute minimum. There is also a risk that trees would be felled for this option, creating a risk of an adverse effect to bat species. However, the use of an embankment structure could offer an opportunity to create new riverine habitat that could benefit a range of aquatic and terrestrial ecology. Consideration should be given as to how to increase the wildlife value of the embankment structure.		This option presents a potential risk to protected species, which could be disturbed by construction practices or potential habitat loss. There is the potential for enhancement opportunities, such as introducing otter holts and / or bird nesting tubes within the defence.	

Assessment summary						
Environmental aspect	**Notable feature**	**Raise A361**	**Raise embankment around Bradiford Reserve**	**PLP in Meadow Road**	**Repair existing tidal defences**	**Do nothing**
Historic environment	Scheduled monuments	There are no heritage features within the A361 region, therefore raising the embankment is not anticipated to have a significant effect on the historic environment of Barnstaple. There are two archaeological monuments present on the river bank close to the A361. Construction best practice would need to be applied to avoid a significant negative effect on these archaeological features.	There are no heritage features in this area, therefore it is unlikely that constructing a flood defence in this area will have a significant negative effect on Barnstaple's historic environment.	There are no scheduled monuments within 500m of Meadow Road, therefore PLP measures will not have any effects on scheduled monuments.	There only heritage features along the tidal defences are four archaeological monuments within or on the bank of the River Taw. Construction best practice would need to be applied to avoid a negative effect on these archaeological features.	There are no scheduled monuments within flood cell A, therefore no effects are anticipated from this option.
	Listed buildings			There are no listed buildings along Meadow Road, however there are three listed buildings within 30m from Meadow Road, including Bradiford Bridge. There is a risk that of permanent adverse effects arising from the type of PLP measures along Meadow Road, however, these are unlikely to be significant as PLP measures are small scale. There is a low risk that temporary adverse effects on the setting of the listed buildings may arise during installation of the PLP measures due to construction activities.		There are two listed buildings at the very edge of flood cell A, along Bradiford Road. There is a risk that this option will cause an increased risk of flooding of the listed buildings.
	Conservation areas			Meadow Road borders the Pilton conservation area, therefore PLP measures have the potential to have a negative visual effect on views from and to the conservation area, which may affect the historic character of the area. This is likely to be a low risk, as PLP measures are small scale and generally do not affect the overall fabric of a building.		A small portion of the Pilton conservation area is within flood cell A, and therefore could suffer an increased risk of flood damage as a result of this option.
	Historic Environment Record			There are no archaeological monuments along Meadow Road, therefore PLP		There are some archaeological monuments within flood cell A

Assessment summary						
Environmental aspect	**Notable feature**	**Raise A361**	**Raise embankment around Bradiford Reserve**	**PLP in Meadow Road**	**Repair existing tidal defences**	**Do nothing**
				measures, which are small scale, are not anticipated to have an effect.		that may be negatively affected by flooding.
Water environment	Surface water	Construction of the raised A361 does not extend into the river channel, however construction materials have the potential to be released to surface water and into the River Taw. There is a risk that these could negatively affect the ecology of the river, which would conflict with the WFD objectives for the Taw-Torridge estuary. Any development proposals that could affect the estuary will need to demonstrate no deterioration in the status of the water body and should work towards helping achieve its status objective.	Construction of a raised embankment has the potential to release construction materials to surface water into the River Taw and Bradiford Water and therefore presents a risk to water quality. These could negatively affect the ecology of the River Taw, which would conflict with the WFD objectives for the Taw-Torridge estuary. Construction best practice would need to be implemented to minimise this risk. Any development proposed would need to demonstrate no deterioration in the status of the water body and should work towards helpings it achieve its status objective.	There is a very low risk that PLP along Meadow Road will affect surface water as PLP measures are small scale.	There is a potential risk that construction for repairs of the existing tidal defences could have a negative effect on surface water due to release of construction materials, particularly along the bank of the River Taw. These materials have the potential to negatively affect the ecology and create a risk to WFD compliance. Construction best practice would need to be implemented to minimise this risk. Any significant repair works proposed would need to demonstrate no deterioration in the WFD status of the waterbody. There is an opportunity to undertake bank rehabilitation during repair, which is identified as a mitigation measure in the RBMP. Benefits may arise from the increased flood protection this option would provide, which would see a reduction in the risk of water contamination as a result of urban flooding.	As with biodiversity, doing nothing will lead to more flooding of urban areas, and as such increase the likelihood of contaminants entering the river, therefore decreasing the surface and groundwater quality. This option provides the opportunity to assist with the managed realignment mitigation measure identified in the RBMP, however the realignment would not be managed.
	Groundwater	Construction of this option poses a low risk to groundwater from the potential for release of construction materials. This risk is	Construction activities present a low risk to groundwater, through potential for contamination from construction materials.	No effects on groundwater are anticipated.	Construction activities present a risk to groundwater, through contamination from construction materials. Significant improvements to	

Assessment summary						
Environmental aspect	**Notable feature**	**Raise A361**	**Raise embankment around Bradiford Reserve**	**PLP in Meadow Road**	**Repair existing tidal defences**	**Do nothing**
		increased if this option involves breaking ground.			the tidal defences would need to demonstrate no deterioration in the WFD status of the waterbody.	
	Water resources	There is a low risk that construction of the flood defences could affect any surface water or private discharges into watercourses. However, the works also offer an opportunity to consolidate and better regulate any such discharges and inclusion of pollution control measures could have a positive effect on water quality in the estuary.		No effects on water resources are anticipated.	There is a low risk that construction of the flood defences could affect any surface water or private discharges into watercourses. However, the works also offer an opportunity to consolidate and better regulate any such discharges and inclusion of pollution control measures could have a positive effect on water quality in the estuary.	No effects on water resources are anticipated.
Landscape and visual amenity	Landscape character	This option has the potential to negatively affect Barnstaple's landscape character by increasing the height of the road, which will further affect views within Barnstaple and increase the division between Pottington and the rest of Barnstaple. The embankment would have a negative effect on the open character of the area and estuary.	The raised embankment could have a negative effect on landscape character by disrupting views from Pottington Business Park to Bradiford Water, and also by differing from the existing flood plain character of the area.	This option is unlikely to have an effect on landscape character because PLP measures will be small scale.	This option is will have an effect on landscape character if the defences are raised, as it will affect the open character of the area and estuary. However, the option may not be significant due to the defences already being part of the landscape character.	This option could have a positive effect on landscape character as it could enhance the open and natural character of the Taw estuary through a reduction in height of flood defences. However, there is potential for adverse effects as damage to property will have a negative effect on the view and existing character of Barnstaple.
Contaminated land		There is a risk that construction activities (particularly raising the A361) could lead to the mobilisation of contaminated materials in the ground, which could affect surface water and groundwater quality. However, construction of the flood defences could offer an opportunity to remediate any ground contamination present in the scheme area.				Effects on contaminated land are not anticipated.
Air quality		There is a risk that construction activities could have a temporary adverse effect on local air quality.				Effects on air quality are not anticipated.
Noise		There is a small risk that construction activities could have a temporary adverse effect on noise levels in the area, particularly around Bradiford Reserve. However, since the A361 is likely to be an area of high noise levels due to the relatively high levels of traffic on the road, negative effects from construction are likely to be negligible.				Effects on noise levels are not anticipated.

Environmental aspect	Notable feature	Assessment summary				
		Raise A361	Raise embankment around Bradiford Reserve	PLP in Meadow Road	Repair existing tidal defences	Do nothing
Population and local community		The flood defences will provide increased protection from flooding for the community, therefore having a permanent positive effect. These effects will reduce the risk of health related effects from flooding on the local population, for example by reducing the risk of stress caused by flooding. The local community will also have less risk of financial implications from flooding. There could be an adverse effect on population if the South West Coast Path is damaged or closed during repair of the coastal defences. However, if mitigation measures are put in place and the path is kept open, the disruption effects are likely to be low.				This option will have a significant negative effect as it will increase the risk of flooding on the local community. There will be further negative effects on the local community through potential health effects resulting from flooding, including stress. Flooding will also increase financial stress for the local population. There is potential for an adverse effect as the South West Coast Path may have to close for safety reasons as the defences deteriorate, and may not be reinstated.
Local economy		These options, particularly Option 1, 2 and 4, will provide permanent increased flood protection for flood cell A, protecting Pottington Business Park and the A361 which provides transport links. Therefore, there is a significant positive effect from these options.				Pottington Business Park would have a significant risk of flooding, therefore this option has a significant adverse effect on the local economy.

