East Sussex County Council

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Cuckmere Pathfinder Project

Options Impact Assessment (Ecology)

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Ecological Interest within the Cuckmere Estuary and the Potential Implications of Proposed Changes in Estuary Management

1. Introduction

1.1. This report sets out the results of an assessment of the potential effects of seven proposed management options for the Cuckmere Estuary (the baseline, and A to F) on the ecology of the estuary south of the A259. The report has been produced as part of the Cuckmere Coastal Pathfinder project, funded by DEFRA and managed by East Sussex County Council. This report has been prepared by Dr Kate Cole, County Ecologist at East Sussex County Council.

1.2. The options under consideration have been identified by the community through the Cuckmere Community Forum and comprise:

The Baseline – Do nothing or do minimum;
Option A – Partial breach managed realignment;
Option B – Full breach managed realignment;
Option C – Engineered reactivation of meanders and creeks;
Option D – Maintain the existing defences;
Option E – Sustain the existing defences – raise banks as sea level rises;
Option F – Sustain the existing defences – raise bank by 300 mm.

1.3. The assessment uses as its baseline the current ecological status of the Estuary, drawn from the existing Site of Special Scientific Interest (SSSI) designation and condition assessment, and an overview of the wider ecological interest drawn from a range of environmental reports that are available for the area. Whilst the bulk of the assessment considers the Estuary south of the A259, the valley north of the A259 to Frog Firle has also been considered. The assessment of the potential effects of each management option has been based on the modelling work carried out by Capita Symonds for the Pathfinder project (Capita Symonds, March 2011).

1.4. This assessment is based on the information currently available and should not be taken as a comprehensive environmental assessment of all the impacts of the options under consideration. Once consensus is reached on the future management of the estuary, a more comprehensive assessment may need to be carried out to fully understand the ecological implications and to fulfil various legal and policy requirements.

2. Policy Context

2.1. The main habitats and species found within the Estuary are summarised below (section 3), and their relative significance is described in terms of distribution (local, regional, national and international where known), and status in terms of relative importance as defined by the level of protection afforded through legislation and/or policy if applicable. Ecological features do not have to be formally designated to be considered significant, and some habitats not covered by a formal site designation may still be afforded some measure of protection through UK policy and/or other legislation.

2.2. The following information drawn from *Planning for Biodiversity and Geological Conservation* (OPDM, 2006) summarises the statutory and policy obligations with regards to nature conservation and planning in England.

2.3. Many important sites for nature conservation have been designated under statutes and international conventions. Along with local sites these comprise a hierarchy of designations summarised in Table 1 below.

Table 1: Hierarchy of site designations

International	Special Protections Areas (SPAs) Special Areas of Conservation (SACs) Ramsar sites
National	Sites of Special Scientific Interest (SSSIs), including National Nature Reserves (NNRs)
Local	Local sites, including Sites of Nature Conservation Importance (SNCIs), Local Nature Reserves (LNRs), Regionally Important Geological and geomorphological Sites (RIGs)

2.4. The UK Biodiversity Action Plan (UK BAP) 1994, reviewed and updated in 2008, sets out the UK Government's response to the Convention on Biological Diversity signed in 1992. It describes the UK's biological resources and commits to a detailed plan for the conservation and protection of existing biological diversity and its enhancement where possible. Local BAPs identify all of the UK BAP priority species and habitats that occur in the area as well as other species of local biodiversity significance. Planning Policy Statement 9 (PPS9) on Biological and Geological Conservation states that sites of regional and local biodiversity and geological interest have a fundamental role to play in meeting overall national biodiversity targets.

2.5. Some individual species receive statutory protection under a range of legislative provisions.

3. Current ecological interest and status

3.1. Designated sites

3.1.1. *Site of Special Scientific Interest*

3.1.1.1. The Cuckmere Estuary lies within the Seaford to Beachy Head Site of Special Scientific Interest (SSSI). SSSIs are legally protected under the Wildlife and Countryside Act 1981, as amended by the Countryside and Rights of Way (CROW) Act 2000 and the Natural Environment and Rural Communities (NERC) Act 2006. In addition to the valley floor south of the A259, the SSSI covers the cliffs and chalk platform from Seaford to Beachy Head, areas of chalk grassland above Foxhole Cottages and along the Seven Sisters, and the estuary floor upstream to Frog Firle. The whole SSSI is considered an outstanding site of national importance for its biological and geological features. The SSSI as a whole supports a diverse range of habitats which in turn support a number of nationally rare, nationally scarce and nationally significant plants, invertebrates and birds.

3.1.1.2. For condition assessment purposes, the valley floor south of the A259 is classified as neutral grassland and has recently (August 2010) been assessed by Natural England as being in favourable condition. The main interest of the grassland in this unit is the assemblage of passage bird species it supports. The grassland is described as generally species poor either side of the Cuckmere channel, dominated by creeping bent (*Agrostis stolonifera*) with occasional Yorkshire-fog (*Holcus lanatus*), timothy (*Phleum pratense*) and cock's-foot (*Dactylis glomerata*) with a saline influence especially towards the southern end, where there is frequent sea couch (*Elytrigia atherica*) and occasional sea barley (*Hordeum marinum*). Sea club-rush (*Bolboschoenus maritimus*) occurs around the margins of the pond located between the channel and the closed meander. Sea wormwood (*Seriphidium maritimum*) also occurs along the central path along the channel, as well as sea beet (*Beta vulgaris* subsp. *maritima*) and sea mayweed (*Tripleurospermum maritimum*). In addition, small areas of saltmarsh vegetation occur along either side of the channel, including sea-purslane (*Atriplex portulacoides*), sea-lavender (*Limonium* spp.), glasswort (*Salicornia* spp.) and annual sea-blite (*Suaeda maritima*), as well as buck's-horn plantain (*Plantago coronopus*), sea mayweed, sea rush (*Juncus maritimus*), greater sea-spurrey (*Spergularia media*), sea aster (*Aster tripolium*) and sea beet. At the northern end of this area, part of the wall of the channel has broken, allowing partial flooding and the development of creeks and saltmarsh

vegetation
(http://www.sssi.naturalengland.org.uk/Special/sssi/unit_details.cfm?situnt_id=1008575).

3.1.1.3. It should be noted that although the full condition assessment for the valley flood south of the A259 refers to an area of MG5 (unimproved neutral grassland), this community was recorded outside the floodplain and is therefore not reported here (Natural England, pers comm.).

3.1.1.4. During the 2005 condition assessment it was noted that although this SSSI unit was considered favourable, Lapwing no longer bred there, and this was attributed, at least in part, to low water levels in the ditches (Natural England, pers comm.).

3.1.1.5. The valley floor upstream of the A259 to Frog Firle is semi-improved grassland and supports the breeding bird assemblage (in part) which is currently assessed as being in favourable condition. As such, the habitat is considered to be in appropriate condition.

3.1.1.6. The shingle beaches either side of the river mouth are classified as supralittoral sediment and these are currently assessed (May 2008) as being in unfavourable condition: this is due to the continuing annual works on the west shingle bank by the Environment Agency which destroys the zonation of the shingle vegetation, affects the perennial vegetation and prevents annual strandline vegetation from forming due to the steep cliffed effects of the works. The annual strandline vegetation is also absent from a large area of the eastern shingle beach, though it is not clear whether this is due to visitor pressure, natural factors or both.

3.1.1.7. The SSSI also has geological importance, the site having been identified in the Geological Conservation Review (Ellis *et al*, 1996). It is considered of particular importance in regard to research into coastal geomorphology. In terms of the estuary, the feature of importance is the shingle beach and the marine delta that forms at the mouth of the river.

3.1.2. *Local Nature Reserve*

3.1.2.1. The western side of the valley floor south of the A259 and the valley floor to the west of the meanders fall within the Seaford Head Local Nature Reserve (LNR). LNR is a statutory designation made under the National Parks and Access to the Countryside Act 1949, as amended by the NERC Act.

3.1.3. *Seven Sisters Voluntary Marine Conservation Area*

3.1.3.1. The shingle beaches either side of the river and the foreshore are included within the Seven Sisters Voluntary Marine Conservation Area (VMCA). This is a non-statutory designation that recognises the ecological, geological and historical interest of the cliffs, beach, foreshore and nearshore sea bed.

3.2. Habitats

3.2.1. *Coastal and floodplain grazing marsh*

3.2.1.1. The floodplain south of the A259 has been classified as ‘neutral grassland’ for condition assessment purposes. The term ‘neutral grassland’ is a broad habitat type that is characterised by vegetation dominated by grasses and herbs on a range of circumneutral soils. It includes dry hay meadows and pastures, together with a range of grasslands which are periodically inundated with water or permanently moist (JNCC, 2006). As the grassland of the floodplain within the Estuary is relatively species poor, and the main interest is in the ditches and the assemblage of species the floodplain as a whole supports, it falls into the sub-category of ‘coastal and floodplain grazing marsh’ (Natural England, pers comm.).

3.2.1.2. Grazing marsh is defined as periodically inundated pasture, or meadow with ditches that maintain the water levels, containing standing brackish or fresh water. Ditches are often especially rich in plant and/or invertebrate communities. Sites may contain seasonal water-filled hollows and permanent ponds with emergent swamp communities (UK BAP, 2008). Coastal and floodplain grazing marsh is listed as a priority habitat under the UK BAP (2008).

