COOPER
MARINE ADVISORS

Fjordr
Marine and Historic Environment Consulting
info@fjordr.com www. fjordr.com

LARGE-SCALE SHORELINE INTERVENTIONS: CONSIDERATIONS FOR THE HISTORIC ENVIRONMENT. RESEARCH PROJECT 7865

Historic England

Cooper Marine Advisors Ltd and Fjordr Ltd

January 2020

LARGE-SCALE SHORELINE INTERVENTIONS: CONSIDERATIONS FOR THE HISTORIC ENVIRONMENT. RESEARCH PROJECT 7865

Document-control grid

This document has been prepared by Cooper Marine Advisors Ltd and Fjordr Ltd for Historic England, to report on the research project; Large-scale shoreline interventions: considerations for the historic environment.

Title	Large-scale shoreline interventions: considerations for the historic environment. Research Project 7865
Author(s)	Bill Cooper, Director, Cooper Marine Advisors Ltd (BCooper@CooperMarineAdvisors.co.uk) Antony Firth, Director, Fjordr Ltd (ajfirth@fjordr.com)
Derivation	Final draft research report
Origination Date	18th July 2019
Reviser(s)	Bill Cooper and Antony Firth
Date of last revision	23rd January 2020
Version	2.0
Status	Final
Summary of Changes	Responding to comments received from Historic England on First Draft.
Circulation	Project team
Required Action	Client sign-off
Filename	https://coopermarineadvisors-my.sharepoint.com/personal/bill_coopermarineadvisors_co_uk/Documents/Projects/Historic England 7865/deliverables/Report/2nd draft/7865 Shoreline Interventions - final - 23 January 2020.docx
Approval	Bill Cooper Antony Firth

Contents

Preface

The research report provides Historic England with a review of large-scale shoreline interventions along with an insight of the anticipated requirements for further projects around the coast of England. The role of the historic environment in existing projects is reviewed for present experience. The report also offers a basis for engagement with relevant parties and to ensure that the interests of the historic environment are adequately considered in future projects.

Acknowledgments

The authors of this research gratefully acknowledge the contributions provided by staff from Historic England (Heritage Protection Commissions; Science Advisors; Marine Planning), Environment Agency, National Trust, Coastal Partnership East and the Association of Local Government Archaeological Officers.

Abbreviations

ABP	Associated British Ports
AD	Anno Domini
ATL	Advance the Line
Brexit	'British Exit' from the EU
CIfA	Chartered Institute for Archaeologist
CITiZAN	Coastal and Intertidal Zone Archaeological Network
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
Defra	Department for Environment, Food & Rural Affairs
DfT	Department for Transport
DSCT	Deep Sea Container Terminal
DP	Dubai Ports
EAC	Europae Archaeologiae Consilium
EC	European Community
EEC	European Economic Community
etc.	et cetera
e.g.	exempli gratia
EIA	Environmental Impact Assessment
EPSG	European Petroleum Survey Group

EU	European Union
FCREM	Flood and Coastal Erosion Risk Management
GPA	Good Practice Advice
ha	hectare
HCP	Habitat Compensation Programme
HELM	Historic Environment Local Management
HER	Historic Environment Record
HM	Her Majesty's
HMNB	Her Majesty's Naval Base
HTL	Hold the Line
km	kilometre
LiDAR	Light Detection and Ranging
LUC	Land Use Consultants
m	metre
MHCLG	Ministry for Housing, Communities and Local Government Committee (formerly DCLG)
MMO	Marine Management Organisation
MHWS	Mean High Water Springs
MPS	Marine Policy Statement
MR	Managed Realignment
NAI	No Active Intervention
N.B.	Nota bene
NFDC	New Forest District Council
NHPP	National Heritage Protection Plan
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
OD	Ordnance Datum
OMReg	Online Managed Realignment Guide
p.	page
PU	Policy Unit
PVF	Public Value Framework
RCHME	Royal Commission on the Historical Monuments of England
RCZAS	Rapid Coastal Zone Assessment Surveys
RSBP	Royal Society for the Protection of Birds
SA	Science Advisor
SCHARP	Scotland's Coastal Heritage at Risk

SMP	Shoreline Management Plan
SCMP	Steart Coastal Management Project
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
UXO	Unexploded Ordnance
UK	United Kingdom
WSI	Written Schemes of Investigation

1. Introduction

The coastal margin is under continual pressure from sea level rise which can lead to increased erosion, reduction of inter-tidal habitats, as well as heightened flood risk. In some cases, existing hard defences may no longer provide the most sustainable medium or long-term option for shoreline management so softer approaches, such as managed realignment schemes, are now being implemented.

Sea level rise is also causing a loss of inter-tidal habitats designated for their importance to nature conservation because these habitats cannot migrate landward when they are backed by fixed sea defences or hard cliffs. Existing legislation requires compensation for the net loss by creating new areas of inter-tidal habitat.

Additional pressure on the coastline may also come from tidal lagoons and land reclamations, especially where a waterside location is essential (e.g. new port facilities) or strongly preferred (some forms of residential development). As well as having a direct impact on the shoreline, if such developments are considered to lead to a net loss of designated inter-tidal habitat then they are also legally required to provide suitable compensatory measures to offset the loss. These compensation sites are typically close by, but are also separate to the areas being developed.

The format of a compensation site is likely to be comparable to the areas sought for managed realignment, and in some cases the two requirements can be combined. Both require areas of available low-lying land adjoining the coast to enable the sea to enter the site and for tidal exchange to recreate a similar (inter-tidal) environment to that which is being lost.

The low-lying land being considered often has a very high potential for the presence of archaeological material covering a wide range of time periods and thematic types. The contexts within which such material may occur includes; shallow sub-tidal, inter-tidal, and areas landward of high water that are protected by flood banks and seawalls. In some cases, these structures may themselves be of historic interest, particularly as evidence of land claim. In broad terms, such contexts encompass places that have a complex history of inundation and reclamation over the course of many thousands of years of human habitation. Typically, such areas have been both land and sea at different times so they may contain archaeological material from both terrestrial and marine contexts. Although perhaps considered marginal today, such areas contained many important resources and have often been a focus of intensive human activity, giving rise to rich archaeological remains. Sites may include visible archaeological remains such as built heritage and earthworks, but much may be hidden and buried also, sometimes at considerable depth. Consequently, the full archaeological potential of these areas may not be readily apparent, which may risk it being overlooked or under-estimated.

As the land that becomes exposed to the sea for managed realignment may have an association (known or unknown) with the historic environment then proper consideration needs to be made through key stages in the development process (e.g. consenting; design; investment, etc.) to ensure avoidance or mitigation of damage. Equally, the areas directly involved in shoreline reclamations are likely to be large and may also include features of historic value facing similar risk.

In view of the multiple pressures on heritage assets in areas of such high archaeological potential, this research study considers the risks to the historic environment arising from large-scale shoreline interventions to help raise awareness of the need to fully consider the historic environment in the course of scheme budgeting, planning and design.

This research provides Historic England with a review of existing and potential future requirements for large-scale shoreline interventions across England. The report also offers a basis for engagement with project developers and relevant Government departments, and their agencies, to ensure that the interests of the historic environment are addressed appropriately.

This research builds on previous work; Climate Change Adaptation Report (Historic England, 2016) and Tidal Range Developments: considerations for the historic environment (Historic England, 2018)

1.1. Structure of the Research Report

Section 1 explains the scope and purpose of the research project.

Section 2 identifies the various types and functions of shoreline interventions considered by the research and the rate of development for existing projects.

Section 3 provides an insight to the anticipated association between heritage assets and the shoreline.

Section 4 considers the primary drivers and associated legislation for each type of shoreline intervention, the supporting strategies (where relevant) and presents available details for the potential locations of sites of interest. Exemplars are offered for each type of shoreline intervention.

Section 5 offers thoughts and recommendations for potential impacts, methods of assessment and approaches to mitigation.

Section 6 summarise key observations from the present experience of stakeholders.

Section 7 brings together a discussion, with recommendations, for future engagement in large-scale shoreline interventions.

Section 8 provides a reference list of key literature, as part of the evidence base for this review.

1.2. Historic Environment

The main areas of the historic environment related to large-scale shoreline interventions are likely to be areas adjacent to and landward of the present coastline; areas which typically have a very high potential for the presence of archaeological material covering a wide range of time periods and thematic types.

For present purposes, the historic environment is defined as all traces of past human activity and includes (Environment Agency, 2018):

- *Palaeo-environmental and geo-archaeological remains (as indicators of past climates, vegetational and landscape change)*
- *Archaeological remains (including wrecks)*
- *Historic buildings, parks and gardens; and*
- *Historic landscapes*.

The National Planning Policy Framework (MHCLG, 2019) also provides a complementary definition for the historic environment as:

All aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged, and landscaped and planted or managed flora.

The UK Marine Policy Statement (UK MPS) (HM Government, 2011), which applies from high water to areas out at sea, defines the historic environment; *as all aspects of the environment resulting from the interaction between people and places through time, including all surviving physical remains of past human activity, whether visible, buried or submerged*.

Specific features within the historic environment are referred to as 'heritage assets', defined in the NPPF (MHCLG, 2019) and UK MPS (HM Government, 2011) as follows:

Heritage Asset: A building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions, because of its heritage interest. It includes designated heritage assets and assets identified by the local planning authority (including local listing)

Those elements of the historic environment – buildings, monuments, sites or landscapes – that have been positively identified as holding a degree of significance meriting consideration are called 'heritage assets'

Both the NPPF and UK MPS make it plain that Government policy regards heritage assets as an irreplaceable resource that should be conserved in a manner appropriate to their significance so that they can be enjoyed for their contribution to the quality of life of existing and future generations (MHCLG, 2019 and HM Government, 2011).

1.3. Evidence Base

The project's evidence base is developed from a review of existing publications, publicly available information associated with shoreline management, the compilation of views from key stakeholders and relevant details collated from recent large-scale shoreline interventions. The evidence base is recognised in the information presented as well as the bibliography of references.

2. Main types of large-scale shoreline interventions

For this research project, large-scale shoreline interventions are taken to be schemes that include a major component which modifies the position of the existing shoreline and by doing so affects associated areas both seaward and landward to achieve one or other of the following functions;

- Managed realignment options for sustainable flood and coastal defence, primarily identified by Shoreline Management Plans;
- Habitat (re)creation to compensate for losses across designated nature conservation sites due to sea level rise (coastal squeeze type);
- Shoreline and waterfront development, including reclamation or impoundment; and
- Accompanying compensatory measures for direct and indirect habitat losses in designated sites attributable to shoreline development.

Apart from land reclamations for development, the remaining schemes are all commonly referred to as managed realignment projects, irrespective of their type and function. In some cases, a managed realignment project may also fulfil multiple roles, led by a primary requirement, such as flood defence, but adopting secondary functions, such as habitat creation / compensation, within the area opened to the sea. Managed realignment can be considered as one form of climate change adaptation in response to the pressure of sea level rise at the coast.

To date, the topic of the historic environment has not initiated any large-scale shoreline interventions, rather, the types of schemes considered in this research have tended to present a risk of impact on the coinciding historic environment.

2.1. Shoreline interventions not considered by this study

As this project is funded by Historic England, the research focuses on the shoreline around England only. Sites around Wales, Scotland and Northern Ireland are not considered. However, many of the generic issues outlined in this report are still likely to be relevant to large-scale shoreline interventions in those countries where there is pressure to alter the shoreline in response to sea level change and/or development pressure. Furthermore, the potential still exists for developments in one region to identify preferred compensatory measures within another, this would also include barrages that are cross-border.

The following forms of shoreline intervention fall outside the scope of this research:

- Habitat creation sites without a connection to the sea.
- Unmanaged realignments where sites have become or will be breached by natural processes and are not subject to any direct physical intervention (and are therefore not promoted through any planning application and are not the subject of a consenting process).
- Indirect interventions, such as changing vegetation on dunes to alter sediment transport.
- Beach replenishment schemes to sustain an existing shoreline alignment.
- Small-scale developments that are not intended to change the position of the shoreline, such as landfalls for cables or pipelines.
- Schemes to upgrade existing hard defences or build new ones as part of a 'hold the line' shoreline management approach.