Table 4-2: Potential key environmental issues in flood cell B associated with flood defence options

Assessment summary									
Environmental aspect	**Notable feature**	**Raise A361**	**Increase height of flood wall at Rolle Quay**	**Increase parapet of Rolle Street bridge**	**Barriers/gate on Rolle Street bridge**	**Piling through Pilton Park**	**Re-routing of Yeo along A39**	**Repair existing defences**	**Do nothing**
Biodiversity and nature conservation	Designated sites	See flood cell A assessment.	Increasing the height of the flood wall is unlikely to significantly affect designated sites as construction will be on urban land. However, the western end of Rolle Quay does border the Taw-Torridge estuary SSSI. Therefore there is a potential risk that construction could damage the features of the SSSI.	Increasing the height of the parapet along Rolle Street bridge is unlikely to have an effect on biodiversity as all construction is small scale and will take place on already disturbed, hardstanding ground.	This option is dependent on the location and size of the barrier. If the barrier is installed at the eastern end of the bridge, there is a risk to the grass verge and trees in this area. However, the loss of this vegetation is unlikely to have significant negative effect due to the small scale of the option. There are also no designated sites, BAP habitat or Key Network Features or Sites that would be affected by this option.	The river bank in Pilton Park is a Key Network Site, therefore is of biodiversity importance for habitat connectivity. Construction best practice would need to be implemented to avoid adverse effects on features of the habitat, as there is potential to transport contaminants from construction materials and ground contamination through piling activities to the River Yeo and downstream to the Taw-Torridge SSSI.	Re-routing the Yeo along the A39 through Pilton Park would have a significant negative effect on biodiversity, as Key Network Features will be permanently lost by filling in the old river channel. Construction best practice would also be required to avoid the risk of adverse effects on the surrounding environment, including carrying contaminants downstream to the SSSI. There may be effects to the Taw-Torridge SSSI through a change in ecology and morphology of this section of river.	Repairing existing defences is unlikely to have a significant effect on biodiversity, as there are no designated sites likely to be affected. Construction best practice would also be required to avoid the risk of adverse effects on the surrounding environment.	Doing nothing could provide benefit to biodiversity by providing more space for important SSSI habitat to migrate to as a result of climate change and coastal squeeze. This would also benefit the BAP habitats present in the river channel. However, doing nothing will lead to more flooding of urban areas and as such flooding is more likely to increase the risk of contaminants entering the river, for example household waste, chemicals, garden products, pesticides, household cleaners, etc. These could have a pronounced impact on water quality and aquatic ecology.
	BAP habitat		Although this option will not encroach on BAP habitat, there is a low risk of adverse effects to the BAP habitat within the River Yeo, from the potential for release of construction materials. Water quality has been identified as a pressure and risk to BAP habitats within the Devon BAP.			Coastal saltmarsh, a BAP habitat, is present along the river bank around Pilton Park, therefore piling would have a negative effect on this environment, by encroaching on and damaging this habitat.	Re-routing the Yeo along the A39 through Pilton Park would have BAP habitat as it will be permanently lost by filling in the old river channel. This option may also worsen the effects of climate change on estuarine habitats by reducing the amount of river habitat (exacerbating coastal squeeze) and constructing a channel	This option does carry the risk to BAP habitat, particularly if construction encroaches into the river. Construction best practice would be required to avoid the risk of adverse effects on the surrounding environment.	

Environmental aspect	Notable feature	Assessment summary: Raise A361	Increase height of flood wall at Rolle Quay	Increase parapet of Rolle Street bridge	Barriers/gate on Rolle Street bridge	Piling through Pilton Park	Re-routing of Yeo along A39	Repair existing defences	Do nothing
							with hard engineering. This is a pressure that has been identified in the Devon BAP, therefore opportunities to mitigate against coastal squeeze should be pursued. Water quality is also at risk of being negatively affected by this option, which could damage the BAP habitat outside of the construction zone.		
	Notable species		Otter have been identified in this region of the River Yeo, and therefore construction best practice and seasonal constraints will be required to avoid significant negative effect upon otter. It is likely that protected species surveys will also be required. This option is unlikely to offer opportunity for enhancements such as otter holts, however consideration should be given to mitigating any risks that may be presented from this option to otter.			Vibration from piling can affect aquatic features in the river, most notably migratory fish species, birds and otter. Otter have been observed in the River Yeo, therefore this option presents a risk to otter. There is also a risk that trees would be felled for this option, creating a risk of an adverse effect to bat species.	This option has potential to significantly adversely affect notable species within the river, as it could cause loss of the habitat utilised by species such as otter. There is also potential for a negative effect on migratory fish species. During creation of the new river bank, options for habitat creation and implementation of other biodiversity enhancements such as otter holts and bird nesting tubes should be considered. There is also a risk that trees would be felled for this option, creating a risk of an	There is a low risk that construction activities could have an adverse effect on notable species within the river. Construction best practice and seasonal constraints may be required to avoid the risk of adverse effects on the surrounding environment.	

Environmental aspect	Notable feature	Assessment summary: Raise A361	Increase height of flood wall at Rolle Quay	Increase parapet of Rolle Street bridge	Barriers/gate on Rolle Street bridge	Piling through Pilton Park	Re-routing of Yeo along A39	Repair existing defences	Do nothing
							adverse effect to bat species.		
Historic environment	Scheduled monuments	See flood cell A assessment.	There is low risk of temporary adverse effects on the setting of the Castle Mount, as the construction zone may be visible from the scheduled monument. It is unlikely that there will be permanent effects as the wall is unlikely to be raised to a height that would affect the setting of the Castle Mount, and the two areas are relatively well screened from each other by trees. This option provides the opportunity to ensure that the design of the flood wall is appropriate for the scheduled monument to avoid significant adverse effects.	These options are unlikely to affect the setting of Castle Mount, as the bridge is unable to be viewed from the Scheduled Monument due to intervening urban development.		No effects on scheduled monuments are anticipated as the closest is Castle Mount, from which these options are unable to be viewed due to intervening urban development.		There are no Scheduled Monuments within flood cell B, therefore this option is unlikely to have effects on Scheduled Monuments. However, there may be temporary adverse effects from this option along Rolle Quay, as for the option which increases the height of the flood wall along the quay.	A small portion of two conservation areas are within flood cell B (Town Centre and Pilton). These small areas would be at increased risk of flooding with this option, therefore this option has the potential to damage the historic setting of the conservation area and any important heritage assets that may be present. There are no listed buildings, scheduled monuments within flood cell B, therefore no effects are anticipated. There are a few archaeological monuments within the flood cell, however these are the wet side of the defences, therefore unlikely to experience an effect different
	Listed buildings		There is a risk of temporary adverse effects during construction on the setting of The Boathouse listed building on the	There is a risk of temporary adverse effects on the setting of the Boathouse listed building during	There is a risk of temporary adverse effects on the setting of the Boathouse listed building during construction.	There is potential for permanent and temporary adverse effects on the setting of listed buildings within the vicinity of the Pilton Park. Piling	There is potential for permanent and temporary significant adverse effects on the listed buildings in the area, particularly Pilton Bridge and	There is limited risk of temporary adverse effects from this option on listed buildings as there are none within the flood	