3.2.1.3. The exact extent of grazing marsh in the UK is not known but it is possible that there may be a total of 300 000 ha. England holds the largest proportion with an estimate in 1994 of 200 000 ha. However, only a small proportion of this is semi-natural supporting a high diversity of native plant species (UK BAP, 2008). The grassland within the Cuckmere Estuary does not fall into this category.

3.2.1.4. Sussex has around 11 400 ha of grazing marsh, with important areas associated with the Arun, Adur, Ouse and Cuckmere. Just under half of Sussex's floodplains consist of wet grassland, however, much of this has been agriculturally improved decreasing its value for wildlife (Sussex Biodiversity Partnership, 2010).

3.2.1.5. Threats to the habitat include: conversion to agriculture through drainage and fertiliser application; a disruption of the hydrology of sites through drainage and flood defences; overgrazing, neglect or early grazing (can affect breeding birds); water pollution, floodplain development, aggregate extraction and recreational pressure; and isolation and fragmentation of sites reducing dispersal opportunities.

3.2.2. *Vegetated shingle*

3.2.2.1. Shingle is an accumulation of pebbles with a diameter between 2 and 200 mm. In Sussex it is composed mainly of flint pebbles derived by marine or glacial erosion of Cretaceous chalk and Tertiary deposits. Shingle closest to the sea is most mobile due to the influence of wave action. As conditions stabilise further from the shore, mixed communities of flowering plants, grasses, mosses and lichens develop, with some being specific to shingle.

3.2.2.2. Shingle structures include spits, barriers or barrier islands resulting from longshore drift, or cuspate forelands where a series of parallel ridges pile up against the shoreline. These structures may support breeding birds including Little Tern and Ringed Plover, and diverse invertebrate communities. Shingle features provide an important protective function for other habitats including sand dunes, saltmarshes and saline lagoons (UK BAP, 2008).

3.2.2.3. Coastal vegetated shingle is an internationally rare habitat occurring mainly in northern Europe, Japan and New Zealand. It has been identified as a priority habitat under the UK BAP, it is a qualifying feature for the identification of SSSIs and it is listed on Annex 1 of the EC Habitats Directive, meaning that SACs can be designated for its protection. Saltmarshes may also be designated Special Protection Areas under the EC Birds Directive, and as Wetlands of International Importance under the Ramsar Convention. The lower reaches of the Cuckmere have been identified as a Biodiversity Opportunity Area for vegetated shingle in the Sussex Biodiversity Partnership.

3.2.2.4. Whilst shingle beaches are widely distributed around the UK coastline, structures sufficiently stable to support perennial vegetation are comparatively rare, with around 5000 ha of the habitat in England. There is around 1000 ha in Sussex, with the most extensive areas being around Rye and Dungeness. There is approximately 5 ha of vegetated shingle within the Cuckmere Estuary, the majority or which occurs on the east beach.

3.2.2.5. Current factors affecting coastal vegetated shingle include the interruption of natural sediment movement from e.g. coastal defence structures, enrichment and pollution, recreational impacts and public pressure, with the impacts often being exacerbated by a lack of awareness. Sea level rise and increased storminess may also present a risk, particularly where shingle exists in narrow fringes, for example where there are no opportunities for landward movement because of hard sea defences.

3.2.3. *Saltmarsh*

3.2.3.1. Coastal saltmarshes in the UK comprise the upper vegetated portions of intertidal mudflats, lying approximately between mean high water neap and mean high water spring tide (UK BAP, 2008). They form a highly productive habitat usually restricted to comparatively sheltered locations in e.g. estuaries and saline lagoons, or on beach plains. Development of saltmarsh vegetation is dependent on the presence of intertidal mudflat. The vegetation consists of a limited

number of salt tolerant species adapted to regular immersion by the tide, and natural systems show clear zonation according to the frequency of inundation.

3.2.3.2. Saltmarsh is an important feeding, roosting and breeding area for many bird species throughout the year. Structurally diverse areas, particularly where freshwater seepages occur, are particularly important for invertebrates, and saltmarshes also provide sheltered nursery sites for several fish species.

3.2.3.3. There is approximately 8 ha of saltmarsh within the estuary; most of this occurs along the river channel, with a small patch of pioneer saltmarsh developing on the west side to the south of the Golden Galleon. There is currently no saltmarsh upstream of the A259. There are just over 638 ha of saltmarsh in Sussex, with the majority found in Chichester Harbour, and smaller amounts in Pagham and Rye Harbours. The most recent saltmarsh surveys of the UK estimate the total extent of saltmarsh (including transitional communities, which is the most common community found within the Cuckmere Estuary) to be approximately 45 500 ha (England 32 500 ha).

3.2.3.4. Saltmarsh has been identified as a priority habitat under the UK BAP, it is a qualifying criterion for the selection of SSSIs, and it is listed (as Atlantic salt meadow) in the EC Habitats Directive, meaning that sites may be designated SACs for their saltmarsh features. Saltmarshes may also be designated SPAs under the EC Birds Directive, and as Wetlands of International Importance under the Ramsar Convention. The lower reaches of the Cuckmere have been identified as a Biodiversity Opportunity Area for saltmarsh in the Sussex BAP.

3.2.3.5. Current factors affecting saltmarsh include 'coastal squeeze' where the habitat is squeezed between rising sea levels and eroding seaward edges and fixed flood defences, land claim (historically for agriculture and today for development and recreation), changes to sediment budgets (from coast protections works, changes in estuary morphology from land claim and/or dredging activities, and the impact of flood defence works over the years) and pollution. The best available information suggests that saltmarshes in the UK are being lost to erosion at a rate of 100 ha per year.

3.2.4. *Intertidal mudflat*

3.2.4.1. Mudflats are sedimentary intertidal habitats created by deposition in low energy coastal environments, particularly estuaries and other sheltered areas. Their sediment consists mostly of silts and clays with a high organic content. Towards the mouths of estuaries where salinity and wave energy are higher, the proportion of sand increases. Mudflats are intimately linked by physical processes to, and may be dependent on, other coastal habitats such as soft cliffs and saltmarshes.

3.2.4.2. Mudflats are highly productive areas that, together with other intertidal habitats, support large numbers of invertebrates, birds and fish. They provide feeding and resting areas for internationally important populations of migrant and wintering waterfowl and important flatfish nursery areas (UK BAP, 2008).

3.2.4.3. There is approximately 5 ha of intertidal mudflat within the Cuckmere estuary, in the river channel, principally south of the A259. Sussex has just over 1100 ha, much of this occurring in a mosaic with saltmarsh and seagrass beds, with the largest expanse in Chichester Harbour (Sussex Biodiversity Partnership, 2010). The UK estuarine resource is estimated at 588 000 ha of which 55% is intertidal area, mostly mud and sandflats with a lesser amount of saltmarsh. Intertidal flats cover about 270 000 ha. The UK has approximately 15% of the north-west European estuarine habitat.

3.2.4.4. Intertidal mudflat has been identified as a priority habitat under the UK BAP. Sites may be designated SACs under the EC Habitats Directive, SPAs under the EC Birds Directive, and Wetlands of International Importance under the Ramsar convention. Much of the intertidal mudflat in Sussex in included in a SAC, SSSI or Site of Nature Conservation Importance (SNCI).

3.2.4.5. Sea level rise is expected to result in the loss of up to 10 000 ha of intertidal mudflat by 2013, with much of this in southern England (Sussex Biodiversity Partnership, 2010). Other threats to the habitat include land claim for development and industry, including hard defences, pollution,

human disturbance (e.g. bait digging and fishing) and the introduction and spread of invasive species such as common cord grass (*Spartina anglica*).

3.2.5. *Saline lagoons*

3.2.5.1. Saline lagoons are bodies of saline water, natural or artificial, partially separated from the sea by a barrier of sediment or rock. They retain a proportion of their seawater at low tide and may develop as brackish, full saline, or hyper-saline water bodies (UK BAP, 2008). They are rare habitats and are highly transient. Under natural conditions losses would be compensated for by lagoon formation in other areas. Saline lagoons generally support soft sediments, which support filamentous green and brown algae, charophytes and tasselweeds. They contain invertebrates rarely found elsewhere, and also provide important feeding and roosting habitat for waterfowl, marshland birds and seabirds. The flora and invertebrate fauna present can be divided into three main components; those that are essentially freshwater in origin, those that are marine/brackish species and those that are more specialist lagoonal species.

3.2.5.2. Within the Cuckmere Estuary, the following water bodies have been classified as saline lagoons; the 'ox-bow lake' of the meanders (7.7 ha), the tidal pool at the back of the west beach (0.3 ha) and the scrape behind the east beach (5.3 ha) (Jacobs Babtie, 2007). In Sussex, saline lagoons cover approximately 69 ha (183 ha including the pits at Rye Harbour and Pett) (Sussex Biodiversity Partnership, 2010). In England, the total area of saline lagoons is about 1300 ha. It is estimated that saline lagoons cover just 5% of Europe's coastline and 13% of coastlines globally. The habitat is therefore nationally rare and of international conservation importance under the EC Habitats Directive. The lower reaches of the Cuckmere have been identified as a Biodiversity Opportunity Area for saline lagoons in the Sussex BAP.

3.2.5.3. Current factors affecting saline lagoons include pollution, artificial control of water and/or infilling, coastal defence works preventing the movement of sediments along the shore, and sea level rise.