Although not considered further in this report, it is fully acknowledged that such forms of shoreline intervention can have major implications for heritage assets at the coast, adding to the impacts that climate change – and human adaptations to climate change – are having on the historic environment ([] add ref Harkin et al 2020 -- Harkin, D., Davies, M., Hyslop, E., Fluck, H., Wiggins, M., Merritt, O., Barker L., Deery, M., McNeary R., and Westley, K. (2020) Impacts of climate change on cultural heritage. MCCIP Science Review 2020, 616–641).

2.2. Scales of shoreline intervention

In the present context, "large-scale" is not intended to imply any minimum threshold for a length of shoreline or an area which may see a change of present status, rather "large-scale" is intended to refer to projects that are subject to a formal consenting process and sites that are of a size likely to encounter a diversity of issues related to the historic environment. In some cases, large-scale shoreline interventions may also be a component of a bigger project rather than a standalone application.

The commonly adopted unit of scale for sites and areas of development is hectares (ha). One hectare is equivalent to 10,000 m^2 or 2.47 acres.

Figure 1 identifies the location all existing shoreline intervention sites (to end of 2019) associated with the shoreline of England (adapted from www.OMReg.net). These sites represent habitat creation schemes (25), managed realignment projects for flood defence (16) and compensation sites for development (9). In many cases, the schemes may be developed with a combination of these purposes. Land reclamation sites are not shown.

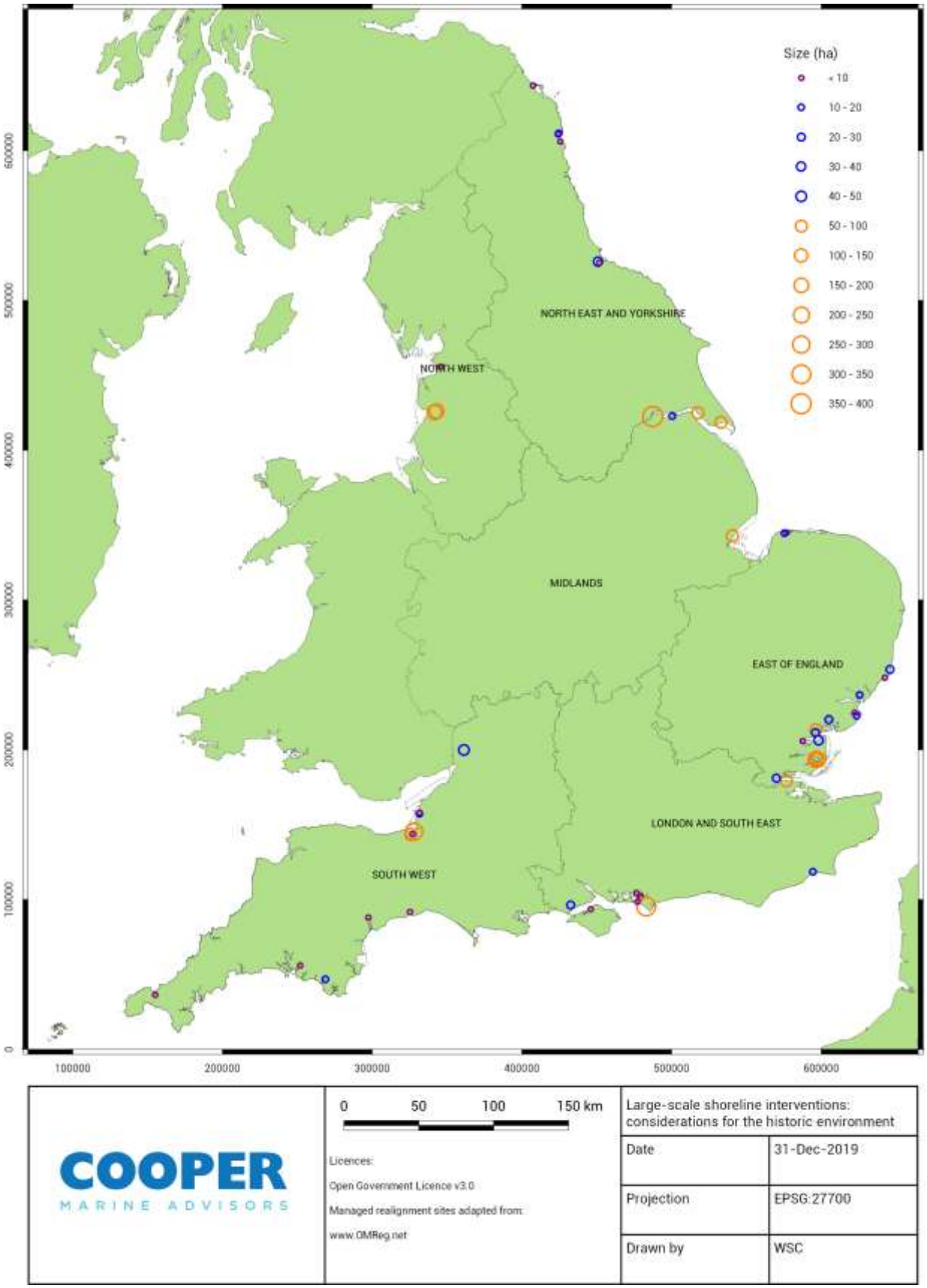

Figure 1. **Location of existing shoreline intervention sites around the English Coast.**

Table 1 summarises the rate of progress, by decade, in developing shoreline interventions around the shoreline of England.

Table 1. Summary of number and scale of shoreline interventions, by decade, in England (1990 to 2019).

Decade	Number of schemes	Average size (ha)	Maximum size (ha)	Total (ha)	Cumulative Total (ha)
1980 - 1989	0	0.0	0.0	0.0	0.0
1990 – 1999	10	12.1	38.0	121.1	121.1
2000 – 2009	22	52.7	370.0	1,159.6	1,280.7
2010 – 2019	18	77.7	302.0	1,399.0	2,679.7

The initial managed realignment project in England was on Northey Island, Blackwater Estuary, Essex, promoted by the National Trust. In comparison to recent schemes, this was a relatively small-scale (0.8 ha) trial (experimental) set-back scheme completed in 1991. (N.B. 'set-back' was a previous descriptive term for 'managed realignment' where a recognised flood defence line would be set-back behind the existing line).

In the first decade of activity (1990 to 1999) there were a further nine similar projects, averaging at around 13 ha. In the following decade (2000 to 2009), the number of projects increased to 22 with an average size also increasing to around 53 ha. For the most recent period (2010 to 2019 to date), the average size of projects has increased as well as the total size of all projects, but this has also been achieved with slightly fewer 'larger' projects.

Whilst this pattern may indicate the general trend of such projects, as well as the tendency for larger sized schemes, the drivers and legislation for implementing such schemes have also evolved in this period. Section 4 reviews the policy drivers which are expected to be relevant to upcoming schemes.

2.3. EIA requirements

Irrespective of the principal driver for a large-scale shoreline intervention, an Environmental Impact Assessment (EIA) is likely to be required to support the application for consent. Existing EIA legislation requires that the environmental sensitivity of geographical areas likely to be affected by development (i.e. reclamation areas and compensation sites) is considered; cultural heritage (including architectural and archaeological aspects) and landscape are included among the factors that must be addressed by EIA. Importantly, EIA encompasses the direct footprint of the development but also (indirect) associated areas where there is a pathway of effect.

A project which addresses a local scale requirement would typically be submitted to the relevant (county or district level) local planning authority and considered under 'The Town and Country Planning (Environmental Impact Assessment) Regulations 2017'.

These regulations recognise different types of development:

Schedule 1; large infrastructure type developments where a full EIA is always required; and

Schedule 2; projects which are subject to screening to determine the need for EIA if there is likely to be significant effects on the environment by virtue of factors such as its nature, size or location. Land reclamation and coastal infrastructure have no minimum size thresholds and schemes involving these types of works appear to always require an EIA.

Medmerry Managed Realignment, Sussex, (302 ha site including 183 ha of new inter-tidal) was determined by Chichester District Council and considered as a Schedule 2 type development. This scheme became operational in 2013.

Schedule 1 developments would normally be considered by the Secretary of State, rather than the local planning authority.

In some cases, these larger developments (e.g. for transport, energy generation, etc.) may also be regarded as major infrastructure (Nationally Significant Infrastructure Projects, (NSIP)), applicable to England and Wales. In these cases, the application is submitted to the Planning Inspectorate under the 'Planning Act 2008' as the primary legislation, with 'The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017' as secondary legislation. This process includes public examination of the application. At the end of their examination the Planning Inspectorate makes suitable recommendations to enable the Secretary of State to make a final decision for granting a Development Consent Order (DCO).

Able Marine Energy Park, Humber Estuary, was considered as a NSIP and was granted a DCO in 2014 but has yet to advance to construction. This scheme includes land reclamation on the south bank of the Humber Estuary (around 1300 m along the shoreline and up to 400 m offshore), immediately upstream of ABP Immingham. The approximate area of planned reclamation is 45 ha, which includes designated inter-tidal and sub-tidal habitats. The expected loss (direct and indirect) of designated inter-tidal habitat is planned to be compensated (as an integral element of the project) by a managed realignment scheme at Cherry Cobb Sands on the opposite bank of the estuary. This site offers around 101.5 ha of new habitat (of which 88 ha is inter-tidal and 13.5 ha sub-tidal) through managed realignment of the existing shoreline. The net change in shoreline character for this project therefore amounts to around 146.5 ha.

3. Shoreline heritage

3.1. Generic model of shoreline evolution

In previous work on the implications of tidal range developments on the historic environment (Historic England, 2018), a generic model of heritage at the coast was presented (Figure 8) that was also derived from published earlier guidance on wave and tidal energy; Historic Environment Guidance for Wave and Tidal Energy. Published by Fjordr Ltd on behalf of English Heritage, Historic Scotland and Cadw, (English Heritage, 2013). This model remains applicable to any type of development that translates from seaward to landward, including shoreline interventions.