Environmental aspect	Notable feature	Assessment summary: Raise A361	Increase height of flood wall at Rolle Quay	Increase parapet of Rolle Street bridge	Barriers/gate on Rolle Street bridge	Piling through Pilton Park	Re-routing of Yeo along A39	Repair existing defences	Do nothing
			opposite bank. Permanent effects are unlikely as there will not be a significant change to the current setting.	construction. There is a risk that the parapets could cause an adverse effect on the historical setting of the boat house, as they are both highly visible from each other. However, there is an opportunity for this option to enhance the historic setting of the Boathouse by improving the quality of the design of the bridge.	Permanent effects are dependent on the design of the barrier. If it is hidden from view when not in use, it is unlikely to have significant negative effects on the Boathouse.	would be visible from the opposite bank, therefore from the listed buildings present on this bank.	Causeway south of Pilton Quay, including features within Pilton Park. These features may have to be removed as part of this option or will be at risk from a change of setting.	cell. There is a risk to two listed buildings which lie on the opposite bank of the River Yeo. These two are the Boathouse and a warehouse. There are unlikely to be significant permanent effects on these listed buildings.	from current effects.
	Conservation areas		There is a risk of temporary adverse effects during construction on the Barnstaple Town Centre conservation area. There is unlikely to be permanent effects as the river frontage would not be changing significantly.	There is a risk of temporary adverse effects on the Barnstaple Town Centre conservation area. Permanent effects on the conservation area are dependent on the design of the parapets, however this option provides the opportunity to enhance the design of the bridge, and therefore	There is a risk of temporary adverse effects during construction on Barnstaple Town Centre conservation area. Permanent effects are dependent on the design of the barrier. If it is hidden from view when not in use, it is unlikely to have significant negative effects on the conservation area.	There may be permanent and temporary adverse effects on the setting of conservation area which covers Pilton Park, particularly the river frontage.	This option will have a permanent negative effect on the historic setting of the conservation area, as it would change the river frontage from its historic setting.	Repairing existing defences has a potential for a temporary adverse effect on the setting of historic features during the construction phase due to a range of construction activities. This option is unlikely to have a significant permanent negative effect on the setting of the historic environment as	

Environmental aspect	Notable feature	Assessment summary: Raise A361	Increase height of flood wall at Rolle Quay	Increase parapet of Rolle Street bridge	Barriers/gate on Rolle Street bridge	Piling through Pilton Park	Re-routing of Yeo along A39	Repair existing defences	Do nothing
				contribute to the setting of the conservation area.				these defences are already part of the historic setting.	
	Historic Environment Record		It is unlikely that the archaeological monuments found along Rolle Quay will be affected as the raising of the wall will not break ground and therefore not disturb any remains.	These options are not anticipated to have any effects on archaeological monuments.		No effects are anticipated on known archaeological monuments, but there is a risk from this option of disturbing archaeology within the area. Construction best practice would need to be applied to avoid significant adverse effect.	No effects are anticipated on known archaeological monuments, but there is a risk from this option of disturbing archaeology within the area. Construction best practice would need to be applied to avoid significant adverse effect.	It is unlikely that there will be adverse effects on archaeological monuments as they are limited within flood cell B. However, care should be taken to avoid potential disturbance to unknown archaeological monuments.	
Water environment	Surface water	See flood cell A assessment.	There is potential that construction of the flood wall would have adverse effects on water quality due to the release of construction materials.	Construction of the bridge parapet has the potential to risk water quality due to the release of construction materials.	Construction of the barriers could have adverse effects on water quality due to the release of construction materials.	Construction of new sheet piles within the river channel has the potential to adversely affect the ecology and hydromorphology of the river. Any development proposals that could affect the River Yeo will need to demonstrate no deterioration in the status of the waterbody and should work towards helping it achieve its status objective. In addition, construction of the flood defence structure could have temporary and	Construction of a new river channel would affect the ecology and hydromorphology of the river. These effects could conflict with the WFD objectives for the water body. Modifying the river channel could lead to the deterioration of the WFD status of the River Yeo and could lead to it being designated as a HMWB. Any development proposals that could affect the River Yeo will need to demonstrate no deterioration in the	Construction could have adverse effects on water quality due to the release of construction materials.	As with biodiversity, doing nothing will lead to more flooding of urban areas, and as such increase the likelihood of contaminants entering the river, therefore decreasing the surface water quality.

Environmental aspect	Notable feature	Assessment summary: Raise A361	Increase height of flood wall at Rolle Quay	Increase parapet of Rolle Street bridge	Barriers/gate on Rolle Street bridge	Piling through Pilton Park	Re-routing of Yeo along A39	Repair existing defences	Do nothing
						permanent impacts on water quality due to the release of contaminating construction materials or the mobilisation of ground contamination.	status of the water body and should work towards helping achieve its status objective. In addition, construction of this structure could have temporary and permanent negative effects on water quality due to the release of construction materials or the mobilisation of ground contamination.		
	Groundwater	See flood cell A assessment.	No effects are anticipated.	No effects are anticipated.	No effects are anticipated.	There is potential for the piling to release contaminants into groundwater during construction. This is a particular risk should long piles be used.	There is potential release contaminants from construction and existing ground contamination into groundwater during construction.	No effects are anticipated.	No effects are anticipated.
	Water resources	See flood cell A assessment.				There is a low risk that construction of this option could affect surface water or private discharges into the estuary. However, the works also offer an opportunity to consolidate and better regulate any such discharge and inclusion of pollution control measures could have a positive effect on water quality in the estuary.	There is a risk that construction of this option could affect surface water or private discharges into the estuary. However, the works also offer an opportunity to consolidate and better regulate any such discharge and inclusion of pollution control measures could have a positive effect on water quality in the estuary.	No effects are anticipated.	No effects are anticipated.

Environmental aspect	Notable feature	Assessment summary: Raise A361	Increase height of flood wall at Rolle Quay	Increase parapet of Rolle Street bridge	Barriers/gate on Rolle Street bridge	Piling through Pilton Park	Re-routing of Yeo along A39	Repair existing defences	Do nothing
Landscape and visual amenity	Landscape character	See flood cell A assessment.	The increase in height of the flood wall has the potential to have a permanent adverse effect on the landscape character, as it may prevent views over the wall into Barnstaple town centre, and will increase the separation of the town from Rolle Quay.	The increase in height of the parapet may have a permanent adverse effect on the landscape character, as it may prevent views over the wall, therefore diminishing the open character of the area. Sensitive design should be considered to reduce the adverse effects.	The installation of a barrier has the potential to have permanent negative effect on landscape character by disrupting the visual amenity of the area. Sensitive design should be considered to reduce the adverse effects.	Piling carries a risk of significant adverse effects on the landscape character and visual amenity of the area, particularly as it would surround a park and a natural river bank.	Re-routing will have a significant negative effect on landscape character as it will be a significant change from the natural course of the river to an artificial structure and would cause the loss of an open space.	Repairing the existing defences is unlikely to have a significant effect on landscape character as this option does not significantly differ from the character of the existing defences.	This option could improve views between flood cell B and Barnstaple town centre. However, there is a risk that flooding will cause damage to buildings, thus negatively affecting the urban landscape character of Barnstaple.
Contaminated land		See flood cell A assessment.	There is a risk that construction activities (particularly the use of sheet piles and re-routing) could lead to the mobilisation of contaminated materials in the ground, which could affect surface water and groundwater quality. However, construction of the flood defences would offer an opportunity to remediate any ground contamination present in the area.						No effects are anticipated.
Air quality		See flood cell A assessment.	There is a risk that construction activities could have a temporary adverse effect on local air quality.						No effects are anticipated.
Noise		See flood cell A assessment.	There is a risk that construction activities could have a temporary adverse effect on local noise levels. The installation of the sheet piles could have a significant negative effect on the local noise environment.						No effects are anticipated.
Population and local community		See flood cell A assessment.	The flood defences will provide increased protection from flooding for the community, therefore having a permanent positive effect. These effects will reduce the risk of health related effects from flooding on the local population, for example by reducing the risk of stress caused by flooding. The local community will also have less risk of financial implications from flooding.				This could have a negative effect on the population that make use of Pilton Park, as it will reduce the amount of greenspace available in Barnstaple. There is also no flood risk benefit from this option, therefore it will not benefit the local	The flood defences will provide increased protection from flooding for the community, therefore having a permanent positive effect. These effects will reduce the risk of health related	This option will have a significant negative effect as it will increase the risk of flooding on the local community. An increase of flooding will have a negative effect on the local community

Environmental aspect	Notable feature	Assessment summary							
		Raise A361	Increase height of flood wall at Rolle Quay	Increase parapet of Rolle Street bridge	Barriers/gate on Rolle Street bridge	Piling through Pilton Park	Re-routing of Yeo along A39	Repair existing defences	Do nothing
							population by reducing the risk of flooding. However, there is an opportunity to increase the amount of green space by infilling the channel and creating a new, larger green space. The existing flood embankment will therefore be redundant, therefore providing more area for the green space.	effects from flooding on the local population, for example by reducing the risk of stress caused by flooding. The local community will also have less risk of financial implications from flooding.	through potential health effects resulting from flooding, including stress. Flooding will also increase financial stress for the local population.
Local economy		See flood cell A assessment.	The flood defences will provide increased protection from flooding for the commercial areas of Barnstaple.				No effects on the local economy are anticipated at this stage, as it is unknown what the land created from the re-routing will be used for.	The flood defences will provide increased protection from flooding for the commercial areas of Barnstaple.	This option will have a significant negative effect as it will increase the risk of flooding on commercial properties.