3.3. Species

3.3.1. *Flora*

3.3.1.1. Several notable plant species have been recorded within the floodplains of the Cuckmere Estuary; a list is provided at Appendix 1. It has been noted that there are fewer records of scarce plants from the west side than from the equivalent area on the east side of the river, south of the A259. This has been attributed, at least in part, to a more restricted range of habitats on the west side (Jacobs Babtie, 2007).

3.3.1.2. A Phase 1 survey of the western floodplain carried out in 2003 reported the following: *Fifteen different habitats were identified during the Phase 1 surveys. In summary, the entire site is considered to be of national importance, given its inclusion within a SSSI. However, the floodplain grassland was generally species poor and of lower botanical interest than might normally be expected within a SSSI. Other habitats in the study area are of more value, as they are likely to support a moderate diversity of species. These include areas of reed swamp/open water, scrub, coarse grassland and broadleaved woodland.* (Jacobs Babtie, 2007).

3.3.1.3. A Phase 1 survey of the eastern floodplain carried out in 2004 reported the following: *Of the floral species recorded during the field survey, none are specially protected but one is of conservation concern. This is the round-headed rampion* (Phyteuma orbiculare) *which is a nationally scarce species being present in less than one hundred 10 km x 10 km grid squares in the British Isles. This species was recorded in the unimproved calcareous grassland on the eastern floodplain (on higher level around the chalk escarpment).* (Jacobs Babtie, 2007).

3.3.2. *Badger (*Meles meles*)*

3.3.2.1. During badger surveys carried out in 2003 and 2004, eight badger setts were recorded on the eastern floodplain (on the higher level around the chalk escarpment). In addition, badger footprints, established pathways and latrines were recorded on the floodplain. It is likely that there is one badger territory on the study area. There was some evidence of badgers in the western

floodplain, although all the setts recorded on the west appeared to be in no more than seasonal use and no main breeding setts were found. It is postulated that the main sett for the badger social group may be located beyond the study area to the west (Jacobs Babtie, 2007).

3.3.2.2. The surveys assessed the level of badger activity within the study area as typical of this part of England, and probably ecologically important on a local level only. However, badgers and their setts are protected under the Protection of Badgers Act 1992 and the Wildlife and Countryside Act 1981, as amended. Any option will therefore need to take this into consideration.

3.3.3. *Water voles (*Arvicola terrestris*)*

3.3.3.1. There are no recent records of water voles within the Estuary, although there is anecdotal evidence that they may be present in the locality. None of the habitat is deemed suitable for water voles due to heavy grazing pressure and lack of emergent vegetation (Jacobs Babtie, 2007).

3.3.4. *Otter (*Lutra lutra*)*

3.3.4.1. There are no confirmed records of otters passing through the Cuckmere catchment, although there are anecdotal records.

3.3.5. *Reptiles*

3.3.5.1. During surveys carried out in 2004, three species of reptiles were recorded on both the eastern and western floodplains; a medium population of common lizard (*Lacerta agilis*), a low population of slow worm (*Anguis fragilis*) and a low population of adder (*Vipera berus*). These species are present both north and south of the A259.

3.3.5.2. These species receive some protection under the Wildlife and Countryside Act 1981, as amended. The populations within the Estuary are likely to be of County value for nature conservation and contribute to the overall value of the SSSI. Any option that could impact on these species will need to take this into consideration.

3.3.6. *Amphibians*

3.3.6.1. A survey of the water bodies within the floodplains carried out in 2001 recorded no amphibians, attributing this to the high salinity levels (Jacobs Babtie, 2007). There is anecdotal evidence that newts (including great crested) and toads may visit the water bodies to breed. Common toads (*Bufo bufo*) have been recorded upstream of the A259.

3.3.7. *Birds*

3.3.7.1. The Estuary supports breeding, wintering and passage birds. The coastal floodplain grazing marsh is particularly important for overwintering species including Teal (*Ana crecca*) and wigeon (*Anas penelope*). A list of species recorded within the valley both north and south of the A259 is provided at Appendix 2. As well as wetland species, this list includes birds associated with hedgerows and woodlands. It also includes rare or 'one-off' sightings.

3.3.7.2. Species recorded as breeding within the Estuary include Canada goose (B*ranta canadensis*), shelduck (*Tadorna tadorna*), hobby (*Falco subbuteo*), oystercatcher (*Haematopus ostralegus*), ringed plover (*Charadrius hiaticula*), bullfinch (*Pyrrhula pyrrhula*) and yellowhammer (*Emberiza citronella*).

3.3.8. *Invertebrates*

3.3.8.1. A list of invertebrates recorded within the Estuary is provided at Appendix 3.

3.3.8.2. Groups normally associated with general freshwater habitats, such as beetles (Coleoptera), bugs (Hemiptera), dragonflies and damselflies (Odonata), snails (Mollusca) and midge larvae (Chironimidae) have been recorded in some of the ponds within the Estuary. Ponds nearest the sea support groups such as prawns (Paleomonetes), amphipods (*Corophium* spp.),

isopods, (Sphaeromitidae) and shrimps (Mysids). These are macro-invertebrates normally associated with marine environments (Jacobs Babtie, 2007).

3.3.8.3. The invertebrate ditch fauna is dominated by taxa such as water bugs (Corixidae), gastropod snails (Hydrobiidae) and flies (Diptera), with smaller numbers of beetles. The invertebrate diversity of the ditches is generally considered to be lower than that of the ponds (Jacobs Babtie, 2007).

3.3.8.4. The ditches within the Estuary are reported as having a greatly reduced molluscan fauna due to their brackish nature (Killeen and Light, 1997). Species present include laver spire shell (*Hydrobia ulvae*), spire shell (*Ventrosia ventrosa*), lagoon cockle (*Cerastoderma glaucum*) and the bivalve (*Abra tenuis*).

3.3.8.5. The lagoon cockle has been recorded in the meanders (Sheader & Sheader, 1984-5) but numbers were greatly reduced during a later survey (Environment Agency, 2001). The population is thought to be declining and may now be absent from the lagoons (Jacobs Babtie, 2007).

3.3.8.6. The habitat behind the shingle beach on the eastern side is an important area for bees, including the Potter Flower Bee (*Anthophora retusa*) (Edwards & Jenner, 2008). This species is on the UK BAP Priority Species List and is listed as RDB1 Endangered for the British Isles.

4. Development of intertidal habitats and associated species

4.1.1. With the exception of options E (sustain existing defences – raise banks as sea level rises) and F (sustain existing defences – raise banks by 300 mm), all the options proposed by the Community Forum will result in some degree of tidal inundation and hence the development of intertidal habitats.

4.1.2. Intertidal habitat development depends on the height of the land and hence the frequency of inundation by the sea. A saltmarsh is an intertidal mud or sand flat that has been colonised by salt tolerant vegetation. Thus, saltmarshes and mudflats are a linked continuum of intertidal habitats.

4.1.3. The colonisation by vegetation differentiates a marsh from a mudflat and facilitates increased sediment accumulation on the marsh surface, which becomes raised relative to that of the adjacent mud and takes on a morphology of its own. Vegetation also helps to stabilise sediments through the binding action of the roots and the effect of vegetation in baffling flow. As such, erosion rates are lower on vegetated marshes than on bare intertidal flats. Creeks are an important component as they provide an extension from the intertidal mudflat and wider estuary into the interior of the marsh system, helping to transport water, and therefore sediment and nutrients, into the marsh interior. They also provide habitat for invertebrates, shelter for birds and conduits for fish and mobile invertebrates.

4.1.4. Creating and restoring intertidal habitats is complex because (a) they are topographically and ecologically complex, (b) they support many species of animals, some of which require specific habitats and linkages to other terrestrial or marine habitats, and (c) they exist and evolve within dynamic coastal settings, subject to changing tidal levels, salinities and long term forcing factors associated with sea level rise and climate change (Atkinson *et al*, 2001). However, reviews of various realignment sites, managed and unmanaged, in the UK and further afield, have demonstrated that intertidal habitat creation is possible within a relatively short time period (less than five years) (e.g. ABP Southampton, 1998; Atkinson *et al*, 2001; Atkinson *et al*, 2004; Wolters *et al*, 2005).

4.1.5. More specifically, case studies from sites around the UK have demonstrated rapid benthic invertebrate colonisation of intertidal mudflats within the first year after inundation, reflected by good usage of the sites by waterbirds from the first winter (ABP Mer Ltd, 2011a), increasing throughout the first four years post inundation, often to nationally and internationally important numbers (ABP Mer Ltd, 2011 b, c, d & e).

4.1.6. In terms of saltmarsh development, this also appears to be rapid. At Freiston in Lincolnshire, 70% of the realignment site was covered by saltmarsh plants within three years, initially pioneers such as glasswort and annual sea-blite, with perennial species including sea purslane and sea aster becoming prevalent by the second and third years (ABP Mer Ltd, 2011b). Similarly, at Nigg Bay in the Cromarty Firth, three distinct zones had developed within 2 years of inundation, ranging from rarely inundated grassland, through saltmarsh to mudflats (ABP Mer Ltd, 2011c), and at Wallasea Island in Essex, saltmarsh coverage of elevated areas increased from less than 1% in the first year to approximately 100% by the fourth year (ABP Mer Ltd, 2011a).