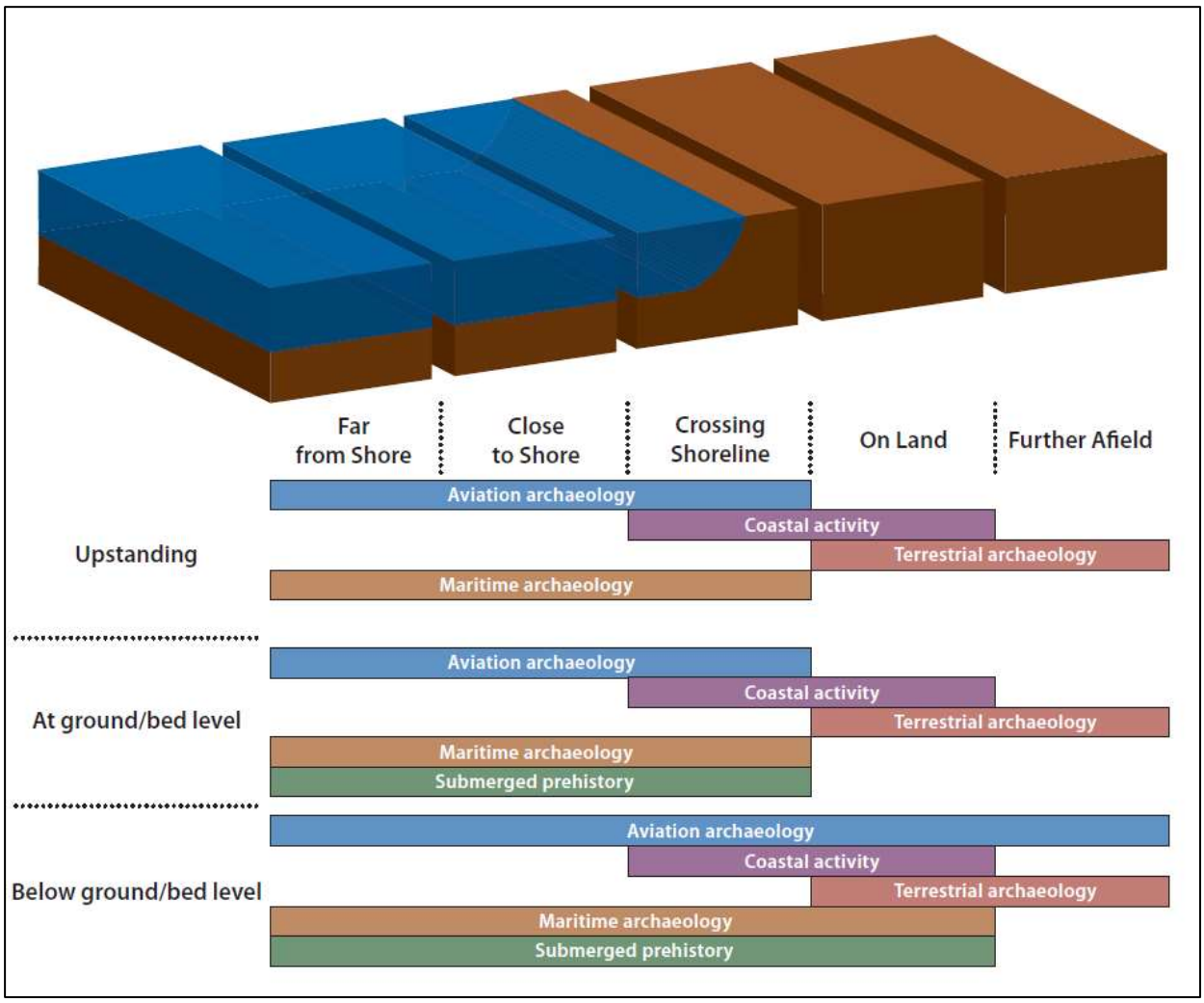

Figure 2. Range of historic environment topics that may be raised by a shoreline development (English Heritage, 2013).

In the present context, shoreline interventions will generally span 'Close to Shoreline' and 'Crossing Shoreline' blocks. Shoreline heritage encompasses structures, features and artefacts that can be:

- above ground (upstanding as historic buildings, old jetties, or metal shipwrecks, for example);
- on the surface of the seabed, inter-tidal area or dry land; or
- buried below the seabed or ground level either because they were dug-in to existing deposits or because later deposits have buried them.

An unfortunate characteristic of low-lying areas favoured for shoreline interventions is that they may often appear featureless, marginal and of low value. Moreover, low levels of activity in recent decades have limited the occasions when archaeological material could be observed, so existing archaeological records for low-lying coastal land have tended to be quite limited, reinforcing the impression that such places are of marginal interest. For much of human history, however, coastal areas have had numerous valuable attributes and resources that have prompted high levels of activity. Several key heritage themes are juxtaposed because of overlapping human interests in shoreline and nearshore areas over centuries, coupled with complex histories of shoreline formation that often include waterlogged deposits that enable much better preservation than on dry land. Consequently, areas subject to shoreline intervention can be important simultaneously for aviation archaeology, maritime archaeology, submerged prehistory, coastal heritage and, as elsewhere, terrestrial (land-based) heritage.

Little of this diverse range of heritage interests may be readily apparent from conventional sources, largely and paradoxically, because of the scale of subsequent human intervention. To understand this, additional detail is offered to the general model (Figure 2). In low-lying coastal areas, sea levels were sufficiently low during the Last Glacial Maximum for there to be extensive plains stretching far beyond our current shorelines (Figure 3). These areas were most likely inhabited, and prehistoric archaeological material is found in places that became submerged by Holocene sea level transgression. Notably, some transgression deposits pre-dating the Holocene transgression are themselves a product of yet earlier sea level change and may contain archaeological and palaeo-environmental evidence dating back to Palaeolithic periods.

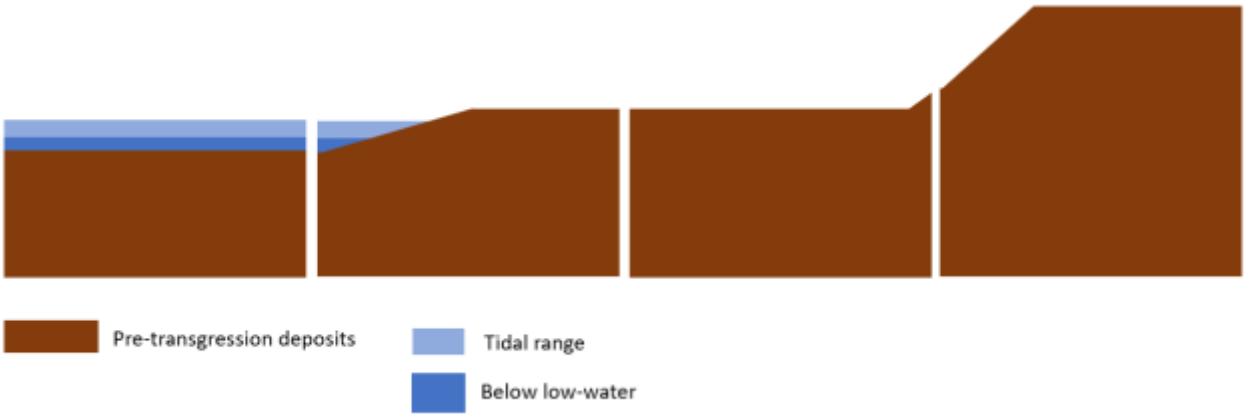

Figure 3. Simple coastal cross-section in early prehistoric periods.

Later in prehistory, rising sea levels started to approach and even extend landward of the current coastline in many places, even though sea level was still several metres lower than today (Figure 4). Coastal areas presented a wide range of valuable resources and were a focus for human activity. Evidence of terrestrial, coastal and maritime activity in prehistory is, therefore, often associated with these former shorelines.

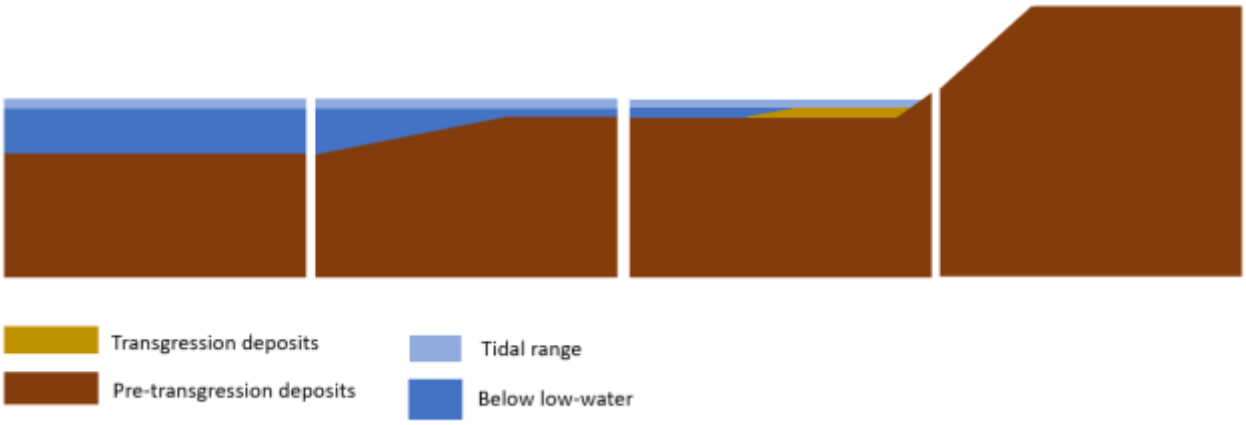

Figure 4. Later prehistory – sea extending landward of current coastline.

As sea level continued to rise on these shallow coastal margins, alluvium was deposited, keeping pace with rising sea levels; the intensification of arable agriculture probably contributed to sedimentation. Coastal marshland continued to be a valuable resource and even in prehistory there may have been efforts to enhance the coastal margin using drainage and sea defences (Figure 5).

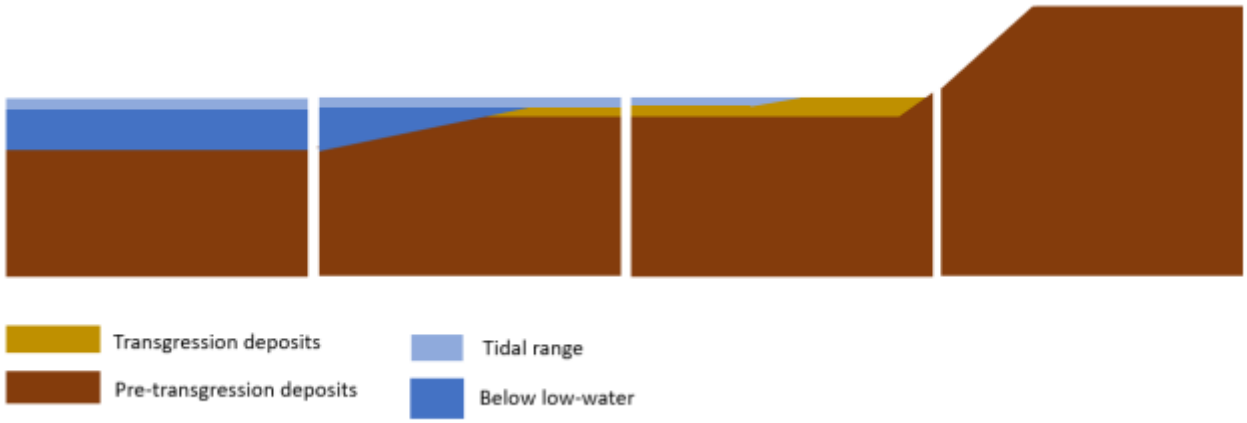

Figure 5. Alluvium extending seaward, influenced by human activity.

Extensive sea defences to enable reclamation have been used in the UK since the Roman period; multiple phases of seawall construction and drainage, pushing outwards and building upwards in the Medieval, Post-medieval and Modern periods have brought us to the present situation (Figure 6). However, this has not been a simple linear process; extensive habitation of coastal margins has been interrupted by flooding and retreat sometimes over prolonged periods in which metres of alluvium may have covered previous traces whilst erosion has removed them elsewhere. Moreover, this simple cross-section does not represent the variability of shoreline environments in plan. Viewed from above, such environments exhibit localised variations in height, the presence of historic channels, and the prior presence of now-buried palaeo-channels. These lateral variations all point to variability in past environments and to patterning of past human activity and the presence and survival of different forms and periods of archaeological material. The simple model presented here only hints at a more complex four-dimensional sedimentary sequence framed by both local and much larger scale cultural and environmental factors.

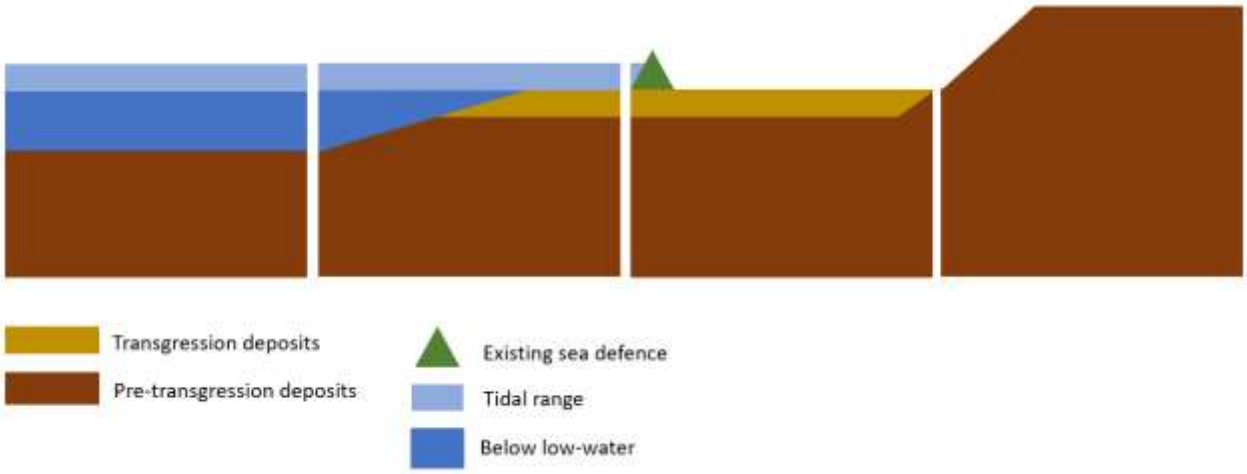

Figure 6. Seawall protecting reclaimed coastal land.