Table 4-3: Potential key environmental issues in flood cell C associated with flood defence options

		Assessment summary				
Environmental aspect	**Notable feature**	**Re-routing of Yeo along A39**	**Raise Raleigh Road standard**	**Increased standard along Castle Quay**	**Raise existing tidal defence**	**Do nothing**
Biodiversity and nature conservation	Designated sites	See flood cell B assessment.	There are no designated sites or species along Raleigh Road, therefore there is a low risk to biodiversity from increasing the flood defences. Risk does arise from construction materials being released into the environment, particularly the River Yeo, where pollutants could be carried downstream to the Taw and affect the SSSI and BAP habitats. Risk arises to river ecology from the installation of the culverts below the bridge, and could result in the permanent loss of river bed and bank habitat. Construction best practice and seasonal constraints would need to be applied during construction to avoid adverse effects on the aquatic ecology.	The northern end of Castle Quay is approximately 20m from the edge of the Taw-Torridge SSSI. Therefore, there is a risk that these options could cause disturbance and damage to a wider area of habitat outside of the footprint of the defence, including the SSSI. Construction best practice and seasonal constraints would need to be applied during construction to avoid a significant effect on the features of the SSSI and riverbed.		Doing nothing will lead to more flooding of urban areas and as such flooding is more likely to increase the risk of contaminants entering the river, for example household waste, chemicals, garden products, pesticides, household cleaners, etc. These could have a pronounced impact on water quality and aquatic ecology.
	BAP habitat			There is also a risk that the new defence will encroach onto the riverbed, which is designated as BAP habitat, intertidal substrate foreshore. Construction of defences in this area would result in the permanent loss of an area of BAP habitat. This option may worsen the effects of climate change on inter-tidal habitats by exacerbating the risk and extent of coastal squeeze in this location. Without provision of adequate mitigation to ensure coastal squeeze effects are addressed through the development process, this option would conflict with a range of biodiversity policies.		
	Notable species			There are notable species present along Castle Quay, including the common kingfisher and common sandpiper. Construction of these option are likely to have similar effects on the species and therefore both have the potential to disturb these species. However, there is opportunity for biodiversity enhancements, such as the introduction of sandpiper nesting tubes in the flood defence.		
Historic environment	Scheduled monuments	See flood cell B assessment.	There are no listed buildings, archaeological or scheduled monuments along Raleigh Road, or along the opposite bank. The western end of Raleigh Road does border Pilton conservation area, so temporary effects may arise from disturbance from construction, but there is unlikely to be any significant permanent effects on the setting of Pilton conservation area from this option as structure are likely to be within the river channel, and therefore unable to be viewed from the conservation area.	Castle Mount is less than 100m from the line of defence along Castle Quay. There is a risk of temporary adverse effects on the setting of Castle Mount during construction, and there are also permanent risks on the setting of Castle Mount as the defences are visible from the scheduled monument. There are positive effects from increasing the standard of defences along Castle Quay, as it will increase protection from flooding to Castle Mount.	Raising existing defences may have an effect on the historic setting of Barnstaple, both permanent and temporary. The defences are visible from Castle Mount, listed buildings and conservation area, so the significance of the effect is dependent on the height and design of the defences. There are positive effects arising from this option, as it will increase the protection from flooding to Barnstaple.	There is a significant negative effect on Barnstaple's historic environment, as there is the Town Centre conservation area, many listed buildings and a scheduled monument, as well as many archaeological monuments. These would all have a greater risk of flooding and, as a result, damage to the historic assets.

Environmental aspect	Notable feature	Assessment summary: Re-routing of Yeo along A39	Raise Raleigh Road standard	Increased standard along Castle Quay	Raise existing tidal defence	Do nothing
	Listed buildings			Castle Quay is itself listed, along with a number of other buildings along the river front. There is a risk of permanent effects on the setting of these buildings as the flood defence structure would be visible from them. There are also temporary risks during construction, which would disturb the setting of these buildings. This option will have a positive effect as it will increase the flood protection for the listed buildings.		
	Conservation areas			Castle Quay is within Barnstaple-Town Centre conservation area, therefore new flood defences structures could have both permanent and temporary visual effects on the conservation area, affecting several important views. These effects may be negative as the flood defences could affect the existing historic urban character of the riverside frontage. There could be some effect for pedestrians entering/exiting the conservation area, particularly by Castle Mount.		
	Historic Environment Record			There are archaeological monuments present along Castle Quay, therefore construction has the potential to disturb these and others that may be present. Construction best practice would need to be applied to avoid significant adverse effect.	There are archaeological monuments present along the line of the tidal defences, however, repair to the existing defences is unlikely to disturb these. Construction best practice would need to be applied to avoid adverse effect to any archaeological monuments present in the vicinity.	

Environmental aspect	Notable feature	Assessment summary: Re-routing of Yeo along A39	Raise Raleigh Road standard	Increased standard along Castle Quay	Raise existing tidal defence	Do nothing
Water environment	Surface water	See flood cell B assessment.	Construction of the culverts could extend into the River Yeo. Construction within the river channel has the potential to negatively affect the ecology and hydromorphology of the river. These effects could conflict with the WFD objectives for the water body. Any development proposals that could affect the River Yeo, and the Taw-Torridge estuary further downstream, will need to demonstrate no deterioration in the status of the water bodies and should work towards helping achieve the status objectives. In addition, construction of the culverts could have temporary and permanent effects on water quality due to the release of construction materials or the mobilisation of ground contamination.	Construction of this option should not extent into the River Taw, however construction materials have the potential to be released to surface water. These could negatively affect the ecology of the river, which would conflict with the WFD objectives for the Taw-Torridge estuary. This option is also in conflict with the recommended mitigation measures for the Taw-Torridge estuary listed in the RBMP, particularly the requirement to remove hard bank reinforcements. Any development proposals that could affect the estuary will need to demonstrate no deterioration in the status of the water body and should work towards helping its status objective.	Construction of this option should not extend into the river channel, however construction materials have the potential to be released to surface water. These could negatively affect the ecology of the river, which would conflict with the WFD objectives for the Taw-Torridge estuary and other water bodies. This option is also in conflict with the recommended mitigation measures for the Taw-Torridge estuary listed in the RBMP, particularly the requirement to remove hard bank reinforcements. Any development proposals that could affect the water bodies will need to demonstrate no deterioration in the status of the water body and should work towards helping its status objective.	As with biodiversity, doing nothing will lead to more flooding of urban areas, and as such increase the likelihood of contaminants entering the river, therefore decreasing the surface water quality. This option could assist in the achievement of the GEP, as it could enhance the ecological value of banks and riparian zone.
	Groundwater		This option could involve disturbance to groundwater through the installation of culverts, therefore there is potential for the release of contaminants into groundwater during construction.	No effects to groundwater are anticipated.		
	Water resources		There is a risk that construction could affect any surface water or private discharges into watercourses. However, the works also offer an opportunity to consolidate and better regulate any such discharge and inclusion of pollution control measures could have a positive effect on water quality in the estuary.	There is a low risk that construction of the flood defences could affect any surface water or private discharges into watercourses. However, the works also offer an opportunity to consolidate and better regulate any such discharges and inclusion of pollution control measures could have a positive effect on water quality in the water bodies.		No effects to water resources are anticipated.