4.1.7. Reviews of realignment sites have demonstrated that colonisation tends to be more rapid if a source of potential colonisers is available (i.e. if there is already mudflats and saltmarsh in the area) and that birds are mobile and quickly adapt to new habitats (Atkinson *et al*, 2001). There is some evidence that whilst UK managed realignment sites are successful in that they develop saltmarsh and biologically active mudflats relatively quickly, they may lack the full range of biodiversity found in surrounding natural intertidal habitats, even decades after inundation (Atkinson *et al*, 2004). However, for some areas it has been estimated that species abundance and community types within the realignment area could be equivalent to those outside the site within 10 years (e.g. ABP Mer Ltd, 2011b). Appropriate intertidal habitat management, e.g. saltmarsh grazing, can also increase biodiversity (Wolters *et al*, 2005).

4.1.8. Realignment sites have also been demonstrated to be important nursery areas for fish, including several commercially important species, within four years of inundation (e.g. ABP Mer Ltd, 2011b).

5. Assessment of effects of proposed management options on ecology

5.1. The modelling carried out through the Pathfinder Project (Capita Symonds, March 2011) includes predictions of habitat change drawn from an understanding of water flow, sediment deposition and erosion. Professional judgement has been used to assess the likely impacts of these changes on the ecology within the estuary, and whether these impacts might be considered broadly neutral, negative or positive over the short, medium and long terms. The likely impacts of any engineering requirements have also been considered and included within the assessment.

5.2. The results of the assessment for each option across each time period are set out in Appendix 4 with a summary table below. A brief description of the likely effects and changes for each option is given along with an assessment of whether the degree of change expected could be considered broadly neutral, negative or positive for ecology.

Table 2: Summary of option assessments

Option	Assessment of effects and changes to ecology	Rating short term	Rating medium term	Rating long term
Baseline	Gradual transition to a largely intertidal habitat across the majority of the estuary, allowing species time to adjust to the new conditions, and to relocate if necessary. Uncertainty over when the first breach will occur. Some of the existing habitats which are already of national importance, either for their intrinsic value (vegetated shingle) or for the species assemblages they support (grassland) will remain and their condition is likely to improve in the medium to long term.	NEUTRAL	NEUTRAL	NEUTRAL
A	Gradual transition to a largely intertidal habitat across approximately half of the estuary, allowing species time to adjust to the new conditions, and to relocate if	NEUTRAL	POSITIVE	POSITIVE

	necessary. Some of the existing habitats which are already of national importance, either for their intrinsic value (vegetated shingle) or for the species assemblages they support (grassland) will remain, whilst others (e.g. saline lagoons) will be lost. The condition of the nationally important vegetated shingle habitat on the beaches will improve. Construction of the floodbank will have some detrimental impacts in the short term. Advantage to the baseline in that the timescale for initial change is more certain.			
B	Transition to a largely intertidal habitat across the majority of the estuary, allowing species time to adjust to the new conditions, and to relocate if necessary. The condition of the nationally important vegetated shingle habitat on the beaches will improve. The construction of the embankment will have some detrimental impacts. However, the resultant environment will be dynamic and diverse and adaptable to natural changes.	POSITIVE	POSITIVE	POSITIVE
C	Relatively rapid transition of the majority of the estuary to an intertidal habitat. Whilst this would be a change from the current ecological interest (in terms of SSSI features), the resultant environment will be of at least equal value in ecological terms, it will be dynamic and diverse, adaptable to natural changes and self-sustaining in the long term. The extensive initial engineering works have resulted in a negative assessment in the short term.	NEGATIVE	POSITIVE	POSITIVE
D	Whilst there will be little loss of SSSI features (with the exception of the saltmarsh within the river channel), there is likely to be some habitat degradation. This will be partly through ongoing beach recycling works which are already considered to be having a detrimental effect on the vegetated shingle, partly as a result of land loss through coastal squeeze, and partly through the potential for overtopping with no means of land drainage.	NEGATIVE	NEGATIVE	NEGATIVE
E	The grassland currently covering the floodplains within the estuary will be retained. However, there will be some habitat degradation (e.g. ongoing detrimental effects of shingle recycling works) and some habitat losses, including the intertidal habitat along the river channel and some of the saline lagoon habitat. The engineering works involved will have some detrimental impacts.	NEGATIVE	NEGATIVE	NEGATIVE

F	The grassland currently covering the floodplains within the estuary will be retained. However, there will be some habitat degradation (e.g. ongoing detrimental effects of shingle recycling works) and some habitat losses, including the intertidal habitat along the river channel and some of the saline lagoon habitat. There will also be direct negative impacts associated with engineering works on the embankments.	NEGATIVE	NEGATIVE	NEGATIVE

6. Discussion

6.1. It is generally considered that naturally functioning ecosystems have a greater capacity to adapt to change (including climate change) and to support a wider range of habitats and species. Without manmade structures, the Cuckmere Estuary would be, and was in the past, a naturally functioning intertidal estuary. Given the impact man has had on the landscape of the Estuary over many years, it is not possible, or indeed desirable, to revert back to a completely natural system. However, in ecological terms, the preferred approach is assumed to be one that will result in a more naturally functioning system. Those options that are predicted to result in coastal habitats such as intertidal mudflats and saltmarsh are therefore assessed as being preferable to those that seek to protect largely terrestrial and/or freshwater habitats. The status of the habitats and species likely to be impacted has also been taken into consideration. For example, if the choice is to lose a habitat that is relatively common and/or that supports a relatively low number of species, over one that is rare, at risk and/or that supports a large number of species, the latter option is considered to be favourable.

6.2. **Baseline.** The baseline option against which the six options put forward by the Community Forum are being assessed is the management option that will proceed if no alternative can be agreed and funded. The baseline option has been considered by the Environment Agency as that which meets Government policies on sustainable coastal management, that is able to respond to the predicted impacts of climate change, and that can be afforded from the public purse given the assets that are involved. It will result in a gradual transition from the current ecosystem to an intertidal environment. Whilst this will mean a change to the current interest of the SSSI, this can be considered to be acceptable in ecological terms as it will result in a net gain in overall biodiversity within the SSSI. A significant advantage of a gradual transition is that it will allow species to adapt to the changing conditions. The option will also result in an improvement in the condition of some habitats within the estuary that are qualifying features of the SSSI. The option involves no significant engineering, and hence there will be no associated impacts from that. As the change is likely to be gradual, the option is assessed as being broadly neutral in the short term. A disadvantage is that the timescale for change is uncertain. As such, this option has been assessed as broadly neutral in the medium to long term.

6.3. **Option A.** Similar to the baseline, this option will result in a gradual transition of part of the estuary to an intertidal estuary. This will mean the retention of some of the existing SSSI features, plus a net ecological gain as a result of the creation of rare and important intertidal habitats. As above, a gradual change will allow species to adapt to the changing conditions, e.g. some of the notable water beetles currently present in water bodies south of the A259 can relocate to suitable habitats already present upstream. Whilst this option will involve some engineering works which could have negative impacts, overall, these impacts are considered to be cancelled out by the ecological gains that are expected. As a result, this option is assessed as broadly neutral in the short term, and positive in the medium to long term.

6.4. **Option B.** This option will result in a change to the current ecology within the Estuary south of the A259, but it is considered that this would be a net gain to the SSSI, as the resultant environment would be ecologically diverse, dynamic and adaptable, and one that is likely to be

sustainable in the long term in response to the impacts of climate change. The option will also result in an improvement in the ecological condition of some of the qualifying features of the SSSI, most notably the vegetated shingle. As above, a gradual change will allow species to adapt to the changing conditions. Some engineering works may be involved which will have some negative impacts, but it is considered that the overall gains will outweigh any of these impacts which are likely to be short term. As such, this option is assessed as being largely positive in the short, medium and long terms.

6.5. **Option C.** This option will result in the rapid transition of the current habitat to a fully functioning intertidal estuary through the engineered reactivation of the remnant saltmarsh creeks within the estuary. Whilst the resultant habitat is likely to be healthy and diverse thanks to the use of the creeks to transport seawater, sediment and nutrients across the floodplains, there are some disadvantages to this particular option in the short term from an ecological point of view. Firstly, it will involve some significant engineering works, including access across the whole estuary, presumably by mechanical excavators. It will also mean that species will not have the opportunity to adapt naturally to the change, and it may therefore be necessary to relocate some species before any works take place. However, once the engineering works are complete, the resultant environment is likely to be dynamic, diverse and sustainable in the long term. Given the short term engineering impacts, this option is assessed as being broadly negative in the short term but positive in the medium to long term.

6.6. **Option D**. This option will retain most of the existing features of the SSSI south of the A259, and as such could be considered as being broadly neutral. However, it is likely to result in degradation of the habitats, some of which are already considered to be in unfavourable condition as a result of the maintenance works associated with flood defence (the vegetated shingle) and some of which are currently considered as being in favourable condition (the floodplain grasslands). In the case of the floodplains, the principle risk is that the current habitats which are largely terrestrial and freshwater in nature, will be periodically inundated by seawater as a result of the defences overtopping. As the seawater will have no means of leaving the floodplain, the habitats will be damaged, and will lose both their intrinsic value and their value as a habitat to species that may depend on them. Given the maintenance of the majority of SSSI features, the option could be assessed as being neutral. However, because of the likely degradation of several habitat features, this option is considered to be broadly negative in the short, medium and long term.

6.7. **Option E.** Similar to option D, this option seeks to retain the existing features of the SSSI south of the A259. Whilst this may be successful to a degree in the short term, there is likely to be some habitat degradation, particularly in terms of ongoing damage to the vegetated shingle habitat, and continuing siltation of the meanders. This option is therefore assessed as being broadly negative in the short term. In the medium to long term, ongoing engineering works and their associated impacts, along with habitat loss (including the existing intertidal habitats and the meanders), mean this option is assessed as broadly negative in the medium and long term.