Evidence of earlier human activity is buried beneath the alluvium, its potential often indicated by the presence of equivalent material in inter-tidal areas seaward of the seawalls. The seawalls and their associated features are themselves heritage assets, and the reclamation sequence will often be associated with other forms of human activity, including industrial uses such as salt production, agriculture and, especially in the late 19th and 20th centuries, military activity ranging from armaments production to defence against invasion. Although anticipated invasions did not materialise, conflicts at sea and in the air often resulted in ships and aircraft becoming casualties at the coast. The apparent emptiness and isolation of these areas today does not reflect the intensity of human activity that they have witnessed in the past (Figure 7) (see Allen & Gardiner (2000), Bell (2007), Bell (2013), Rippon (2001) and Wilkinson, et al., (2012).

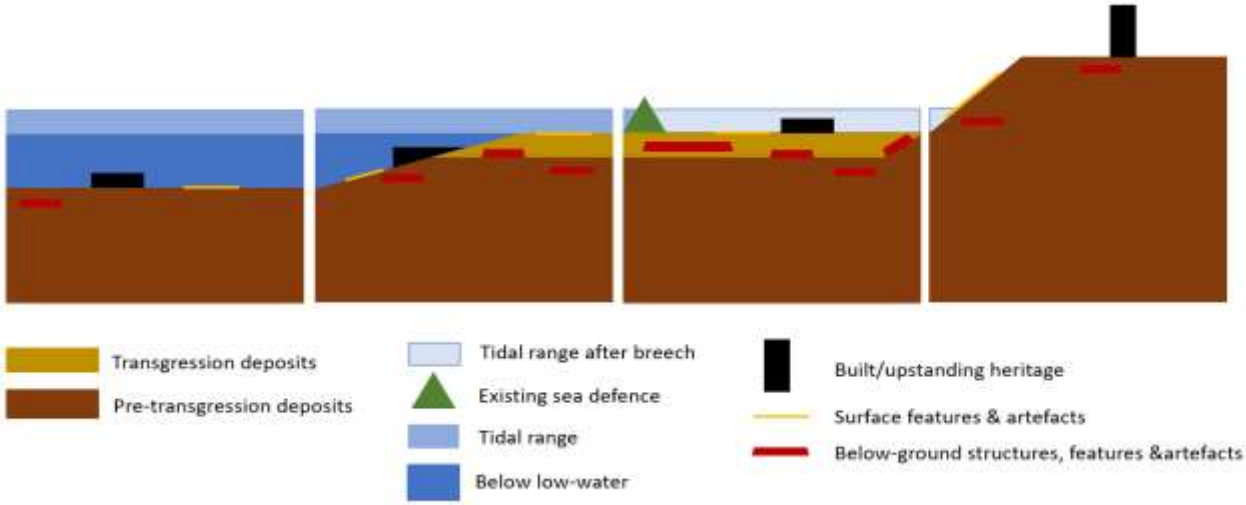

Figure 7. Sequence of archaeological evidence of many different forms in multiple contexts in the vicinity of historic, current and future shorelines.

These low-lying coastal landscapes are a result of centuries of human intervention and hide a rich legacy. However, there is now increasing recognition that simply building higher seawalls to keep pace with rising sea levels and combat increasing storminess, driven by climate change, is unsustainable. The types of shoreline intervention discussed in this report are just the latest phase of human activity, whether to address climate change and the associated consequences including habitat loss, or in renewed pursuit of the valuable attributes that coastal areas present.

Where the driver is commercial development rather than shoreline management or habitat creation, there may be pressure to focus on coastal brownfield sites where there has been previous intensive human activity resulting in infrastructure and/or contamination that is to be addressed remedially. As well as presenting practical issues for archaeological assessment and mitigation, sites such as coastal military bases or former industrial facilities that are now regarded as brownfield may themselves be historically significant and warrant building recording and archaeological mitigation.

There is, of course, significant concern for the physical evidence of the past that might be lost through current phases of human activity. What should be kept in mind is that these places also provide a record of how people have addressed and adapted to changing shorelines over millennia; the opportunity should not be missed to learn from this record as we adapt to our rapidly changing environment.

3.2. Climate change risks

Climate change is having major impacts on the rich and complex heritage of shoreline sequences where they are exposed to sea level rise and increased storminess, generally seaward of existing sea defences or in places where there is no protection. Exposure and loss of archaeological material in unprotected coastal areas is recognised as a very major concern (e.g. Cook, Johnston, & Sleby, 2019). Initiatives such as CITiZAN (https://citizan.org.uk/) and Scotland's Coastal Heritage at Risk (SCHARP - http://scharp.co.uk/) are beginning to address this issue, but these initiatives are heavily reliant on volunteers and are clearly outstripped by the scale of coastal change and loss. The importance of initiatives such as these to the subject of large-scale shoreline intervention is that their work demonstrates emphatically the range and significance of archaeological material at the coast and which extends into areas that are currently protected by existing sea defences. These initiatives also demonstrate the high level of public interest in coastal heritage and recognition of the associated social value.

The importance of coastal heritage and the threats which climate change poses has been recognised for some time. Notably, in the 1990s English Heritage (now Historic England) and the Royal Commission for the Historic Monuments of England (RCHME) carried out a major assessment of England's Coastal Heritage (Fulford, Champion, & Long, 1997)). In turn, this prompted a programme of Rapid Coastal Zone Assessment Surveys (RCZAS) that is still in progress, significantly increased baseline knowledge of archaeology in the coastal zone (Murphy P. , 2014). The reports arising from the RCZAS programme are available online (https://archaeologydataservice.ac.uk/archives/view/rczas/); historic environment data from the RCZAS have been incorporated within local authority Historic Environment records (HERs). Both pre-dating and in parallel to the RCZAS, there has been a great deal of interest in archaeology on foreshores and coastal marshes in many places around England. Consequently, there is a wealth of evidence underpinning the understanding of the coastal zone as being particularly rich in heritage. However, the predominantly desk-based and walkover/surface collection methodologies used in earlier investigations are predominantly applicable to places where archaeological material is exposed, either on higher ground such as cliffs or hills backing the coastal plain, or in inter-tidal areas; they are not attuned to revealing archaeology buried in reclamation deposits behind existing seawalls. Although reasoned inferences can be drawn about archaeological potential, such areas would typically appear largely blank in terms of recorded sites. Intrusive methodologies such as trenching and coring, together with watching briefs during groundworks and the relatively recent use of high-resolution LiDAR has, on necessarily

smaller scales, repeatedly confirmed the inferred potential of these apparently blank areas. Archaeological investigation in the course of shoreline interventions, such as groundworks prompted by managed realignment, have been particularly important in this respect. The 2014 review by Historic England (as English Heritage) of coastal heritage concluded; '*It seems probable that future works at [Managed Realignment] schemes will be one of the principal new sources of new information on historic coastal land use*' (Murphy P. , 2014).

3.3. Significance

The significance of heritage assets, set within their wider landscape, is key to deciding how to address features that may be affected by large-scale shoreline interventions. The significance of some heritage assets may already be determined, indicated by their designation under heritage legislation as being of national importance (Listed Buildings, Scheduled Monuments and Protected Wrecks) or having been similarly recognised through national planning designations (Registered Battlefields, Registered Parks and Gardens). Designated heritage assets are certainly present in places subject to large-scale shoreline interventions; they require specific consideration and, in many cases, additional legal consent for works. However, most heritage assets in shoreline areas are not designated, indeed, they may be buried and effectively unknown prior to shoreline intervention being contemplated. Notwithstanding, non-designated heritage assets may be as significant as designated assets (i.e. also of national importance) and are subject to the same principles. Furthermore, heritage assets that do not meet the threshold of national importance may be of considerable significance nonetheless, and are also a material consideration in consenting process.

Guidance on managing significance and the implications for planning activities that may affect heritage assets is set out in:

Historic Environment Good Practice Advice in Planning: 2 (GPA 2): Managing Significance in Decision-Taking in the Historic Environment (https://historicengland.org.uk/images-books/publications/gpa2-managing-significance-in-decision-taking/) (Historic England, 2015).

Although framed expressly in relation to land-based planning consent through local planning authorities, the advice in GPA 2 is also relevant to large-scale shoreline interventions seeking consent through other mechanisms, such as national infrastructure planning and marine licensing.

Where an intervention is contemplated with potential consequences for heritage assets in the wider surroundings, then the following advice is relevant:

> *GPA 3: The Setting of Heritage Assets* (2nd Edition) (https://historicengland.org.uk/images-books/publications/gpa3-setting-of-heritage-assets/) (Historic England, 2017).

The basis on which specific forms of heritage asset are considered significant is set out in a series of Selection Guides and Introductions to Heritage Assets, some of which pertain to asset types that may be found in shoreline environments (Table 2).

Table 2. Examples of Selection Guides and Introductions to Heritage Assets relevant to heritage asset types present in shoreline areas.

Listing Selection Guides	
Maritime and Naval Buildings	https://historicengland.org.uk/images-books/publications/dlsg-maritime-naval-buildings/
Military Structures	https://historicengland.org.uk/images-books/publications/dlsg-military/
Scheduling Selection Guides	
Maritime and Naval	https://historicengland.org.uk/images-books/publications/dssg-maritime-naval/
Military Sites Post-1500	https://historicengland.org.uk/images-books/publications/dssg-military-post1500/
Introductions to Heritage Assets	
Artillery Defences	https://historicengland.org.uk/images-books/publications/iha-artillery-defences/
Pre-Industrial Salterns	https://historicengland.org.uk/images-books/publications/iha-roman-medieval-sea-river-flood-defences/
River Fisheries and Coastal Fish Weirs	https://historicengland.org.uk/images-books/publications/iha-river-fisheries-coastal-fish-weirs/
Roman and Medieval Sea and River Flood Defences	https://historicengland.org.uk/images-books/publications/iha-roman-medieval-sea-river-flood-defences/

4. Large-scale shoreline interventions in policy and practice

As previously explained, large-scale shoreline interventions are typically being driven by climate change adaptation, natural and human pressures on protected habitats, and by the economic importance of coastal locations. This section reviews the policy and legislation drivers supporting the main types of large-scale shoreline intervention identified in Section 2. The potential locations for further large-scale shoreline interventions are also presented. Some locations are inherently linked to an existing site, such as replacing an unsustainable flood defence or the expansion of existing infrastructure (e.g. ports), whilst other locations may need to be found to provide 'like for like' compensation for a loss elsewhere.

4.1. Managed Realignment for flood and coastal defence

4.1.1. Policy drivers

Figure 2 (Defra, 2009) provides a schematic indicating the present relationships between national flood and coastal erosion risk management (FCERM) policy, strategic (regional-scale) plans and individual schemes. The relationship to existing EU directives is also included. In the present context, The EU Floods Directive (2007/60/EC) is most relevant, which has been addressed in the England and Wales through the adoption of (non-statutory) Shoreline Management Plans (SMPs) for the open coast.