Environmental aspect	Notable feature	Assessment summary: Re-routing of Yeo along A39	Raise Raleigh Road standard	Increased standard along Castle Quay	Raise existing tidal defence	Do nothing
Landscape and visual amenity	Landscape character	See flood cell B assessment.	There is a low risk that this option will negatively affect Barnstaple's landscape character as Raleigh Road does not have any significant features. There is risk that a flood defence will be built to a height that would disrupt views of the river, negatively affecting the open space character of the landscape and increase the division between the town and river.	Increase in the height of defences has the potential to have a significant negative effect on landscape character and visual amenity of Barnstaple, particularly along Castle Quay, as currently there is are no visual barriers between the quay and the river. Raising defences may prevent views towards the river from Barnstaple, of which there are a couple of key views, and also towards Barnstaple from the opposite bank. Sensitive design should be considered to reduce the adverse effects.		This option could positively influence landscape character as it could increase views within Barnstaple and decrease the separation between the town centre and the River Taw. However, there could be a significant negative effect on landscape character due to increased risk of flood damage.
Contaminated land		See flood cell B assessment.	There is a risk that construction activities (particularly the installation of culverts) could lead to the mobilisation of contaminated materials in the ground, which could affect surface water and groundwater quality. However, construction of the flood defences would offer an opportunity to remediate any ground contamination present within the area.			No effects are anticipated.
Air quality		See flood cell B assessment.	There is a risk that construction activities could have a temporary adverse effect on local air quality.			No effects are anticipated.
Noise		See flood cell B assessment.	There is a risk that construction activities could have a temporary adverse effect on local noise levels.			No effects are anticipated.
Population and local community		See flood cell B assessment.	The flood defences will provide increased protection from flooding for the community, therefore having a permanent positive effect. These effects will reduce the risk of health related effects from flooding on the local population, for example by reducing the risk of stress caused by flooding. The local community will also have less risk of financial implications from flooding.	The flood defences will provide increased protection from flooding for the community, therefore having a permanent positive effect. These effects will reduce the risk of health related effects from flooding on the local population, for example by reducing the risk of stress caused by flooding. The local community will also have less risk of financial implications from flooding. Construction of these options could affect the PRoW that runs along the riverfront at Castle Quay towards the Long Bridge. Mitigation measures should be undertaken to avoid disruption to the footpaths.		This option will have a significant negative effect as it will increase the risk of flooding on the local community. An increase of flooding will have a negative effect on the local community through potential health effects resulting from flooding, including stress. Flooding will also increase financial stress for the local population.

Environmental aspect	Notable feature	Assessment summary				
		Re-routing of Yeo along A39	Raise Raleigh Road standard	Increased standard along Castle Quay	Raise existing tidal defence	Do nothing
Local economy		See flood cell B assessment.	The flood defences will provide increased protection from flooding for the commercial areas of Barnstaple, particularly from the improved defences along Castle Quay protecting Barnstaple town centre.			This option will have a significant negative effect as it will increase the risk of flooding on commercial properties, particularly as this flood cell includes the town centre, which contains much of Barnstaple's commercial activity.

Table 4-4: Potential key environmental issues in flood cell D associated with flood defence options

Environmental aspect	Notable feature	Assessment summary: Replace existing defences to meet design standard	Assessment summary: Do nothing
Biodiversity and nature conservation	Designated sites	There are unlikely to be effects from construction on the Taw-Torridge SSSI and Yeo Valley Woodland due to distance. There is a Key Network Site present along the line of the defence, therefore construction of a new defence could cause permanent loss of habitat that provides important habitat connectivity within the area. Notable species such as the little grebe and common frog have been observed along this line of defence, therefore disturbance to vegetation may result in a loss of habitat for these notable species.	Doing nothing will lead to more flooding of urban areas and as such flooding is more likely to increase the risk of contaminants entering the river, for example household waste, chemicals, garden products, pesticides, household cleaners, etc. These could have a pronounced impact on water quality and aquatic ecology. Rivers are a BAP habitat and this option could present a risk to this habitat and designated sites downstream.
	BAP habitat		
	Notable species		
Historic environment	Scheduled monuments	There are no historic assets within the region of the flood defence line or within the flood cell, therefore no effect on historic environment is anticipated.	
	Listed buildings		
	Conservation areas		
	Historic Environment Record		
Water environment	Surface water	Construction could have permanent or temporary adverse effects on water quality due to the release of construction materials into the watercourse.	As with biodiversity, doing nothing will lead to more flooding of urban areas, and as such increase the likelihood of contaminants entering the river, therefore decreasing the surface water quality.
	Groundwater	No effects to groundwater are anticipated.	
	Water resources	No effects on water resources are anticipated.	
Landscape and visual amenity	Landscape character	Impact to landscape character is dependent on the design of the defences. An increase in height of defences may lead to a disconnection from the river as it could prevent views to the river. Sensitive design should be considered to reduce adverse effects.	Impacts to landscape character could occur through increased connection to the river, therefore helping preserve the open character of the area. However, negative effects to landscape character could occur through a deterioration in urban character through flood damage.
Contaminated land		There is a risk that construction activities could lead to the mobilisation of contaminated materials in the ground, which could affect surface water and groundwater quality. However, construction of the flood defences would offer an opportunity to remediate any ground contamination present within the area.	No effects are anticipated.

Environmental aspect	Notable feature	Assessment summary	
		Replace existing defences to meet design standard	Do nothing
Air quality		There is a risk that construction activities could have a temporary adverse effect on local air quality.	No effects are anticipated.
Noise		There is a risk that construction activities could have a temporary adverse effect on local noise levels.	No effects are anticipated.
Population and local community		The flood defences will provide increased protection from flooding for the community, therefore having a permanent positive effect.	This option will have a significant negative effect as it will increase the risk of flooding on the local community. An increase of flooding will have a negative effect on the local community through potential health effects resulting from flooding, including stress. Flooding will also increase financial stress for the local population.
Local economy		No effects are anticipated as this flood defence is protecting a residential area, not a commercial area.	This option will have a negative effect as it will increase the risk of flooding on commercial properties.

Table 4-5: Potential key environmental issues in flood cell E associated with flood defence options

Assessment summary							
Environmental aspect	**Notable feature**	**Improve defence standard including Rock Park**	**Improve defence standard excluding Rock Park**	**New walls at Coney Gut**	**New defences at Pill House**	**Removal of properties at risk**	**Do nothing**
Biodiversity and nature conservation	Designated sites	Taw-Torridge SSSI is 600m downstream the northern extent of flood cell E's defences, therefore it is unlikely that there will be significant adverse effects on the features of the SSSI. However, risk to the SSSI increases if construction of this option takes place within the river channel. Rock Park is a Key Network Site and also contains Key Network Features. Construction within Rock Park may cause a permanent loss of habitat within the Key Network Site, therefore having a negative effect on biodiversity.	The Key Network Site extends north of Rock Park, therefore will be affected by the construction of this option. Allowing flood storage in Rock Park may also damage the habitat within the Key Network Site, however this may not be significant as the park contains sport pitches which is amenity grassland that has little biodiversity value. The allowance for flood storage in this area creates the opportunity for habitat creation within Rock Park. This could potentially be inter-tidal habitat, allowing the features of the SSSI to extend into the area.	Coney Gut provides some Key Network Sites and Features, therefore there is potential that a new wall could cause permanent loss of habitat in these locations. There is unlikely to be an effect on designated sites, notable species or BAP habitat from this option as they are not present, however construction best practice would need to be implemented to avoid negative effects from the potential to transport contaminants within Coney Gut.	The area around Pill House and the substation is designated as a Key Network Site, therefore flood defences could cause the permanent loss of habitat that is important for habitat connectivity within Barnstaple.	No effects on biodiversity are anticipated from the removal of properties at risk. Surveys may be required to ensure that there are no protected species within these buildings, such as bats.	The BAP habitats present in the flood cell are not wetland habitats, therefore could be damaged from increased flood events, therefore having a negative effect on biodiversity. Conversely, other BAP habitat could benefit from doing nothing, such as the BAP habitats present in the River Taw, as it would allow them to increase in area and be less vulnerable to coastal squeeze. This could also benefit the SSSI. Doing nothing will also lead to more flooding of urban areas and as such flooding is more likely to increase the risk of contaminants entering the river, for example household waste, chemicals, garden products, pesticides, household cleaners, etc. These could have a pronounced impact on water quality and aquatic ecology. Rivers are a BAP habitat and this option could present a risk to this habitat and designated sites downstream.
	BAP habitat	The River Taw in this area has coastal saltmarsh BAP habitat. There would be a permanent adverse effect on the BAP habitat should the defences extend towards the river, but there is a risk of temporary negative effects on BAP habitat from release of construction materials, increasing pressure on water quality, which has	Although Rock Park will be excluded from construction of defences, BAP habitat is still present in the River Taw north of Rock Park, therefore there are risks from construction to BAP habitat. Allowing flood storage within the southern end of Rock Park could affect the deciduous woodland BAP habitat at the southern end of the park, as it will be flooded, potentially		Deciduous woodland is present along the northern side of the substation, which is BAP habitat. New defences around the substation may cause permanent loss of the habitat, producing a permanent negative effect from this option.		