6.8. **Option F.** This option is broadly similar to option E. The initial engineering works required, and their likely impacts, along with the issues of habitat degradation described above, mean that this option has been assessed as broadly negative for ecology in the short term as well as the medium to long term.

7. Conclusion

7.1. In assessing the options for future management of the Cuckmere Estuary against impacts on ecology, it has been assumed that the preferred approach would optimise opportunities to enhance biodiversity, locally as well as nationally and internationally, and to encourage development of an ecosystem that is suited to the local conditions, making it adaptable to change and sustainable in the long term.

7.2. Evidence from a broad range of ecological surveys indicates that the principle ecological interest south of the A259 is the habitats and species that reflect the proximity of the site to the sea, e.g. invertebrate assemblages in the brackish water bodies, and coastal habitats such as the existing saltmarsh and mudflats, the saline lagoons and the vegetated shingle. Whilst the site is

also of national importance for the bird assemblages it supports, the habitat these species use is generally considered to be of low intrinsic value, and there is alternative habitat available within the SSSI which is in better condition (i.e. the floodplains north of the A259).

7.3. Natural England has indicated that a change to some of the qualifying features of the SSSI could be acceptable if the result is a more biodiverse, dynamic and sustainable ecosystem.

7.4. As a result, options A, B and C are all assessed as having broadly positive impacts on ecology as they will result in a more natural ecosystem that is likely to be able to respond positively to the predicted impacts of climate change.

7.5. Options D, E and F are all assessed as having broadly negative impacts on ecology, as whilst they may maintain several of the current features of the SSSI south of the A259, the overall health of the system is likely to decline in the longer term.

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Appendix 1 – Species of rare plants recorded in the Cuckmere Valley, north and south of the A259 (to the northern extent of the SSSI).
NB this list includes records from above the floodplain.

Species	Status	WCA	Local status/BAP	Last recorded
Alopecurus bulbosus (bulbous foxtail)	Nationally Scarce			1987
Althaea officinalis (marsh mallow)	Nationally Scarce			1992
Atriplex laciniata (frosted orache)				2001
Bupleurum tenuissimum (slender hare's ear)	Nationally Scarce/NERC s41		Priority BAP	1989
Cakile maritima (sea rocket)				2007
Carex divisa (divided sedge)	Nationally Scarce/NERC s41		Priority BAP	1991
Centaurea calcitrapa (red star-thistle)	Critically Endangered/NERC s41		Introduced	1998
Euphrasia pseudokerneri (chalk eyebright)	Endangered/NERC s41		Priority BAP	2004
Frankenia laevis (sea-heath)	Near Threatened			1992
Fumaria densiflora (dense flowered fumitory)				1989
Hippophae rhamnoides (sea-buckthorn)	Nationally Scarce			1979
Hordeum marinum (sea barley)	Nationally Scarce/NERC s41		Priority BAP	1993
Hydrocharis morsus-ranae (frogbit)				1999
Lathyrus aphaca (yellow vetchling)	Nationally Scarce			1966
Limonium binervosum subsp. binervosum (rock sea-lavender)				2004
Marrubium vulgare (white horehound)	Nationally Scarce		Introduced	1990
Matthiola incana (hoary stock)	Naturalised			1996
Medicago polymorpha (toothed meddick)	Nationally Scarce			2007
Orchis ustulata (burnt orchid)	Endangered/NERC s41		Priority BAP species	1999
Ophrys sphegodes (early spider-orchid)	Nationally Scarce	Schedule 8		1996
Parapholis incurva (curved hard grass)	Nationally Scarce			1993
Hennediella heimii (a moss)			Endangered	1994
Rumex maritimus (golden dock)				1996
Ruppia cirrhosa (spiral tasselweed)	Near Threatened			1996
Ruppia maritima (beaked tasselweed)				1994
Salicornia dolichostachya (long-spiked glasswort)				2003
Salicornia fragilis	Nationally Scarce			2003

(yellow glasswort)				
Salicornia pusilla (one-flowered glasswort)	Nationally Scarce			1992
Sarcocornia perennis (perennial glasswort)	Nationally scarce			1993
Trifolium squamosum (sea clover)	Nationally Scarce			1978
Weissia tortilis (a moss)	Nationally Scarce/NERC s41		Priority BAP	1994

Appendix 2 – Bird species recorded in the Cuckmere Valley, north and south of the A259 to the northern extent of the SSSI, plus those listed on SSSI citation.

Species	SSSI citation	Recorded		Species	SSSI citation	Recorded
Barnacle goose		X		Little stint		X
Black headed gull		X		Magellan goose		X
Blackbird		X		Magpie		X
Black redstart		X		Mandarin duck		X
Black tailed godwit		X		Mallard		X
Blue tit		X		Meadow pipit		X
Brent goose		X		Merlin		X
Canada goose		X		Mute swan		X
Carrion crow		X		Oystercatcher		X
Cattle egret		X		Peregrine falcon	X	X
Cetti's warbler		X		Pied wagtail		X
Chaffinch		X		Pink footed goose		X
Chiff chaff		X		Red knot		X
Common goldeneye		X		Redshank		X
Common gull		X		Red-breasted merganser		X
Cormorant		X		Reed bunting		X
Curlew		X		Reed warbler		X
Curlew sandpiper		X		Ringed plover		X
Dunlin		X		Robin		X
Dunnock		X		Rock pipit		X
Fieldfare		X		Rook		X
Firecrest		X		Sand martin		X
Fulmar	X			Sandpiper		X
Goldfinch		X		Shelduck		X
Goosander		X		Shoveler		X
Great black backed gull		X		Skylark		X
Great grey shrike		X		Snipe	X	X
Great tit		X		Song thrush		X
Great white egret		X		Sparrowhawk		X
Greater scaup		X		Spotted redshank		X
Green sandpiper		X		Starling		X
Green woodpecker	X	X		Stone curlew		X
Greenfinch		X		Stonechat	X	X
Greenshank		X		Swallow		X
Grey wagtail		X		Swift		X
Hedge sparrow		X		Teal	X	X
Heron		X		Temminck's stint		X
Herring gull		X		Twite		X
Hobby		X		Water pipit		X
House martin		X		Water rail		X
Jackdaw		X		Wheatear		X
Kentish plover		X		Whimbrel		X
Kestrel		X		Whinchat		X
Kingfisher		X		White-fronted goose		X
Lapwing		X		Whitethroat		X
Lesser black backed gull		X		Whooper swan		X
Lesser whitethroat	X			Wigeon	X	X
Linnet		X		Woodchat shrike		X
Little egret		X		Woodpigeon		X

Little grebe		X		Yellow wagtail		X
Little gull		X		Yellowhammer	X	
Little ringed plover		X				

Appendix 3 – List of invertebrate species recorded in the Cuckmere Valley, north and south of the A259 to the northern extent of the SSSI.

Species	IUCN Red Data List	National Status	Local Status	Last recorded
Agabus conspersus (water beetle)		Notable/Nb		2001
Agraecina striata (spider)				2006
Agriotes sordidus (click beetle)	pRDB3			1945
Amara strenua (ground beetle)				2000
Anacaena bipustulata (scavenger water beetle)		Notable/Nb		1984
Anax parthenope (lesser emperor dragonfly)				1999
Andrena bimaculata (hymenopteran)		Notable/Nb		2006
Bembidion fumigatum (ground beetle)		Notable/Nb		1975
Bembidion maritimum (beetle)				1972
Bembidion saxatile (ground beetle)		Notable/Nb	Presumed extinct	1892
Berosus affinis (scavenger water beetle)		Notable/Nb		2001
Berosus fulvus	RDB3			2001
Berosus spinosus (beetle)				2001
Bledius tricornis (rover beetle)		Notable/Nb		1994
Brachytron pratense (hairy dragonfly)				1996
Cassida vittata (borded tortoise beetle)		Local		1987
Cercyon depressus (scavenger water beetle)		Notable		1977
Cercyon tristis (beetle)		Notable/Nb		1999
Coenagrion pulchellum (dragonfly)	Near Threatened			1992
Coelambus parallelogrammus (water beetle)		Notable/Nb		2001
Conocephalus discolor (long-winged conehead)	Rare	Notable/Na		1999
Cucullia asteris (starwort moth)				1993
Dolichopus strigipes (long-legged fly)		Nationally scarce		1994
Philorhizus vectensis (ground beetle)	pRDB3	NERC s41	Priority BAP	1977
Dytiscus circumflexus (water beetle)		Notable/Nb		1963
Enochrus bicolor (scavenger water beetle)		Notable/Nb		2001
Enochrus melanocephalus (scavenger water beetle)		Notable/Nb		1993
Haliplus apicalis (crawling water beetle)		Notable/Nb		1964
Haliplus heydeni (crawling water beetle)		Notable/Nb		1963
Hebrus pusillus (true bug)		Notable/Nb		1999
Helochares lividus (scavenger water beetle)		Notable/Nb		1963
Helophorus alternans (beetle)		Notable/Na		2001
Helophorus fulgidicollis (scavenger beetle)		Notable/Nb		2001
Helophorus nanus (scavenger beetle)		Notable/Nb		1986
Heterota plumbea (rove beetle)		Notable		1977
Hydaticus seminiger (beetle)		Notable/Nb		1999