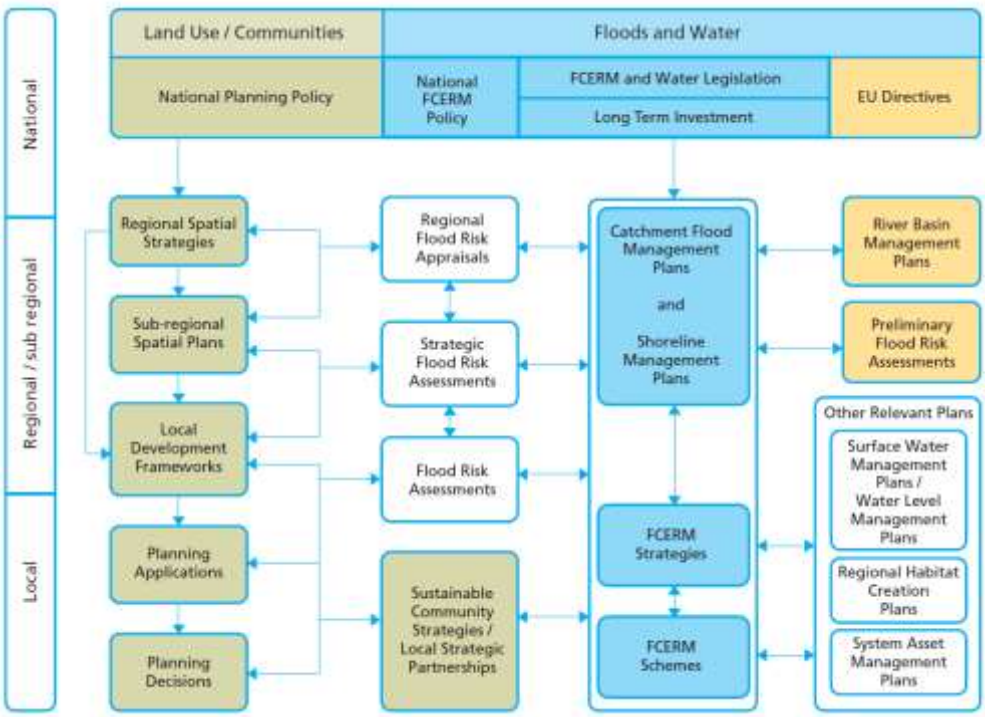

Figure 8. Schematic representation of the relationship between high level plans, strategies, schemes and other planning initiatives, (Defra, 2009).

Whilst this is a well-established relationship, there remain ongoing reviews so that policy, strategies and implementation remain relevant to the long-term vision of creating a nation resilient to flooding and coastal change to the year 2100, as well as allowing alignment with better understanding of climate change through the UK Climate Projections (UKCP) programme. In this context, the UK Government is due to publish a National Policy Statement (NPS) for flood and coastal erosion risk by the end of 2019 (a call for evidence closed on 19 August 2019) whilst the Environment Agency has also recently consulted on their draft National Flood and Coastal Erosion Risk Management Strategy for England (Environment Agency, 2019), with the final strategy due to be published by Spring 2020. The draft strategy mentions the '*natural, built and historic environment*' but without apportioning any priorities.

The draft strategy also sought views from consultation on various strategic objectives and associated measures, which included Strategic Objective 2.4:

> *Between now and 2050 places affected by flooding and coastal change will be 'built back better' and in better places.*

Measure 2.4.1: By 2025 the Environment Agency will work with government, insurers and financial institutions to review the legal, policy and behavioural changes needed to 'build back better and in better places' and improve the resilience of homes and business.

Measure 2.4.2: By 2021 coast protection authorities and the Environment Agency will refresh the shoreline management plans and keep them under review.

Some consultation responses have interpreted the concept of 'build back better and in better places' as a form of managed realignment.

There appears to be several upcoming issues for Historic England to take note of:

- Upcoming Government NPS for Flood & Coastal Erosion Risk Management.
- Revised National Flood and Coastal Erosion Risk Management Strategy.
- Potential for a revision for Shoreline Management Plans and consequential reappraisal of policy options aligned to Government Policy and the revised strategy.

4.1.2. Shoreline Management Plans

A SMP provides a regional consideration (coastal cell or sub-cell) of the risks associated with coastal processes impinging on a shoreline and sets out suitable policy options to help to reduce these risks to people and the developed, historic and natural environment.

The first round of SMPs did not extend into estuaries. Presently, we are at the second iteration of SMP (SMP2), noting the potential for a further SMP review by 2021 (Environment Agency, 2019), whilst bearing in mind that this review also depends on the outcome of the finalised FCERM strategy.

To date, SMPs have been developed in a collaborative approach by a Coastal Group comprising of members from the local councils covered by each SMP, along with a representative from the relevant region of the Environment Agency. Other parties represented in the process include Natural England and key stakeholders who own or operate assets along the shoreline, such as industry bodies and the National Trust. Historic England is also represented in many of the Coastal Groups (e.g. East Anglia Coastal Group) or as an associate member. The lead organisation of any Coastal Group has tended to been a member of a local authority or the Environment Agency.

For context, there are 20 SMPs which cover the coast of England; a distance of around 5,219 km. Two of these SMPs also extend into Wales. For the coastline of England, these SMPs are split into 1683 separate Policy Units (PU) each given an associated policy option for the sustainable management over the short, medium and long term.

The policy option is determined as either Managed Realignment (MR), No Active Intervention (NAI), Hold the Line (HTL) or Advance the Line (ATL), as appropriate to the PU and achieving the most sustainable option.

For SMP2, the short-term is taken as the period 0 to 20 years and up to 2025 (Epoch 1). Thereafter, the policy option may alter for the medium-term (20 to 50 years, up to 2055; Epoch 2) and long-term (50 to 100 years, up to 2105; Epoch 3), as necessary.

The MR policy provides for managed realignment of the shoreline (typically landwards, but also seawards) with suitable management measures to control or limit the future movement of the shoreline. The typical requirement for MR is that there is sufficient space behind the existing defence line to relocate a new defence which creates a more sustainable option than the existing defence, or other policy options. A breach is then opened in the existing defence line and tidal exchange is permitted into the area between the former and new defence line. This area needs to be low-lying land within the tidal frame but may also re-profiled to promote the creation of new habitats (e.g. to deliver specific quotas of inter-tidal mudflats and saltmarshes which also help to act as a soft defence). The profiling may also include excavation of new drainage channels with the material won used to make the new flood embankments. Further channels and features are likely to form as a result of the introduction of tidal processes, which may cut and erode archaeological deposits. The criteria mean that managed realignment may only be a feasible option for some areas of the coastline. Although this policy typically applies to low-lying areas at risk of flooding, the policy can equally apply to cliffed areas, whereby suitable measures slow down cliff recession for a period of time.

The ATL policy would also modify the existing shoreline with new defences built seaward of existing defences, where funding permits, which may involve a significant reclamation of land in the process. Interestingly, this policy is only presently applied in two cases, both at the mouth of the Suffolk Stour as a short-term option (thereafter hold the line for the medium and long-term). These cases are associated with the ports of Harwich and Felixstowe, with the latter pre-dating Phase 1 of the Felixstowe South Reconfiguration (Berths 8 & 9) completed in 2011 which reclaimed around 12 ha of land (of a consented 28.5 ha) to create a new 730 m long deep water quay. The inference here is that the height of the quayside provides adequate flood protection.

Current SMP guidance (Defra, 2006) sets out the main issues to consider when assessing shoreline management policies which includes; historic and archaeological features in historic environment records and areas of high archaeological potential, including marine archaeological features, scheduled monuments, listed buildings and registered battlefields. A companion guide for the historic environment was also published in 2006 by English Heritage (English Heritage, 2006). Most of the present SMPs appear to give the greatest attention to designated heritage assets rather than those which may be nationally important but are currently undesignated for whatever reason, or areas considered to have high but as yet unquantified archaeological potential.

Referring to SMP mapping data (available from www.data.gov.uk and initially created in 2010) provides a means to identify stretches of the coast around England where the policy option is MR. Table 3 summarises the number of policy units with a managed realignment option for each time period, along with comparable information for other types of policy option. What is evident from this summary is that hold the line becomes a less sustainable option in the long-term, with no active intervention becoming more widespread. The option for managed realignment is likely to become capacity limited by various constraints beyond the medium term, such as further availability of low-lying undeveloped land in to which to realign.

Table 3. Number and type of SMP2 policy units for short, medium and long-term periods.

Policy Option	Time period		
	Short	Medium	Long
Managed realignment (MR)	210	319	299
No active intervention (NAI)	563	586	637
Hold the line (HTL)	908	774	753
Advance the line (ATL)	2	0	0

In the short-term time period (to 2025) there are 210 MR policy units around the coastline of England, including the Outer Humber Estuary. The inner part of the Humber Estuary is considered in a separate flood risk management strategy (Environment Agency, 2008). The 210 policy units amount to around 534

km of the coast (approximately 10.2% of the shoreline around England), and have an average unit length of 2.54 km. In contrast, HTL is the most common policy option (908 Policy Units) and represents around 55.3% of the shoreline around England.

Of note is that the length (in km) of the policy unit for any MR policy option does not immediately correlate with the area (in hectares) which may be 'opened up' for tidal exchange. Notwithstanding, 534 km of coast for which the preferred option is MR is still likely to amount to a very substantial area of archaeological interest.

For some MR policy units there may be an initial phase of realignment for the short-term, followed by further phases of MR in the medium and long-term, enabling adaption to the continued pressures on the coastline. In other cases, a policy unit assigned as HTL or NAI in the short-term may become MR later in either the medium or long term. Similarly, MR in the short-term may become NAI or HTL in the medium or long-term.

Figure 9 presents the policy units with a short-term SMP2 policy option for MR around the coastline of England, by Historic England Region, noting that SMP2 coverage does not extend fully into the Humber Estuary where there are further managed realignment sites. There is some correlation between Policy Units identified as MR and MR sites which have now been implemented (Figure 1).

Table 4 provides a breakdown of policy units attributed with a short-term policy option for MR by administrative region of Historic England. This information demonstrates that, even in the short-term (to 2025), MR will be a major cause of shoreline intervention in five of the six Historic England administrative regions, the exception being Midlands Region despite including an exposed coastline between The Wash and the Humber Estuary.

Table 4. Number Managed Realignment Short-term Policy Units by Region

Region	Number of MR Policy Units	Total length of shoreline (km)
North West	46	121
South West	67	147
London and South East	27	103
East of England	40	107
Midlands	0	0
North East and Yorkshire	30	56
Total	210	534

* This data excludes Policy Options upstream of the Outer Humber Estuary.