Environmental aspect	Notable feature	Assessment summary: Improve defence standard including Rock Park	Improve defence standard excluding Rock Park	New walls at Coney Gut	New defences at Pill House	Removal of properties at risk	Do nothing
		been identified in the Devon BAP.	causing damage to the woodland. There is potential for habitat creation, which could create important BAP habitat.				
	Notable species	Notable species have not been identified in the area, however, construction best practice should be implemented to avoid adverse effects to species. There is also a risk that trees would be felled for these options, creating a risk of an adverse effect to bat species.			Barn owls have been observed around Pill House, therefore construction best practice would need to be applied, such as seasonal constraints, to avoid adverse effects on the barn owl. There is also a risk that trees would be felled for this option, creating a risk of an adverse effect to bat species.		
Historic environment	Scheduled monuments	There are no schedule monuments present in the area, therefore no effects are anticipated.					
	Listed buildings	There is a risk of permanent and temporary adverse effects on the setting of the listed buildings along New Road at the northern end of Rock Park. There is a risk of permanent effects on the setting of these buildings as the flood defence structure would be visible from them. There are also temporary risks during construction, which would disturb the setting of these buildings. This option will have a positive effect as it will increase the flood protection for the listed buildings.			Pill House is a listed building (Grade II*), along with Greendale Farmhouse (Grade II). There may be temporary and permanent adverse effects on the setting of the listed buildings from this option. However, there will also be a permanent positive effect on the listed buildings as they will be	There is the potential that some of the listed buildings will be close to construction and a risk that they may need to be removed to aid construction. Removal of the listed buildings, or other historic features should be avoided. There may be temporary negative effects on the listed buildings on New	Listed buildings could be significantly negatively affected from increased flood risk and therefore flood damage.

Environmental aspect	Notable feature	Assessment summary: Improve defence standard including Rock Park	Improve defence standard excluding Rock Park	New walls at Coney Gut	New defences at Pill House	Removal of properties at risk	Do nothing
					protected from flooding and damage.	Road from demolition activities.	
	Conservation areas	There is a risk of permanent and temporary negative effects on the setting of Newport conservation area, particularly if the river front changes significantly. The defences may also effect the views from within the conservation area to the river, and from the park into the conservation area.		The majority of Coney Gut is not within a conservation area, with the exception of the western end. There may a small effect from new walls on the conservation area in this area, however the effect is unlikely to be significant due to the small scale.	Pill House is not in a conservation area and is unlikely to be able to be viewed from the nearest one due to intervening urban development, therefore there are no anticipated effects on conservation areas from this option.	The majority of Coney Gut is within Newport conservation area, therefore removal of buildings may cause a permanent adverse effect on the historic setting of the area, particularly if the buildings are historic. There would also be temporary adverse effects from demolition activities.	Conservation areas cover a large portion of this flood cell, therefore the area could be negatively affected by the increased risk of flooding and flood damage.
	Historic Environment Record	There are only a few archaeological monuments recorded in this area, however construction best practice should be applied to adverse effect on archaeological monuments that may be present.					
Water environment	Surface water	Construction along the River Taw frontage has the potential to release construction materials into the River Taw. These could negatively affect the ecology of the river, which would conflict with the WFD objectives for the Taw-Torridge estuary. These options could also be in conflict with the recommended mitigation measures for the Taw-Torridge estuary listed in the RBMP, particularly the requirement to remove hard bank reinforcements. Any development proposals that could affect the estuary will need to demonstrate no deterioration in the status of the water body and should work towards helping achieve its status objective.		Construction of new walls along Coney Gut have the potential to negatively affect water quality in Coney Gut through release of construction materials. This option is potentially in contravention with the WFD mitigation measures for Coney Gut, all of which are in place. In particular, it is against installing earth banks instead of flood walls and removal of hard bank reinforcement.	New defences at Pill House are unlikely to have a significant effect on surface water due to the distance from the river bank the defences would be constructed. However, there is a low risk that construction materials may enter surface water and flow into the River Taw, potentially affecting its WFD objectives.	This option has the potential to release construction materials into surface water, creating a temporary negative effect.	As with biodiversity, doing nothing will lead to more flooding of urban areas, and as such increase the likelihood of contaminants entering the river, therefore decreasing the surface water quality. This option could assist in the achievement of the GEP, as it could enhance the ecological value of banks and riparian zone.
	Groundwater	No effects to groundwater are anticipated.					
	Water resources	There is low risk that these options could affect the surface water or private discharges into watercourses. However, the works also offer an opportunity to consolidate and better regulate any such discharges and inclusion of pollution control measures could have a positive effect on water quality within the River Taw and Coney Gut.					No effects are anticipated.

Environmental aspect	Notable feature	Assessment summary: Improve defence standard including Rock Park	Improve defence standard excluding Rock Park	New walls at Coney Gut	New defences at Pill House	Removal of properties at risk	Do nothing
Landscape and visual amenity	Landscape character	This option could negatively affect landscape character through increasing the height of the defences, increasing the separation between the land and river front, particularly in Rock Park. It is also likely that there will be temporary visual effects from construction of the defences.	This option has the same effects as the previous option, with the exception that allowing Rock Park to flood may cause damage to vegetation that is a key part of the landscape in the park and along the river front.	Due to the confined nature of the watercourse, it is unlikely that new walls will have a significant effect on the landscape character of this area as the watercourse is surrounded by urban development. There is a path along the northern bank, which the new wall may increase the division between this and the river, therefore having a negative effect.	New defences around Pill House may have a negative effect on landscape character as it would have a visual effect on the historic nature of the building. However, the significance may be small due to the small scale of the defences. There will also be a temporary negative effect from construction of the defences.	Removing properties will have a temporary and permanent effect on the landscape character of Barnstaple, particularly if the buildings contribute to the historic setting of the conservation area.	Impacts to landscape character could occur through increased connection to the river, therefore helping preserve the open character of the area. However, negative effects to landscape character could occur through a deterioration in urban character through flood damage.
Contaminated land		There is a risk that construction activities could lead to the mobilisation of contaminated materials in the ground, which could affect surface water and groundwater quality. However, construction of the flood defences would offer an opportunity to remediate any ground contamination present in the area. An old landfill, Park School Railway Cutting, is present close to the substation, therefore care should be taken if excavating in the area to avoid release of contaminated materials.					No effects are anticipated.
Air quality		There is a risk that construction activities could have a temporary adverse effect on local air quality.					No effects are anticipated.
Noise		There is a risk that construction activities could have a temporary adverse effect on local noise levels.					No effects are anticipated.
Population and local community		This option would provide increased flood protection for the local community, therefore having a permanent positive effect. This option will also protect the park and sports facilities, having a positive effect on people's lifestyles. Construction could affect the PRoW that runs along the riverfront in the park. Mitigation measures should be undertaken to avoid disruption to the footpaths.	This option would have a positive effect on the local community by increasing flood protection, however there would be a temporary negative effect from the loss of the sports fields during and after flood events. Construction could affect the PRoW that runs along the riverfront in the park. Mitigation measures should be undertaken to avoid disruption to the footpaths.	This option will provide increased protection from flooding for the community, therefore having a permanent positive effect.	This option will have a positive effect on the local population as it will protect the local electricity supply by protecting the substation. Construction could affect the PRoW that runs along the riverfront in the park and around Pill House. Mitigation measures should be undertaken to avoid disruption to the footpaths.	This option may have a negative effect on the local community as it will not increase protection, but people will lose their homes, potentially having to leave the area against their wishes.	This option will have a significant negative effect as it will increase the risk of flooding on the local community. An increase of flooding will have a negative effect on the local community through potential health effects resulting from flooding, including stress. Flooding will also increase financial stress for the local population.