Species	IUCN Red Data List	National Status	Local Status	Last recorded
Hydraena testacea (small water beetle)		Notable/Nb		2001
Hydrochus ignicollis (scavenger water beetle)	RDB3			2001
Hydrophilus piceus (great silver water beetle)	Rare			1999
Hydrovatus clypealis (water beetle)		Notable/Na		2001
Laccobius atrocephalus (scavenger water beetle)		Notable/Nb		1963
Licinus depressus (ground beetle)		Notable/Nb		1975
Limnoxenus niger (scavenger water beetle)		Notable/Nb		1994
Phytobius leucogaster (weevil)		Notable/Nb		1993
Ochthebius auriculatus (small water beetle)		Notable/Nb		2001
Ochthebius marinus (small water beetle)		Notable/Nb		2001
Ochthebius punctatus (small water beetle)		Notable/Nb		2001
Ochthebius viridis (small water beetle)		Notable/Nb		1979
Orthoceratium lacustre (long-legged fly)				1994
Paederus fuscipes (beetle)		Notable/Nb		1999
Panagaeus bipustulatus (ground beetle)		Notable/Nb		1974
Peltodytes caesus (crawling water beetle)		Notable/Nb		2001
Pterostichus anthracinus (ground beetle)		Notable/Nb		1975
Rhantus suturalis (water beetle)		Notable/Nb		1994
Scopula emutaria (rosy wave moth)				1994
Stratiomys singularior (soldier fly)		Notable		1994
Sympetrum fonscolombii (red-veined darter)				2007
Sympetrum sanguineum (ruddy darter)				1999
Epichnopterix retiella (bagworm moth)				1995

Appendix 4 – Options Appraisal Tables

Policy Option	**Baseline 'Do Nothing' (or 'Do Minimum' – EA to maintain clearance of river mouth for 15 years or until the river system becomes self regulating)**		
Feature/Impact	**0-20 years**	**20-50 years**	**50-100 years**
River channel	Largely unchanged with slight increase in exposed mud and no new formation of saltmarsh.	Largely unchanged with slight increase in exposed mud and no new formation of saltmarsh.	The main channel will have become integrated with the floodplain. Small pockets of saltmarsh vegetation but much of the existing saltmarsh will be eroded and lost.
Floodplain	No change to the habitat in cell A, gradual formation of mudflats and possibly pockets of pioneer saltmarsh in cell B, little change to cell C although possible influx of more salt tolerant species.	Possible formation of reed beds around meanders, continuing development of intertidal habitat in cell B with no net loss of saltmarsh (whilst existing pockets nearest the river are likely to be lost, new areas are likely to colonise). Formation of tidal creeks in cell C, with associated development of small areas of intertidal habitat and the possibility of saline reed beds. Overall an increase in habitat diversity and the development of transitional habitats.	The majority of cell A will remain as grassland, although more salt tolerant species are likely to colonise, particularly in the southern part of the cell. The meanders will largely disappear although some standing water will remain as saline lagoons. Tidal creeks will develop near the river with saltmarsh developing at the margins. A mosaic of intertidal mudflat and saltmarsh will develop across cells B and C with areas of standing water remaining as saline lagoons.
Beach	The east beach will remain largely unchanged. Recycling of material from the mouth to the west beach will continue for some time, and hence, the vegetation on the west beach is unlikely to recover to a favourable condition in the short term.	The east beach may move landwards and its angle may adjust slightly, with the beach lengthening as a consequence. However, it will remain stable and largely unchanged. The west beach will lose material and swing round to a more stable position. Despite a reduction in volume, an increase in stability is likely to mean and increase in the amount and condition of shingle vegetation.	The east beach may continue to move landwards and may be more vulnerable to overtopping, but it will remain largely unchanged. The west beach will remain stable and slightly protected, which is likely to result in an improvement in the shingle vegetation community.
Engineering impacts	None/negligible, although ongoing shingle recycling will continue to have a detrimental impact on the shingle habitat of the west beach.	None/negligible.	None/negligible.
Summary of ecology and concluding remarks	*The estuary is nationally important for several of the existing habitats (in the case of the grassland because of the birds they support). The ecology of the estuary will remain largely unchanged, although some additional intertidal habitats will start to develop on the western floodplain. Some of the bird species that currently utilise the western floodplain*	*Significant areas of the existing habitats and their associated species, several of which are already of national importance, would be maintained within the estuary. In addition, the areas of intertidal habitat would increase, and there is likely to be a subsequent increase in the range and diversity of species, most notably birds, that use the estuary. The*	*Some of the existing wildlife interest within the estuary would be maintained, primarily the grassland around the meanders. Whilst some of the existing grassland would be lost, this would be replaced by areas of intertidal habitats which are of at least equal ecological importance. Intertidal habitats would continue to develop and spread across the wider*

	may be displaced by an influx of more coastal species, but these are not likely to be in significant numbers at this stage and there is unlikely to be a net loss, as there is still suitable habitat available to them upstream of the A259. Similarly, some of the invertebrate species present within the ditches on the western floodplain are likely to relocate upstream where conditions are likely to be more suitable.	*condition of the vegetated shingle habitat on both sides of the river mouth is likely to improve.*	*estuary, ranging from mudflats on the lowest ground to saltmarsh in the higher areas. These would attract a variety of animals, most notably wildfowl and wading birds. Some saline lagoon habitat would be lost (i.e. some of the meander) but there will be an increase in creek habitats.*
Assessment	**NEUTRAL**	**NEUTRAL**	**NEUTRAL**

Policy Option	**A – Partial Breach Managed Realignment**		
Feature/Impact	**0-20 years**	**20-50 years**	**50-100 years**
River channel	In habitat terms, the river channel will remain largely unchanged. As the river channel widens slightly, there will be a slight increase in the area of exposed mud at low tide. It is unlikely that any significant new areas of saltmarsh will form.	The channel will remain largely unchanged, but where it continues to widen and the revetments break down, the extent of exposed mud at low tide will increase. It is unlikely that any new areas of saltmarsh will form and the existing areas along the channel are likely to be lost.	Below the cut, the channel will have become an integral part of the surrounding intertidal floodplains. There will be some pockets of saltmarsh along the channel but the existing areas will have been lost.
Floodplain	Cell A will remain largely unchanged. The meanders will continue to silt up, with the associated risks of increasing temperatures and decreasing oxygen levels during hot periods. Cell B will become fully intertidal, with a mosaic of mudflats and saltmarsh, the majority of the land being high enough for pioneer saltmarsh species to colonise. Cell C will remain largely unchanged although more salt tolerant species are likely to develop in some areas, meaning an increase in transitional habitats.	Cell A will remain largely unchanged. The meanders will continue to silt up, with the associated risks of increasing temperatures and decreasing oxygen levels during hot periods. Cell B will continue to develop as intertidal habitats with some poorly drained areas remaining permanently wet. Whilst the existing saltmarsh near the river channel will be lost, new areas will develop. The majority of cell C will remain unchanged although there will be some intertidal habitat development and there may be an increase in the area of saline lagoons.	The habitat of cell A will remain as grassland, and the meanders will have largely disappeared, although some areas of standing water may remain. The intertidal habitats of cell B will continue to develop, with a mosaic of mudflats and saltmarsh. Cell C will also be largely intertidal with some mudflats nearest the river, and saltmarsh surrounding the remaining saline lagoon behind the east beach.
Beach	The west beach will continue to lose material and will therefore reduce in size. The east beach will remain stable and may increase in volume.	Although smaller, the west beach is likely to be more stable, and as there will be no ongoing recharge and recycling works, the vegetation present should have recovered, albeit that only pioneer species are likely to be present. The east beach will remain stable and largely unchanged from an ecological point of view.	The east beach may continue to move landwards and may be more vulnerable to overtopping, but it will remain largely unchanged. The west beach will remain stable and slightly protected, which is likely to result in an improvement in the shingle vegetation community.

Engineering impacts	Initial breach of the embankments into cells B and C may result in some localised loss of existing saltmarsh, but there is unlikely to be any net loss of intertidal habitat. Maintenance and strengthening of river channel protecting cell A and construction of new embankment to protect Foxhole valley will involve some land take. The knock-on effects of the construction (e.g. where the material will come from, how it will be imported onto site, etc) are unknown. Ongoing recycling of beach material for up to five years will continue to have a detrimental impact on the shingle vegetation of the west beach.	Maintenance, including strengthening and widening of embankments protecting cell A and Foxhole valley, resulting in some land take around the embankments. The knock-on impacts of the construction and maintenance (e.g. where the material will come from, how it will be imported onto site etc) are unknown.	Maintenance, including strengthening and widening of embankments protecting cell A and Foxhole valley, resulting in some land take around the embankments. The knock-on impacts of the construction and maintenance (e.g. where the material will come from, how it will be imported onto site etc) are unknown.
Summary of ecology and concluding remarks	*The ecology of the estuary will remain largely unchanged to the east of the river, whilst a mosaic of intertidal mudflat and saltmarsh will start to develop on the western floodplain. Some of the bird species that currently utilise the western floodplain may be displaced by an influx of more coastal species, but these are not likely to be in significant numbers at this stage and there is unlikely to be a net loss, as there is still suitable habitat available to them upstream of the A259. The ecological condition of the meanders is likely to decline as they continue to silt up. Some of the invertebrate species present within the ditches are likely to relocate to more suitable habitat upstream. Construction of the new embankment will result in some land take and is likely to cause disturbance, at least in the short term. The shingle vegetation should begin to recover once the shingle recharge and recycling works cease and the beaches realign and reach equilibrium. Overall, any losses and/or negative impacts are likely to be outweighed by gains in ecological health and diversity.*	*The north east side of the estuary would remain largely unchanged, whilst the southern and western side would continue to develop a mosaic of intertidal saltmarsh and mudflats which is likely to attract a variety of wildfowl and wading birds. Whilst there would be some change to the current wildlife, the habitats and species that would be attracted would be equally important, and those species that may be displaced are likely to relocate upstream. The condition of the vegetated shingle habitat on both sides of the river mouth is likely to improve.*	*Intertidal habitats would continue to develop across the estuary, ranging from mudflats in the lowest areas to saltmarsh in the higher areas around the meanders. These habitats would attract a variety of animals, most notably wildfowl and wading birds. Whilst there would be some change to the current wildlife, the habitats and species that would be attracted would be equally important, and those species that may be displaced are likely to relocate upstream. The condition of the vegetated shingle habitat on both sides of the river mouth is likely to improve.*
Assessment	**NEUTRAL**	**POSITIVE**	**POSITIVE**