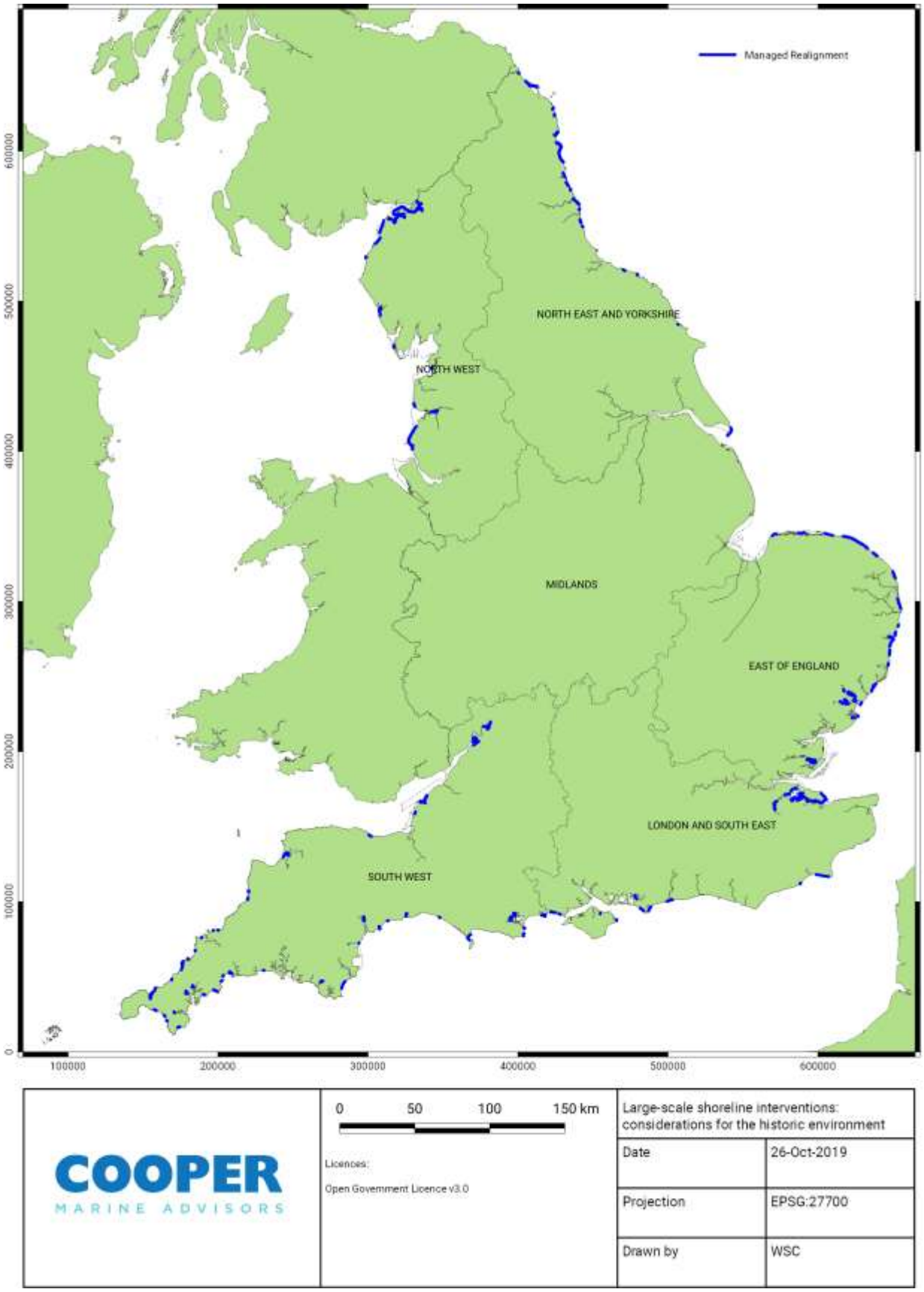

Figure 9. **Location of SMP Managed Realignment Policy Units (short-term) around England.**

4.1.3. Schemes

Importantly, SMP policy options are un-costed and are not binding commitments to developing any flood and coastal defence schemes. An individual scheme would need to be promoted to secure appropriate funding (grant aid) and justified by a business case to demonstrate costs versus benefits provided. The present approach is to apply the Flood and Coastal Erosion Risk Management (FCERM) project appraisal guidance (Environment Agency, 2010). This guidance sets out the topics that should be considered when describing and quantifying impacts, which includes the historic environment. Notably, there is no specific supporting guidance to help establish the value of impacts on the historic environment. Instead the suggestion is that Historic England should be consulted to determine the most suitable approach.

For some stretches of the coastline, the SMP options have been considered at a higher-level of detail to produce coastal defence strategies. These strategies normally cover a discrete part of a SMP cell or sub-cell, however, at present, these strategies do not cover the entire coastline of England. The purpose of the strategy is to establish and recommend the preferred flood and coastal erosion management option(s) and present estimated costs. These options are then consulted on. Where significant works may be promoted by the strategy then this is likely to be a precursor to implementing a specific scheme.

4.1.4. Exemplar

Medmerry is included in the North Solent SMP2 (Selsey Bill to Hurst Spit) as part of policy unit PU 5A01 (Selsey West Beach to Brackelsham) (NFDC, 2010). The short-term policy option is MR, and once the policy is implemented this becomes HTL for the medium and longer term.

The MR policy option originates from the Pagham to East Head Coastal Defence Strategy (Environment Agency, 2007), which was produced ahead of the second iteration of the SMP process. The motivation for the MR scheme came from a re-assessed flood risk due to rising sea levels making the existing practice of maintaining the height of a 2.92 km shingle bank (barrier beach) economically and technically unsustainable as a long-term option.

The 2007 strategy provided the basis for the Environment Agency to promote the Medmerry MR scheme (i.e. develop and implement managed realignment scheme with new defences set back from the sea), engage with stakeholders and support the business case and application for grant funding from HM Treasury. The business case was approved in 2009 and planning permission consented in 2010. Construction took place between 2011 to 2013 with breaching of the shingle bank in September 2013 when RSPB took over day to day management of the site (Environment Agency, 2016).

An initial desk-based assessment for the project suggested that there was a low risk of significant heritage being present. Archaeological investigations during and after construction (Krawiec, 2017;

Murphy, 2016) demonstrated the presence, however, of a wide range of significant features and deposits. Two suspected aircraft crash sites were avoided by redesigning elements of the scheme. Extensive evidence of a Bronze Age settlement and cremation cemetery, and a Medieval fish weir were excavated. Additional material was uncovered (and consequently destroyed) by erosion prompted by the reconfiguration of the shoreline, including further prehistoric deposits (including human remains and burnt mounds); post-medieval features including a braced timber structure, fishing baskets, remains of a farmstead, and drainage features; and Second World War anti-invasion defences. The investigation of material uncovered by consequential erosion prompted by the reconfiguration of the coastline was considered to be beyond the responsibility of the scheme so monitoring and recording of archaeological features had to be carried out by a community group in a voluntary capacity (Environment Agency, pers. comm.).

4.2. Habitat creation

4.2.1. Policy drivers

The requirements for habitat creation (or re-creation) originate with the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) which was initially adopted into UK legislation as 'The Conservation (Natural Habitats, &c.) Regulations 1994' and through subsequent revisions became 'The Conservation of Habitats and Species Regulations 2017'. This legislation serves to protect (Natura 2000) European sites and European marine sites, a network of nature protection areas in the territory of the European Union designated as Special Protection Areas (SPA) and Special Areas of Conservation (SAC).

A draft statutory instrument known as The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 is prepared to come into force on the day the UK leaves the EU with the intention to retain the Natura 2000 sites as a 'national site network'.

Habitat creation schemes are designed to compensate for losses at Natura 2000 sites which are at risk from factors such as 'coastal squeeze' as well as any direct losses attributed to flood and coastal risk management activities. Schemes which deliver compensation for natural losses could be considered as examples of climate change adaptation. The general expectation is that a 1:1 ratio is applied for losses at Natura 2000 sites, however, compensating for losses associated with shoreline developments may be up to a 1:3 ratio (to address uncertainties), although this ratio varies case-by-case. Compensatory measures for development related losses are considered separately in Section 4.4.

4.2.2. Coastal squeeze

Coastal squeeze occurs when the location of high water is fixed against a coastal defence structure (such as a seawall) or a natural feature (such as a cliff or a shingle bank) and the location of low water migrates landwards towards the fixed location of high water in response to sea level rise. Any inter-tidal habitat between high and low water is prevented from landward translation by the fixed position of high water and experiences a reduction in width and therefore a potential net loss. In contrast, where the location of high water is not fixed against a feature then the habitat has the potential to migrate landward. Figure 10 offers a schematic of (a) unconstrained saltmarsh migration, (b) coastal squeeze against a fixed structure and (c) coastal squeeze against a natural feature.

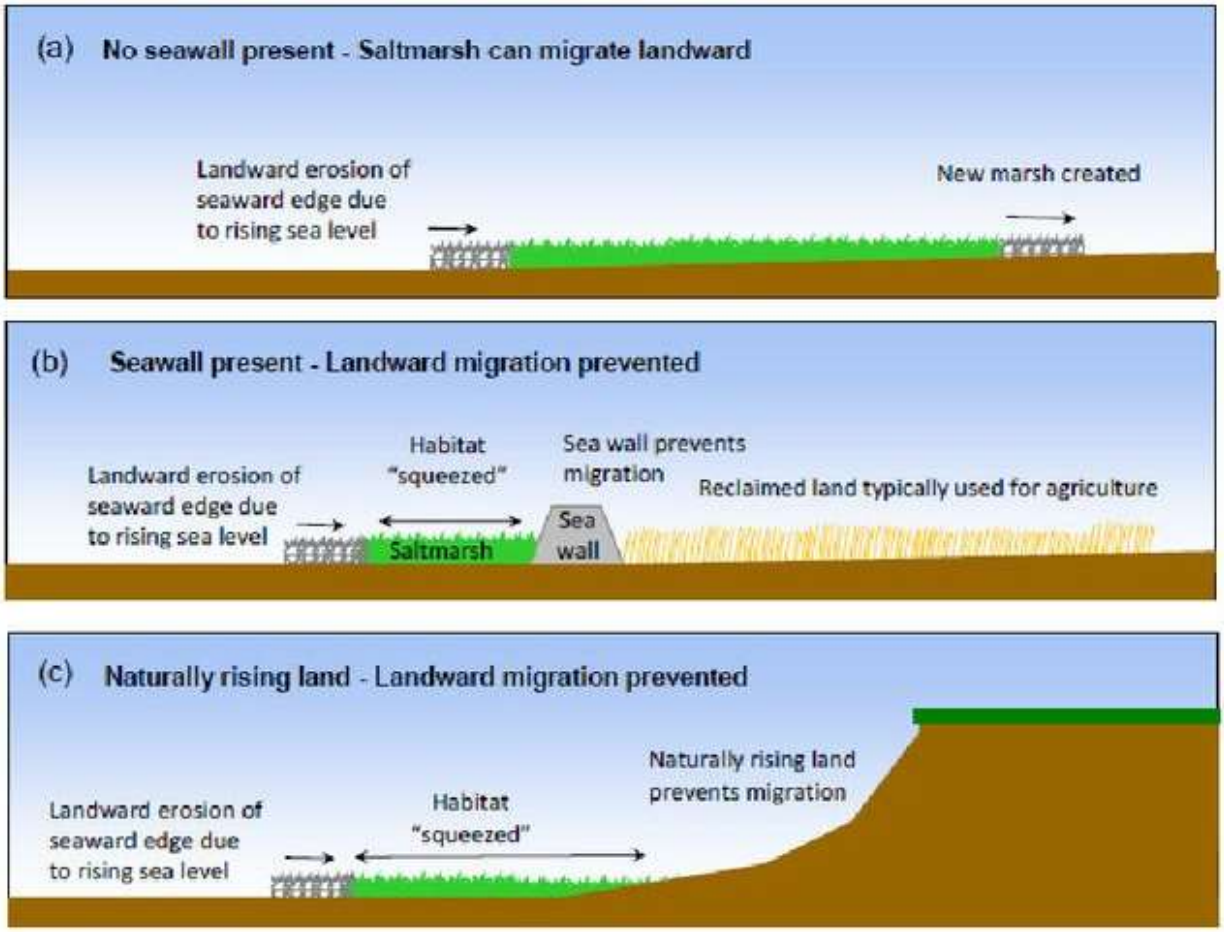

Figure 10. Schematic of inter-tidal coastal squeeze (Pontee, 2013).

Coastal squeeze is not limited to saltmarsh habitats and losses due to coastal squeeze can occur for other types of habitats, such as inter-tidal mudflats. In addition, coastal squeeze against a flood defence can also compromise the defence structure where the foreshore levels are eroded.

The potential for coastal squeeze will exist at SMP policy units with a policy option for the short, medium and long-term of hold the line (HTL) which overlap with nature conservation designations, and where the high water line is expected to be held at the designated flood defence within these time frames. Designated habitats that are subject to a net loss are subject to a legal obligation to be compensated with compensatory habitats.

4.2.3. Coastal Change Management Areas

In tandem with the development of SMPs, coastal authorities are also required to identify areas within their Local Plans that are likely to be affected by coastal change (physical change to the shoreline through erosion, coastal landslip, permanent inundation or coastal accretion); these areas are called Coastal Change Management Areas (CCMA). Their purpose is to help decide what development may be appropriate in a CCMA but also to make provisions for development and infrastructure that needs to be relocated away from a CCMA (Ministry of Housing, Communities & Local Government, 2019). Present guidance for the planning system regarding CCMA is provided in (DCLG, 2010).