Environmental aspect	Notable feature	Assessment summary					
		Improve defence standard including Rock Park	Improve defence standard excluding Rock Park	New walls at Coney Gut	New defences at Pill House	Removal of properties at risk	Do nothing
Local economy		These options will protect the commercial interests within flood cell E, therefore having a permanent positive effect on the local economy.					This option will have a significant negative effect as it will increase the risk of flooding on the local economy.

4.1 Discussion

This appraisal provides a high-level assessment of the associated potential environmental risks and benefits for each of the concept flood defence options.

4.1.1 Flood cell A

Raising the A361 would include construction on two Key Network Features, and therefore has the potential to cause the permanent loss of two sites important for habitat connectivity. This would be in conflict with the draft Local Plan, which aims to increase biodiversity with development. These sites may be particularly important due to the close proximity to the Taw-Torridge SSSI, creating habitat connectivity between the SSSI to other habitats.

If raising the A361 requires foundations that potentially extend into groundwater, a risk arises of contamination to groundwater. This option may also adversely affect landscape character, as the raised road will create further division between Barnstaple and the rest of the Taw-Torridge estuary.

It is unlikely that raising the A361 will affect the historic environment of Barnstaple, as there are no heritage features, although care should be taken to avoid damage to archaeological monuments that may be present in the construction zone.

Raising the embankment around Bradiford Reserve could encroach onto the nature reserve and therefore permanently damage its habitat features. The southern end of the proposed embankment borders the Taw-Torridge Estuary SSSI and Key Network Features, potentially causing damage to the SSSI. Construction of the embankment will also produce a risk to the notable and protected species that have been observed in the reserve. Construction also has the potential to release contaminating materials to surface water, into the sensitive Taw Estuary, conflicting with WFD objectives.

Effects to landscape character may be adverse from Pottington Business Park, however the effects are likely to be localised as this area is generally isolated from the rest of Barnstaple. Raising an embankment around Bradiford Reserve is not likely to have any effects on the historic environment, groundwater or water resources.

PLP in Meadow Road is unlikely to have any significant effects on the environment, with the exception of a potential localised adverse effect to the historic environment on the Pilton conservation area and the listed buildings in the area.

Repairing the existing tidal defences has the potential to negatively affect the Taw-Torridge SSSI and Key Network Features and Sites from construction that encroaches into these habitats. Construction materials could also be released into the neighbouring SSSI and BAP habitat, adversely affecting biodiversity. Construction best practice would also need to be applied to avoid damage to the archaeological monuments that are present along the river bank. There could be an adverse effect on population if the South West Coast Path is damaged or closed during repair of the coastal defences. However, if mitigation measures are implemented and the path remains open, the disruption effects are likely to be low.

All of these options (with the exception of PLP) would need apply construction best practice and seasonal constraints to avoid significant negative effect on the features of the SSSI and surrounding habitat.

Doing nothing would provide benefit to biodiversity as it may allow more opportunities for habitat creation, however there are significant negative effects on local population and economy through increased flood events affecting residential and commercial properties. There could be negative effects to biodiversity and water quality, as the increased flooding of urban areas could introduce and mobilise contaminants into the river system.

4.1.2 Flood cell B

Increasing the height of the defences along Rolle Quay, the parapet and barriers on Rolle Street bridge may have temporary adverse effect during construction on the setting of Castle Mount and the Boathouse. The conservation area is also at risk from a degradation of its setting during construction, however significant permanent effects on historic environment are unlikely as the

nature of the defence is unlikely to change significantly. There will however be a negative effect on landscape character from raising the walls, as it will exacerbate the division between Rolle Quay and the River Yeo. Other than the risk of release of construction materials, low risk of adverse effects is anticipated to biodiversity. Construction best practice will need to be applied to avoid adverse effect to surface water and biodiversity to avoid disturbance to otter which have been observed in the River Yeo in this location.

There is a large risk that piling through Pilton Park will have a significant adverse effect on biodiversity, as Pilton Park is a Key Network Site and BAP habitat is present in the River Yeo in this location. Piling may significantly damage the aquatic ecology of the River Yeo and also remove vegetation around the edge of the park, reducing its habitat connectivity potential. Vibration from piling can affect aquatic features in the river, most notably migratory fish species, birds and otter. Construction best practice and seasonal constraints would be required to minimise the risk to biodiversity. Piling may also have a permanent and temporary adverse effect on the setting of the conservation area and listed buildings within the vicinity of Pilton Park, as piling is often unsightly. To mitigate these effects, design will have to be sensitive to its surroundings. Piling may also have a significant adverse effect on the landscape character of the area, as it would amend the natural river bank and park.

Piling also presents a significant adverse risk to surface water and groundwater, as it could mobilise contaminated materials in the ground, affecting water quality. This contamination could be transported downstream to the River Taw, potentially causing negative effect on the Taw-Torridge SSSI. Piling activities will also have a negative effect on the noise levels of the area.

Re-routing the River Yeo would have a significant negative effect on biodiversity, as BAP habitat and Key Network Features will be permanently lost through infilling of the river channel. The change in hydromorphology and ecology of the river may conflict with the River Yeo's WFD objectives, and also may result in a change to the hydromorphology and ecology downstream and into the River Taw. Modifying the river channel has the potential to lead to the deterioration of the WFD status of the River Yeo and could lead to it being designated as a HMWB. This option may also exacerbate coastal squeeze by reducing the amount of coastal saltmarsh habitat.

Re-routing the Yeo will significantly change the historic setting and landscape character of the area, potentially having a negative effect on the listed buildings and conservation area. The landscape character will be affected through the loss of a natural river setting and the loss of open space. The loss of open space may also adversely affect the local population as it will reduce the amount of accessible green space available. Unlike the other options, this option does not provide increased flood protection, so does not benefit the local population in that way. However, the infilling of the channel provides an opportunity to increase the area of public space through making the flood embankment redundant and creating a new park in the area of infill.

Repairing the existing defences is unlikely to have a significant effect on biodiversity, historic environment, landscape or groundwater. Some negative effects may arise from release of construction materials into surface water.

Doing nothing would provide benefit to biodiversity as it may allow more opportunities for habitat creation, however there are significant negative effects on local population and economy through increased flood events affecting residential and commercial properties. There could be negative effects to biodiversity and water quality, as the increased flooding of urban areas could introduce and mobilise contaminants into the river system.

4.1.3 Flood cell C

Raising the SoP along Raleigh Road is unlikely to present a risk to biodiversity, historic environment or landscape as it is not close to any significant features. Risk of negative effects arise from the culverts, as it would involve construction in the river channel. There could be permanent loss of river bank and river bed habitat, and construction materials could be released into the River Yeo and downstream to the River Taw, conflicting with WFD objectives.

Increasing the standard of flood defences along Castle Quay and raising the existing defences may have significant negative effect on the historic environment, including that of Castle Mount scheduled monument, the listed buildings and conservation area along the river front. Archaeological monuments are also present along the river front, those unknown may be at risk of damage during construction. An increase in the height of defences, or amending the type of defences, may cause a negative effect on landscape character as it could increase the division between Barnstaple and the estuary, while also affecting views to the river. These two options are unlikely to have significant effects on biodiversity, however there is the potential for release of construction materials into the River Taw, creating a risk to ecology, particularly where construction would take place close to the Taw-Torridge SSSI. Increasing the standard of the defences along Castle Quay may worsen the effects of climate change on inter-tidal habitats by exacerbating the risk and extent of coastal squeeze in this location. These two options are also potentially in conflict with the mitigation measures outlined in the RBMP.