Policy Option	B – Full Breach Managed Realignment		
Feature/Impact	**0-20 years**	**20-50 years**	**50-100 years**
River channel	There may a small increase in the area of mud exposed at low tide as the river channel widens slightly. It is unlikely that any new saltmarsh will form within the channel.	There may a small increase in the area of mud exposed at low tide as the river channel widens. It is unlikely that any new saltmarsh will form within the channel.	The river channel below the cut will have become an integral part of the intertidal habitat of the surrounding floodplains. Whilst some pockets of saltmarsh will remain along the channel, the majority of the existing saltmarsh will have been eroded and lost.
Floodplain	Cell A will remain largely unchanged. Cell B will become intertidal with a mosaic of mudflats and saltmarsh, the majority of the land being high enough to allow colonisation by pioneer saltmarsh species. With an influx of salt tolerant species in higher areas, there will be an increase in transitional habitats. The creation of the tidal lagoon will result in the loss of some grassland, and a section of the existing saline lagoon, and an increase in the amount of exposed mud at low tide. The remainder of cell C will show an increase in transitional habitats, and the development of some intertidal mudflats and saltmarsh.	Cell A will remain largely unchanged, although the health of the meanders is likely to improve as the water is more regularly flushed and the channel is deepened. Tidal creeks are likely to develop from the existing meander channel into the surrounding floodplain, with a subsequent spread of more salt tolerant species. The intertidal habitats in cell B will continue to develop, the majority being covered by saltmarsh, and demonstrating zonation from mudflats, through pioneer saltmarsh through to higher marsh habitat. Intertidal habitats in cell C will continue to develop and mature with a transition from mudflats through saltmarsh to coastal grazing marsh. The tidal lagoon will have begun to silt up and will now form a saline lagoon.	Cell A will comprise a mosaic of intertidal mudflats and saltmarsh with transitional habitats and coastal grazing marsh. The lower section of the meander will have become a tidal creek with extensions branching into the surrounding floodplain. Cell B will now be a well established area of intertidal habitat, interacting naturally with the river. The mosaic of mudflats and saltmarsh will remain a dynamic system, changing as deposition rates decrease. Cell C will also be fully intertidal, with a transition from mudflats and saltmarsh through to coastal grazing marsh. The excavated reservoir will have shallowed considerably through the deposition of silt and will remain as a saline lagoon.
Beach	The west beach will continue to lose material and will therefore reduce in size. The east beach will remain stable and may increase in volume.	Although smaller, the west beach is likely to be more stable, and as there will be no ongoing recharge and recycling works, the vegetation present should have recovered, albeit that only pioneer species are likely to be present. The east beach will remain stable and largely unchanged from an ecological point of view.	The east beach may continue to move landwards and may be more vulnerable to overtopping, but it will remain largely unchanged. The west beach will remain stable and slightly protected, which is likely to result in an improvement in the shingle vegetation community.
Engineering impacts	Initial breach of the embankments may result in some localised loss of existing saltmarsh, but there is unlikely to be any net loss of intertidal habitat. Construction of embankments to protect the canoe barn and the A259 and to divide cells A and C will result in land take. Excavation of a reservoir to the east of the lower reaches of the river will involve significant land take and a	Ongoing maintenance of the embankments.	

	reduction in the area of the existing saline lagoon. Works to raise the height of the concrete track along the east side of the estuary will involve some land take (although this will probably be temporary). The knock-on effects of the construction works (e.g. where the material will come from, how it will be imported onto site etc) are unknown. Ongoing recycling of beach material for up to five years will continue to have a detrimental impact on the shingle vegetation of the west beach.		
Summary of ecology and concluding remarks	*The north east end of the estuary would remain unchanged due to the new embankment. The west side and remainder of the east side would start to form a mosaic of intertidal saltmarsh and mudflats which is likely to attract a variety of wildfowl and wading birds. Much of the existing habitat would be lost (neutral grassland, brackish ditches and freshwater bodies). However, there would be no net loss in the range of habitats present within the SSSI and there would be a net gain in ecological terms through the increase in rare intertidal habitats and the move to a more dynamic and ecologically diverse system.*	*The very north east end of the estuary would remain unchanged due to the embankment in place. The remainder will continue to develop as a mosaic of intertidal saltmarsh and mudflats which is likely to attract a variety of wildfowl and wading birds. Whilst there would be some change to the current wildlife, the habitats and species that would be attracted would be equally important, and there would be no net loss in the range of habitats present within the SSSI as the habitats upstream will remain unchanged. There would be a net gain in ecological terms through the increase in rare intertidal habitats and the move to a more dynamic and ecologically diverse system. The condition of the vegetated shingle habitat on both sides of the river mouth is likely to improve.*	*The north east will retain some grassland. Elsewhere established intertidal habitats would be in place, ranging from mudflats in the lowest areas to saltmarsh in the in the southern end around the meanders. These habitats would attract a variety of animals, most notably wildfowl and wading birds. Any species displaced by the transition from a freshwater to a saline system are likely to have relocated upstream, and the ecosystem within the estuary is likely to be largely self-sustaining and robust in terms of adapting natural change such as rising sea levels.*
Assessment	**POSITIVE**	**POSITIVE**	**POSITIVE**

Policy Option	**C – Engineered Reactivation of Meanders and Saltmarsh Creeks**		
Feature/Impact	**0-20 years**	**20-50 years**	**50-100 years**
River channel	It is likely that the banks of the channel will become wider and shallower, resulting in larger areas of exposed mud at low tide and a loss of the saltmarsh that currently exists along the channel.	No significant change in habitats within the channel although the course of the river may change slightly.	No significant change in habitats within the channel although the course of the river may change slightly.
Floodplain	Small areas of intertidal mudflats and saltmarsh will develop around the reactivated	The grassland in cell A will be dominated by salt tolerant species, and whilst the areas of	The extent of saltmarsh and mudflat within cell A will have increased, and the floodplain

	meanders and tidal creeks in cell A, although the majority of the floodplain will remain grassland, with a transition to more salt tolerant species. Areas of standing water are likely to become increasingly brackish/saline. Cell B will be regularly inundated and large areas of standing water are likely to remain between tides. As a result, a mosaic of intertidal habitats will develop, with large areas of mudflat and a transition to saltmarsh around the margins. Cell C is likely to become the most diverse in terms of habitats, with a mosaic of mudflats, saltmarsh and coastal grazing marsh around the existing saline lagoon that is likely to remain.	intertidal mudflat and lower saltmarsh will have increased slightly, the frequency of tidal inundation will still be relatively low. Saline lagoons will be present across the floodplain. The proportion of mudflat to saltmarsh in cell B will change as land levels are raised by deposition, and the area of saltmarsh increases as a result. Cell C will remain a diverse area in terms of habitat with a transition of habitats from mudflats through saltmarsh to grazing marsh, with high levels of accretion encouraging the spread of saltmarsh.	will be dominated by salt tolerant species. Saline lagoons will be present across the floodplain. Land levels within cell B will continue to increase with a subsequent increase in the amount of saltmarsh within the intertidal habitat mosaic. Cell C will remain a diverse area in terms of habitat with a transition of habitats from mudflats through saltmarsh to grazing marsh, with high levels of accretion encouraging the spread of saltmarsh. The saline lagoon is likely to be lost or at least reduced in area through sedimentation.
Beach	The west beach will continue to lose material and will therefore reduce in size. The east beach will remain stable and may increase in volume.	Although smaller, the west beach is likely to be more stable, and as there will be no ongoing recharge and recycling works, the vegetation present should have recovered, albeit that only pioneer species are likely to be present. The east beach will remain stable and largely unchanged from an ecological point of view.	The east beach may continue to move landwards and may be more vulnerable to overtopping, but it will remain largely unchanged. The west beach will remain stable and slightly protected, which is likely to result in an improvement in the shingle vegetation community.
Engineering impacts	The short term engineering impacts are likely to be great as removal of all the embankments and in-channels embankments, along with excavation of the remnant creeks will require access to all parts of the estuary by diggers. Works to raise the height of the concrete track along the east side of the estuary and the Vanguard Way along the west side will involve some land take (although this will probably be temporary). Ongoing recycling of beach material for up to five years will continue to have a detrimental impact on the shingle vegetation of the west beach.	Raising of the A259 and additional revetment will require some land take, albeit temporary.	None/negligible.
Summary of ecology and concluding remarks	*The north east end of the estuary would remain unchanged due to the new embankment. The west side and remainder of the east side would start to form a mosaic of intertidal saltmarsh and mudflats which is*	*Intertidal habitats would continue to develop across the estuary, ranging from mudflats in the lowest areas to saltmarsh in the higher areas around the meanders. These habitats would attract a variety of animals, most notably*	*Mature intertidal habitats would be established across the estuary, ranging from mudflats in the lowest areas to saltmarsh and salt tolerant grassland in the higher areas around the meanders. These habitats would*