If the CCMA is associated with any loss of designated habitat either directly by coastal squeeze, or indirectly by relocation of development then there is a legal requirement to compensate for the loss through a habitat creation scheme.

4.2.4. Schemes

To date, most habitat creation schemes have been implemented as part of a managed realignment project designed to deliver a sustainable flood defence. The habitat creation component is included to compensate for losses at designated sites elsewhere. The area considered for habitat creation is largely the area available between the old and new flood defence line. Once the habitat compensation site is established then the same levels of nature conservation designation are expected to be given.

The integration of habitat creation within a flood defence scheme is recognised as a measure to help manage and reduce flood and coastal erosion risk. In England, Working with Natural Processes (WWNP) is promoted by the Environment Agency to help make the business case for a flood defence scheme which integrates 'soft defence' features (Environment Agency, 2018). For example, the inclusion of a fronting saltmarsh to help dissipate wave energy, thereby enabling reduction of wave heights reaching a flood defence.

Environment Agency provides biennial reports on progress with the Habitat Compensation Programme (HCP) in England (Environment Agency, 2018). The report summarises details of the amount of habitat created in response to legal compensatory requirements (Article 6(4) of the Habitats Directive), as well as

projections of future loss relevant to the short, medium and long-term, where available. HCP is managed at a regional level with ten areas;

i. North West HCP (equating to the English component of the North West and North Wales SMP);
ii. Severn Estuary HCP (English Coastline only)
iii. Devon and Cornwall HCP
iv. South Wessex HCP
v. Solent & South Downs HCP
vi. South East HCP
vii. Thames HCP
viii. East Anglia HCP
ix. Humber HCP; and
x. North East HCP.

The report shows that to the end of 2017, the amount of inter-tidal habitat (saltmarsh and mudflat) either completed, or in the process of being implemented, amounts to 1,317 ha (this figure excludes habitat created for compensatory measures due to developments). This compares to a predicted net loss of -1,021 ha to the end of 2025 (Epoch 1 / short term period adopted for SMP policies). Therefore, the net balance is +296 ha. Of note, is that much of the positive balance is due to schemes within the Humber Estuary HCP area which is expected to have a net balance of +332 ha (includes Outstrays to Skeffling Managed Realignment Scheme, which is yet to be completed at the time of producing this review, which plans to create over 400 ha of new mudflats and saltmarsh).

However, provisional figures also suggest the continued pressure at the coast due to sea level rise will result in an additional loss of designated habitat from 2026 to 2050 (Epoch 2 / medium term) of 853 ha, and from 2051 to 2100 (Epoch 3/ long-term) of 2,048 ha. For equivalent time periods, the Severn Estuary HCP (which includes parts of Wales) has highest projected habitat losses of a 318 and 765 ha, respectively.

To address future demands there is a pipeline of potential habitat compensation sites for each HCP management area which amounts to 3,577 ha of new inter-tidal habitat (NB habitat losses aim to be compensated within the same HCP management area). The final amount of land required to deliver new inter-tidal habitat which falls within any scheme is always greater to include for flood banks, connecting drainage channels to the sea and the area of tidal exchange, so the total amount of shoreline intervention will be above 3,577 ha.

Separate to the Environment Agency led HCP, the Marine Management Organisation (MMO) has recently published a national dataset to identify potential sites suitable for future inter-tidal habitat creation (MMO,

2019). These potential sites (Figure 11) are all located within the present 'coastal' floodplain (to provide low-lying land) but are seemingly not restricted to locations where the present SMP policy may be MR.

The dataset contains over 770 sites ranging in size from around 10 to nearly 14,000 ha, with the Humber Estuary and The Wash collectively accounting for over 46% of the potential total area. The largest potential site is at the back of The Wash (Holbeach at 13,948 ha), noting the frontage for this site has the SMP policy of HTL for the short, medium and long term. Finally, the inclusion of a site in the dataset does not indicate if land is available for inter-tidal habitat creation (e.g. landowners may well not be interested to sell), or how much of an impact undertaking managed realignment may have on adjacent estuarine or coastal habitats.

Table 5 provides a breakdown of potential habitat creation areas by administrative region of Historic England.

Table 5. Potential habitat creation areas by administration region of Historic England.

Region	Number of sites	Average area of site (ha)	Max area of site (ha)	Total area of all sites (ha)
North West	168	149	2,849	25,049
South West	98	215	2,949	21,101
London and South East	178	188	6,027	33,381
East of England	220	418	11,812	91,955
Midlands	40	1316	13,948	50,635
North East and Yorkshire	66	521	9,669	34,407
Total	**770**			**256,528**

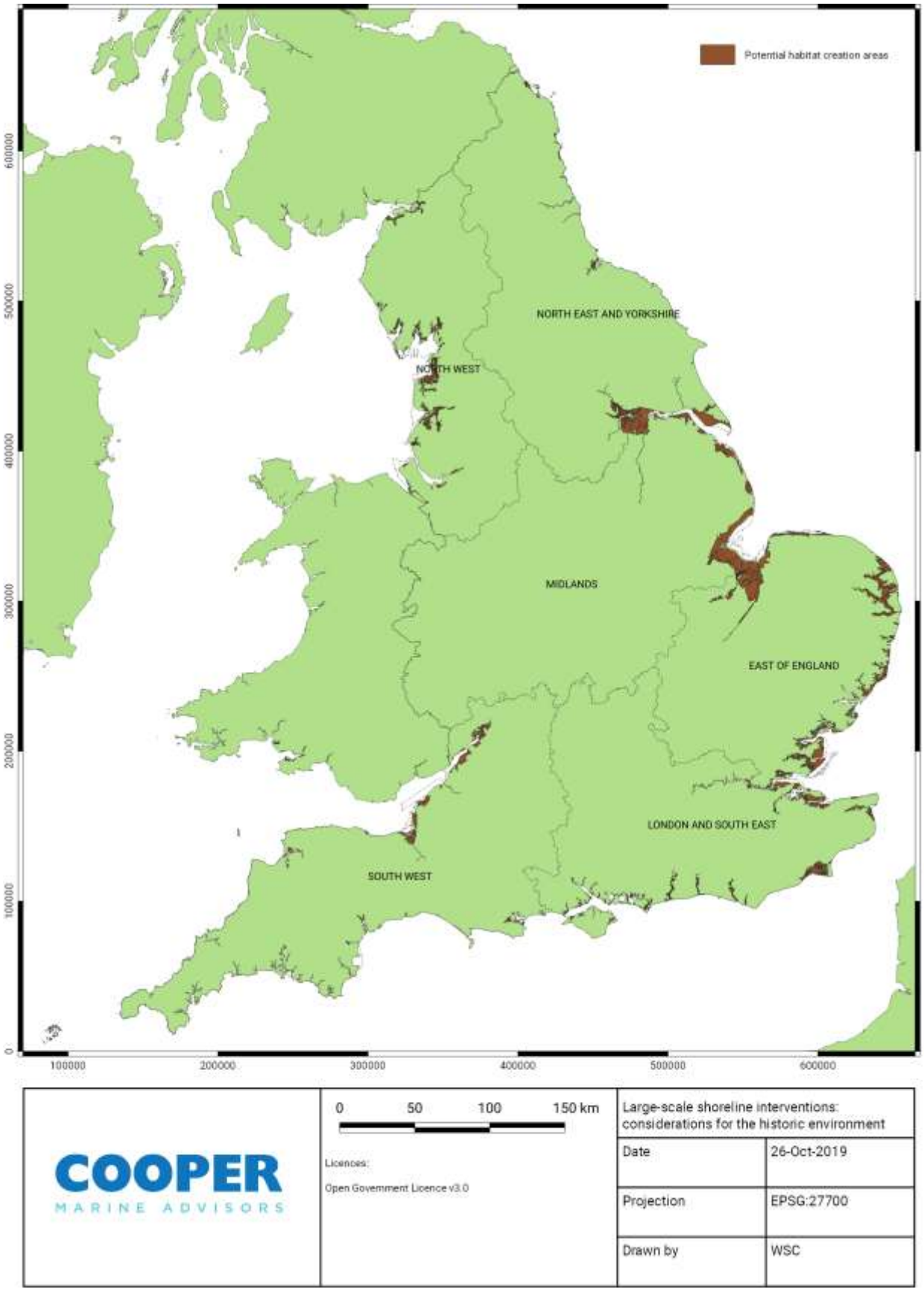

Figure 11. **Potential areas for inter-tidal habitat creation around England (MMO, 2019).**

4.2.5. Exemplar

Steart Coastal Management Project (SCMP) represents a scheme which was led foremost by the requirements of habitat compensation for losses elsewhere in the Severn Estuary HCP area. MR flood defence formed part of the scheme design but was not the primary motivation for the scheme. The scheme was completed in 2014 and covers a total area of 262 ha (excludes Otterhampton Marsh and Stockland Marshes), within which there is 183 ha of saltmarsh and 40 ha of inter-tidal mudflat. The design of the scheme was delivered with reference to principles of WWNP.

SCMP was accompanied by multiple stages of archaeological investigation to inform the processes of consenting, design and implementation, and to mitigate the archaeological impacts that occurred. Archaeological investigations were commissioned by the Principal Contractor, Team van Oord, for the Environment Agency; curatorial advice was provided by English Heritage and Somerset County Council. The investigations showed that the Steart Peninsula had been subject to settled inhabitation in the Middle-late Iron Age, in the Romano British period, in the Medieval and early Post-medieval periods. These periods saw drainage and/or reclamation, permanent settlement, arable and pastoral farming, fishing and clear evidence of trade with other areas, including internationally. Periods of intense use of the landscape, including major investment in reclamation, were interspersed with sometimes prolonged periods where people stepped back due to environmental and perhaps cultural factors. Despite catastrophic events such as freshwater flooding and storm events, field boundaries and drainage channels evident in the modern landscape were shown to have extensive continuities with the early Medieval period, and perhaps even the Romano-British period. Surviving archaeological evidence included systems of ditches, extensive cobbled surfaces, artefactual assemblages including foreign imports, human remains, animal, fish and shellfish remains, and a wide range of palaeo-environmental evidence indicating how the environment had changed under the influence of natural and human processes over more than 5000 years. The suite of investigations included analysis and overarching interpretation of how the Steart landscape and associated human inhabitation had developed, published as an archaeological monograph by Wessex Archaeology for the Environment Agency (Higbee & Mepham, 2017).

4.3. Shoreline and waterfront development

4.3.1. Policy drivers

For this research, shoreline and waterfront development are considered as large-scale activities that may reshape and typically move the shoreline seawards, including;

- Enclosure of foreshore and sea areas (e.g. for land reclamation, port expansion or to locate other infrastructure); and

- Tidal range power developments (e.g. for barrages and lagoons) which may alter the tidal profile and create a potential net loss of inter-tidal area.

Large-scale enclosure of sea areas to reclaim land has been practised for millennia, often forming the low-lying coastal land that is now the focus for managed realignment or habitat creation. Sea areas have also been enclosed by piers and moles to provide harbours, also reaching a significant scale in recent centuries (e.g. Tyne, Sunderland, Dover and Portland Harbours; for the historical development of North Sea ports see https://archaeologydataservice.ac.uk/archives/view/northsea_eh_2016/index.cfm). Whilst the sea area within harbour walls may remain tidal, the construction of the harbour and the change to the wave and current regimes within the harbour basin still amount to major shoreline interventions with implications for the historic environment. The enclosure of sea areas is often accompanied directly or subsequently by land reclamation for port purposes or for development land.

These types of projects are likely to require significant private sector investment with decisions for investment linked to favourable economic conditions. The anticipated scale of such projects would also suggest they are considered as Nationally Significant Infrastructure Projects (NSIPs) with applications submitted to National Infrastructure Planning and require planning approval through the Planning Act 2008.