Doing nothing would provide benefit to biodiversity as it may allow more opportunities for habitat creation, however there are significant negative effects on local population and economy through increased flood events affecting residential and commercial properties. There could be negative effects to biodiversity and water quality, as the increased flooding of urban areas could introduce and mobilise contaminants into the river system. There are also significant negative effects on the historic environment, as there are numerous listed buildings, a scheduled monument and conservation area in this flood cell that will have an increased risk of flooding, and therefore flood damage.

4.1.4 Flood cell D

Replacing existing defences to meet design standard is unlikely to have effects on designated sites, such as the Taw-Torridge SSSI due to the large distance. There is a Key Network Site along the defence line which could be permanently lost, along with notable species that have been observed in the region, such as the common frog. There are no historic features within the vicinity of the defence line, therefore effects on Barnstaple's historic environment are not anticipated. Effects to landscape character are dependent on the design of the defences, which is currently unknown.

Doing nothing has significant negative effects on local population and economy through increased flood events affecting residential and commercial properties. There could be negative effects to biodiversity and water quality, as the increased flooding of urban areas could introduce and mobilise contaminants into the river system.

4.1.5 Flood cell E

Improving the defence standard for all of Rock Park may cause a permanent adverse effect on BAP habitat in the river, if the defences were to extend into the river channel. Rock Park is a Key Network Site, so construction in this area could cause loss of habitat important for connectivity and therefore have a permanent negative effect on biodiversity. These effects will be the same for the option of creating flood storage in the southern end of Rock Park, as habitats will be damaged from inundation by flood water. This could also affect the BAP habitat of deciduous woodland on the southern boundary of the park. The damage to vegetation may also negatively affect the landscape character of the area.

Improving the defences along the River Taw frontage also has the potential to affect the setting of Newport conservation area, possibly affecting views to the river. This construction along the Taw could also release contaminating materials into the River Taw, conflicting with its WFD objectives. This option could also be in conflict with the recommended mitigation measures for the Taw-Torridge estuary, and therefore set back the river's achievement of GEP.

New walls at Coney Gut are not likely to have a significant effect on biodiversity, as there are relatively few biodiversity features in the area and it is small scale. The setting of listed buildings may be negatively affected, however the majority of Coney Gut is not within a conservation area so the effect is unlikely to be significant, with only the western end of the defences being within the conservation area. Due to the confined nature of Coney Gut, effects on landscape and visual amenity are not anticipated. Construction of new walls at Coney Gut is potentially in contravention with the WFD mitigation measures, which seek to remove hard engineering.

New defences around Pill House may damage the deciduous woodland along the northern side of the substation. This area is also a Key Network Site. Construction of the defences may cause permanent loss of this BAP habitat. This option carries a risk to the historic setting of Pill House, however, there would also be a permanent positive effect on the listed buildings as this option provides protection from flooding. Sensitive design should be utilised to avoid significant negative effect on the historic setting of Pill House and also the landscape and visual amenity.

Removing properties at risk along the southern side of Coney Gut may have a significant permanent effect on the listed buildings within the vicinity of the properties at risk. The majority of Coney Gut is within a conservation area, therefore removal of buildings may cause an adverse effect on the historic setting and landscape character of the area, particularly if the buildings have historic value. This option will only have a limited effect on the local community as it will not increase flood protection, but it will have a negative effect on those that will lose their homes.

The construction programme should take the local community and economy into consideration as it could provide disruption, thus having a temporary negative effect. These options are also likely to lead to a range of environmental benefits. The new defences would increase protection for people and property in Barnstaple and could reduce flood risk to sensitive historic sites such as listed buildings in the town centre. The defences would reduce the impacts of sea level rise caused by climate change on these aspects and would also make a positive contribution to the local economy by reducing the risk of flooding to the town.

Doing nothing would provide benefit to biodiversity as it may allow more opportunities for habitat creation, however there are significant negative effects on local population and economy through increased flood events affecting residential and commercial properties. There could be negative effects to biodiversity and water quality, as the increased flooding of urban areas could introduce and mobilise contaminants into the river system. There are also listed buildings within this flood cell that could be negatively affected by increased risk of flooding.

5 Recommendations

5.1 Scope of future environmental work

The environmental impacts of any flood defence scheme would need to be assessed further during the development of the preferred concept option so as to inform its detailed design and the requirement for appropriate mitigation measures.

A number of surveys and assessments would be required to gain a more detailed understanding of the environmental baseline and the potential environmental issues associated with the scheme. These surveys would need to be agreed in advance through consultation with NDC and other relevant stakeholders, including the Environment Agency, Historic England and Natural England.

The following sections provides an overview of the potential consenting requirements and scope of further environmental assessment work that may be required to support the development of a preferred option for each flood cell. The scope of such work is directly linked to the location and scale of flood defence interventions required.

Planning permission for the preferred option may be required as may several other consents including Flood Risk Management consent from the Environment Agency and a Marine Licence from the Marine Management Organisation (MMO) for the construction of the scheme. Early consultation with NDC would be recommended to determine the likely consenting requirements and supporting information necessary to inform the consenting process.

Should planning permission for the scheme be required, the preferred option may require formal screening by NDC under the Town and Country Planning (Environmental Impact Assessment) Regulations 2011 to determine the requirement for a statutory EIA. An option is more likely to require a statutory EIA if it is a significant engineered solution, particularly if located immediately adjacent to or within the Taw Estuary. An option is most likely to fall under Schedule 2, section 10(h) of the regulations, which relate to *'Inland-waterway construction not included in Schedule 1, canalisation and flood-relief works.'* The applicable threshold for an EIA under this category is works exceeding one hectare in size.

If planning permission has been granted and the project requires the PRoW to be stopped or diverted, application should be made to DCC under section 257 of the Town and Country Planning Act 1990. However, PRoW issues should be considered at an early stage of the planning process to minimise the overall impact of the proposed option on the PRoW and to reduce the risk of delay later on.

A Preliminary Ecological Appraisal (PEA), following the Institute of Ecology and Environmental Management guidelines (IEEM, 2013), would be required to provide detailed baseline ecological data and to identify potential ecological constraints, opportunities and associated mitigation measures. The PEA would include an Extended Phase I Habitat Survey following JNCC methodology. The PEA would inform the requirement for further Ecological Impact Assessment (EcIA) and protected species surveys. Careful consideration of the potential effects on the Taw-Torridge Estuary SSSI would be required and it is recommended that early consultation with Natural England is undertaken.

A detailed historic environment assessment may be required to determine the potential impacts of the preferred concept option on heritage features within the surrounding area. This assessment would be prepared in line with the Institute for Archaeologists *Standard and Guidance for historic environment desk-based assessment* (2012) and would be carried out with reference to the relevant legislative and planning frameworks. A field reconnaissance survey would also be required to assess the condition of the known sites, to identify further sites of heritage significance or archaeological potential and to identify potential effects (both direct and indirect) of the project.

A Landscape and Visual Impact Assessment (LVIA) would need to be undertaken to assess the potential significant landscape impacts associated with the preferred concept option. This should be undertaken in accordance with the Guidelines for Landscape and Visual Impact Assessment 3rd edition (Landscape Institute and the Institute of Environmental Management and Assessment, 2014). This would include the identification of landscape and visual receptors within the study area, and would include a description of the magnitude of impacts arising from the development on the landscape environment and visual amenity.

Interventions to the form and functioning of the riverine and coastal environment require assessment to ensure that WFD objectives are not compromised. Therefore, a hydromorphological audit would be required to assess the impacts of the scheme on the combined hydrological and geomorphological processes in the area. Information gathered from the assessment would allow a conceptual model of local system function to be developed, which would provide important information concerning the river and coastal system and would enable the project to be assessed against sustainability objectives.

The potential impacts associated with the construction phase of the project would need to be considered due to the potential risks to water quality and ecology in the watercourses, and impacts on local air quality and noise levels affecting local residents, businesses and recreational activities. Appropriate construction working methods and pollution prevention measures would need to be identified to ensure the risks to the water and groundwater environment are effectively managed.

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