	likely to attract a variety of wildfowl and wading birds. Habitat development is likely to be relatively rapid due to reactivation of the remnant creeks which would aid the transfer of seawater, sediment and nutrients across the floodplains. However, there would be significant engineering works involved in this option. The rapid change will also make the natural relocation of some species (e.g. water beetles) more difficult. Much of the existing habitat would be lost (neutral grassland, brackish ditches and freshwater bodies. However, there would be no net loss in the range of habitats present within the SSSI and there would be a net gain in ecological terms, through the increase in rare intertidal habitats and the move to a more dynamic and ecologically diverse system.	*wildfowl and wading birds. Whilst there would be some change to the current wildlife, the habitats and species that would be attracted would be equally important, and there would be no net loss in the range of habitats present within the SSSI as the habitats upstream will remain unchanged. There would be a net gain in ecological terms through the increase in rare intertidal habitats and the move to a more dynamic and ecologically diverse system.*	*attract a variety of animals, most notably wildfowl and wading birds. The ecosystem within the estuary is likely to be largely self-sustaining and robust in terms of adapting natural change such as rising sea levels.*
Assessment	**NEGATIVE**	**POSITIVE**	**POSITIVE**

Policy Option	**D – Maintain the Existing Defences**		
Feature/Impact	**0-20 years**	**20-50 years**	**50-100 years**
River channel	No significant change to habitat.	The river channel habitat will remain largely unchanged with a slight increase in the area of exposed mud and a slight reduction in the area of saltmarsh.	There will be a slight increase in the area of exposed mud. Any existing saltmarsh within the channel will be lost through erosion.
Floodplain	The ecology of the valley floor in all three cells will remain largely unchanged, although overtopping of the embankments during a flood event would damage the existing vegetation.	The grassland habitats of cells A and C will remain largely unchanged. Cell B is likely to be regularly inundated on spring tides, with a likelihood that the water will remain on the floodplain for a long period due to the lack of drainage. This will damage the existing vegetation and will not allow colonisation by saltmarsh plants, so will result in areas of mudflat which are unlikely to be particularly productive.	The grassland habitats of cells A and C will remain largely unchanged. Cell B is likely to be regularly inundated on spring tides, with a likelihood that the water will remain on the floodplain for a long period due to the lack of drainage. This will damage the existing vegetation and will not allow colonisation by saltmarsh plants, so will result in areas of mudflat which are unlikely to be particularly productive.
Beach	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More frequent overtopping may result in a loss of	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More frequent overtopping may result in a loss of	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More frequent overtopping may result in a loss of

	some of the more important areas of established shingle vegetation at the back of the east beach.	some of the more important areas of established shingle vegetation at the back of the east beach.	some of the more important areas of established shingle vegetation at the back of the east beach.
Engineering impacts	Maintenance of the embankments and associated land drainage structures will require access to the embankments, but the ecological impacts are likely to be negligible. Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.	Maintenance of the embankments and associated land drainage structures will require access to the embankments, but the ecological impacts are likely to be negligible. Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.	Maintenance of the embankments and associated land drainage structures will require access to the embankments, but the ecological impacts are likely to be negligible. Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.
Summary of ecology and concluding remarks	*The ecology of the estuary will remain largely unchanged. As the estuary is nationally important for several of the existing habitats (in the case of the grassland because of the birds they support), this could be taken as a neutral impact. However, there is likely to be some habitat degradation, partly as a result of ongoing recycling works at the mouth and the associated impacts on the vegetated shingle habitat, and partly through the possibility of more frequent overtopping.*	*The ecology of the estuary will remain largely unchanged. As the estuary is nationally important for several of the existing habitats (in the case of the grassland because of the birds they support), this could be taken as a neutral impact. However, there is likely to be some habitat degradation, partly as a result of ongoing recycling works at the mouth and the associated impacts on the vegetated shingle habitat, and partly through the possibility of more frequent overtopping.*	*The ecology of the estuary will remain largely unchanged. As the estuary is nationally important for several of the existing habitats (in the case of the grassland because of the birds they support), this could be taken as a neutral impact. However, there is likely to be some habitat degradation, partly as a result of ongoing recycling works at the mouth and the associated impacts on the vegetated shingle habitat, and partly through the possibility of more frequent overtopping.*
Assessment	**NEGATIVE**	**NEGATIVE**	**NEGATIVE**

Policy Option	**E – Sustaining the Defences: raising banks as sea level rises**		
Feature/Impact	**0-20 years**	**20-50 years**	**50-100 years**
River channel	The river channel habitat will remain largely unchanged.	The existing saltmarsh within the channel will be lost and reverted to mudflat.	The area of mudflat is likely to be lost.
Floodplain	No change to the existing habitat.	The meanders would have shallowed considerably due to sedimentation, and will therefore become more ‘unhealthy’ as a result of rising temperatures and decreasing oxygen levels. The valley floor habitat would remain unchanged.	The meanders would have silted up, resulting in a loss of saline lagoon habitat. The valley floor habitat would remain unchanged.
Beach	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More frequent overtopping may result in a loss of some of the more important areas of established shingle vegetation at the back of	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More frequent overtopping may result in a loss of some of the more important areas of established shingle vegetation at the back of	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More frequent overtopping may result in a loss of some of the more important areas of established shingle vegetation at the back of

	the east beach.	the east beach.	the east beach.
Engineering impacts	The addition of hard revetments will result in the loss of the riverbank habitat (currently mud with some saltmarsh species). Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.	Ongoing loss of riverbank habitat through additional revetments and loss of land adjacent to the channel as a result of widening of the embankments. The knock-on effects of this work are unknown (e.g. what material will be used, how it will be imported, where it will be stored etc). Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.	Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.
Summary of ecology and concluding remarks	*The ecology of the estuary will remain largely unchanged. As the estuary is nationally important for several of the existing habitats (in the case of the grassland because of the birds they support), this could be taken as a neutral impact. However, there is likely to be some habitat degradation, partly as a result of ongoing recycling works at the mouth and the associated impacts on the vegetated shingle habitat, and through loss of some riverbank habitat.*	*The majority of the floodplains will remain as neutral grassland. However, the meanders will continue to silt up, making them less suitable for the invertebrate and fish species that currently inhabit them, and hence less attractive to the birds that use them. There will also be direct land loss along the river channel resulting from widening of the embankments, and the saltmarsh that currently exists within the channel will be lost through erosion. Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.*	*The majority of the floodplains will remain as neutral grassland. However, the meanders will have silted up, resulting in a loss of saline lagoon habitat. The intertidal habitat along the river will have disappeared. Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.*
Assessment	**NEGATIVE**	**NEGATIVE**	**NEGATIVE**

Policy Option	**F – Sustaining the Defences: raising banks by 300 mm**		
Feature/Impact	**0-20 years**	**20-50 years**	**50-100 years**
River channel	The river channel habitat will remain largely unchanged.	The existing saltmarsh within the channel will be lost and reverted to mudflat.	The area of mudflat is likely to be lost.
Floodplain	No change to the existing habitat.	The meanders would have shallowed considerably due to sedimentation, and will therefore become more ‘unhealthy’ as a result of rising temperatures and decreasing oxygen levels. The valley floor habitat would remain unchanged.	The meanders would have silted up, resulting in a loss of saline lagoon habitat. The valley floor habitat would remain unchanged.
Beach	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More	The west and east beaches are likely to remain unchanged. As regular recharge and recycling will be required, the west beach will remain in unfavourable condition. More	Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.

	frequent overtopping may result in a loss of some of the more important areas of established shingle vegetation at the back of the east beach.	frequent overtopping may result in a loss of some of the more important areas of established shingle vegetation at the back of the east beach.	
Engineering impacts	Some land take and disturbance issues associated with the raising of the embankments. The knock-on effects of this work are unknown (e.g. what material will be used, how it will be imported, where it will be stored etc).	Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.	Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.
Summary of ecology and concluding remarks	*The ecology of the estuary will remain largely unchanged. As the estuary is nationally important for several of the existing habitats (in the case of the grassland because of the birds they support), this could be taken as a neutral impact. However, there is likely to be some habitat degradation, primarily as a result of ongoing recycling works at the mouth and the associated impacts on the vegetated shingle habitat.*	*The majority of the floodplains will remain as neutral grassland. However, the meanders will continue to silt up, making them less suitable for the invertebrate and fish species that currently inhabit them, and hence less attractive to the birds that use them. The saltmarsh that currently exists within the channel will be lost. Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.*	*The majority of the floodplains will remain as neutral grassland. However, the meanders will have silted up and disappeared. The intertidal habitat within the river channel will be lost. Ongoing recycling of beach material will continue to have a detrimental impact on the shingle vegetation of the west beach.*
Assessment	**NEGATIVE**	**NEGATIVE**	**NEGATIVE**