The NPS for Ports (DfT, 2012) provides a framework for decision making on proposals for new port developments. The policy recognises the potential (generic) impacts of new development (not specific to land reclamation), including those on the historic environment, and sets out the expectations to be addressed in an Environmental Statement supporting the application.

At the present time tidal range schemes are not covered by the NPS for Renewable Energy (EN-3) (DECC, 2011) with a suggestion that either EN-3 would be updated when such schemes were likely to move towards the planning process, or a separate NPS would be created. For tidal power developments, potential locations are reviewed in Historic England (2018). The present economic conditions for tidal power developments remain in doubt since other forms of renewable power are providing a lower cost of energy option. Consequently, most tidal range projects have become dormant. Further reading on the subject of potential implications of tidal range developments on the historic environment is available in Historic England (2018).

In some cases, shoreline and waterfront developments may also require compensatory measures for any net loss of designated sites (expected to be mainly inter-tidal losses). The area required to compensate for losses associated with shoreline developments may be up to a 1:3 ratio (to address uncertainties),

although this ratio has typically varied on a case by case basis. This means that there could be greater need to focus on the compensation site than the area of reclamation simply because of the larger area involved. Compensatory measure for development related losses are considered separately in Section 4.4.

4.3.2. Schemes

For ports, larger (container) vessels with deeper draughts drive much of the need for more extensive sheltered water, longer quayside berths, and improved handling facilities, which in turn may require a combination of capital dredging of berths and navigation channels, and construction of breakwaters. Similarly, but usually on a smaller scale, marine construction or redevelopment can include equivalent interventions. Such investment would still require an economic case, but the UK's protracted withdrawal from the European Union (Brexit) may be inhibiting some investment decisions (in the short-term) due to uncertainties in future trading conditions. Other (non-port) infrastructure may simply be addressing a need for extra land area.

Figure 12 indicates the sites of recent (from 1990 to present day) shoreline and waterfront development around the English Coast. The largest reclamations (derived as direct land take) are associated with sites in the Outer Thames Estuary;

- London Gateway, a new container terminal completed in 2017 with 2.6 km of realigned shoreline and a reclaimed area of around 92 ha. The associated compensation for habitat loss was delivered as the Stanford Wharf Nature Reserve, see Section 4.4.

- Sheerness, land reclamation for port expansion in 1994/5 of around 50.6 ha which included loss of Lappel Bank (an area of mudflats and saltmarsh in the Medway Estuary). The compensation requirements for this development are discussed in Section 4.4.

Other types of reclamation include Samphire Hoe at the base of the cliffs near to Dover (Shakespeare Cliff). An area of around 25 ha was reclaimed using spoil from the construction of the Channel Tunnel. The site was later converted into a country park and opened in 1997. Although this is a reasonably large reclamation the value of the historic environment at such a location was considered relatively low due to its remoteness and the site having been an eroding cliff since the Holocene.

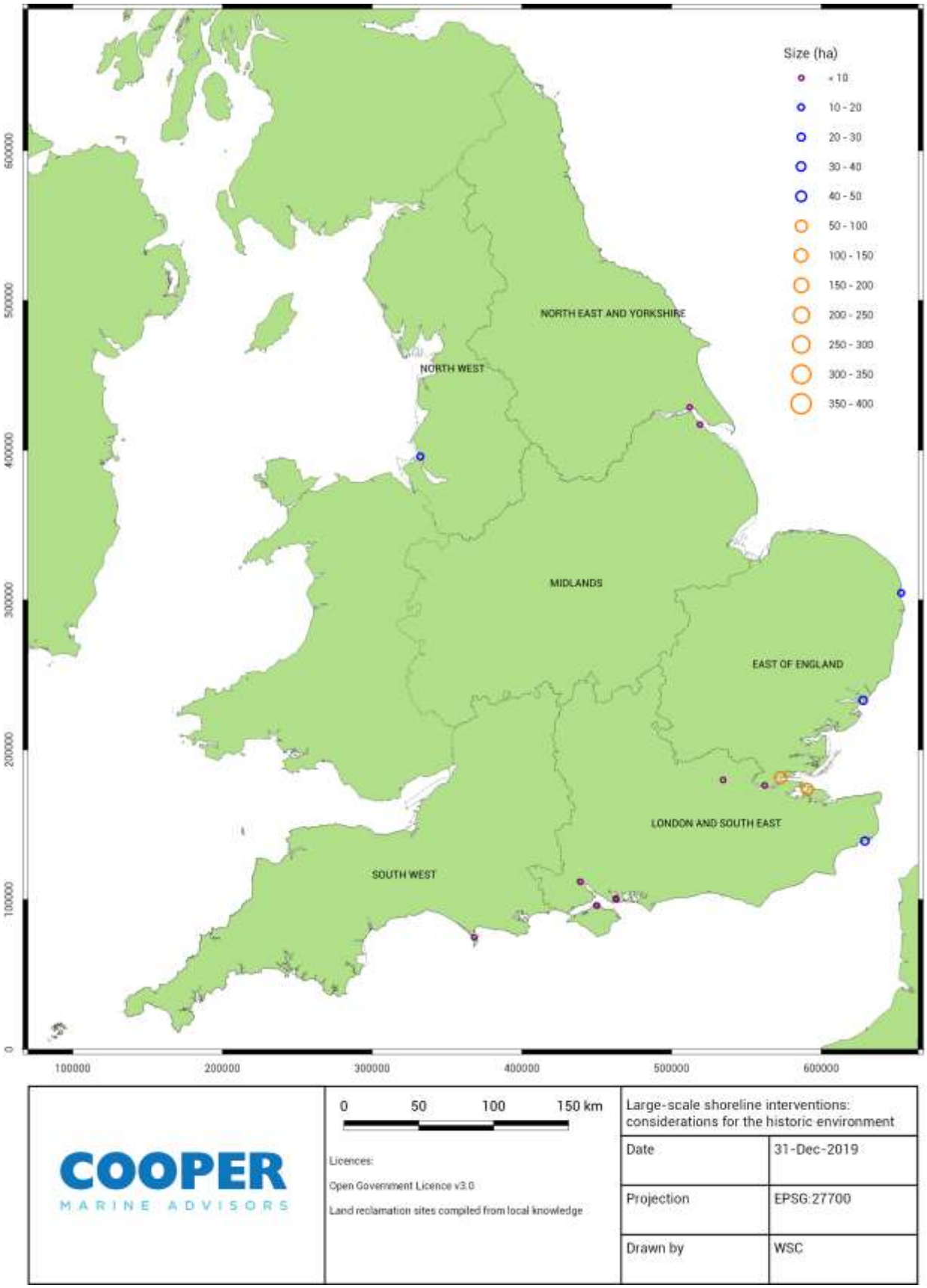

Figure 12. Location of recent land reclamation areas around the English Coast.

4.3.3. Port and harbour development

The most common type of upcoming land reclamation is likely to be related to port development and driven by the need to keep pace with changes in vessel size (larger vessels with deep draughts) and type, as well as increases in vessel traffic and cargo handling requirements.

For example, the recent development of Green Port Hull in the Humber Estuary is a bespoke facility servicing the offshore wind market. This scheme required land reclamation of around 7.7 ha (largely from the partial infilling of Alexandra Dock, a Grade II listed structure), with associated dredging of new river berths.

In HMNB Portsmouth, recent works at Victory Jetty (small area of reclamation around 0.4 ha and deepening of berths) were completed to accommodate the new aircraft carriers (HMS Queen Elizabeth and HMS Prince of Wales). This reclamation is a small site in close proximity to designated heritage assets.

In 2005, the Weymouth and Portland National Sailing Academy redeveloped part of the former Naval Dockyard in Portland Harbour, including reclamation of around 2 ha of land. The venue was later used for the 2012 Olympics.

a. Pending Schemes

There are several existing consented developments which have not yet advanced. One example is the 1.2 km long Deep Sea Container Terminal (DSCT) at Avonmouth which the Bristol Port Company received consent for in 2010. The original consent conditions required works to be completed by 2020, however, for the scheme to remain active a 10-year extension to the Harbour Revision Order (HRO) was requested. Presently, the Secretary of State is minded to grant the extension. The development includes approximately 55 ha of land reclamation (33 ha of inter-tidal and 22 ha of sub-tidal) within the Severn Estuary SAC and SPA, along with capital dredging of new river berths. Loss of inter-tidal habitat will be compensated for by a 120 ha site on the Steart Peninsula with tidal exchange directly across the shoreline (west of and adjacent to the Steart Coastal Management Project).

b. Future schemes

The Department for Transport (DfT) has encouraged major ports (defined as handling more than 1million tonnes of cargo per year) to develop Port Master Plans, and consult on these plans with local stakeholders, including planning authorities and regional development agencies in order to help co-ordinate medium-term planning. To help facilitate this process DfT developed guidance (DfT, 2008) with a recommendation that the outlook for master plans was up to 30 years ahead. The guidance seeks plans to consider expected environmental impacts of potential future development, with suitable mitigation measures and

offsetting for residual impacts. Amongst others, the guidance recognises cultural and architectural heritage as one theme of potential environmental impact.

In 2014, England Heritage responded to the DfT guidance for port master plans and commissioned a study to:

"*develop practical proposals to assist English Heritage in conserving the historic environment in ports and harbours, through consultation with the industry on how they accommodate the historic environment agenda, how liaison with English Heritage works, lessons learned, and win-win proposals for enhancing conservation of the historic environment*".

The project recommended four measures to improve engagement with the ports industry (Fisher Associates, 2014; Environment Agency, 2010; Environment Agency, 2018):

- **Measure 1**: Build better relationships
- **Measure 2**: Standalone guidance on how to deal with historic environment and heritage assets
- **Measure 3**: Update master planning/other guidance
- **Measure 4**: Heritage Partnership Agreements (HPAs) (non-statutory/statutory)

To date, several major ports have produced port master plans which are available online, this includes the master plan for the Port of Southampton (ABP, 2016). This plan provides recognition of cultural heritage with acknowledgement that capital dredging has the potential for heritage related impacts. Although no specific mention is made in this plan to reclaim new areas of foreshore the inference is that by 2020 the feasibility of developing their 240 ha 'strategic land reserve' of Dibden Bay would be advanced. When formally submitted as a planning application this scheme would now be considered as a NSIP. Logically, reclamation across the designated inter-tidal, combined with extensive capital dredging, would be required to develop any scheme where vessels required berths. A previous scheme to develop a 1.8 km long container terminal at Dibden Bay, including reclamation across 42 ha of environmentally designated inter-tidal mudflat (part of the Solent and Southampton Water SPA), was refused planning permission in 2004. The present land area of Dibden Bay was bunded using – in part – surplus Mulberry Harbour components ("Beetles") from the Second World War and was reclaimed using spoil from channel dredging in the period 1948 to late 1960s (NFDC, 2004).

Guidance was produced in 2016 for the assessment and management of marine archaeology in port and harbour development (Wessex Archaeology, 2016). This guidance identifies land reclamation as one of the key activities with the potential for a direct impact, as well as indirect effects of preventing access to

archaeological material for future research and the potential benefits of accretion in some cases to help preserve features. The guidance does not (directly) consider the historic environment associated with compensation sites to offset for habitat loss as a consequence of the development.

4.3.4. Other types of shoreline development

Ports and harbours are not the only development type that may lead to new areas of land reclamation.

In some cases, the pressures for housing can lead to proposals for increasing land areas by reclamation. One present example is Tipner West in the north-eastern corner of Portsmouth Harbour which aims to reclaim around 20 ha attached to around 23 ha of existing land which was recently used as a military firing range and a breakers yard for scrapped ships. The development proposal includes around 4,000 new homes. Given this development is within the Portsmouth Harbour SPA (including the SSSI) there is likely to be a requirement for additional areas to compensate for any loss of habitats, noting the listed operations likely to damage the special interest includes reclamation of land from sea.

A different example is the proposed Hull Lagoon, a large impoundment feature (not for tidal power generation) extending around 13.5 km from Humber Bridge to the Port of Hull, requiring between 700 to 1,500 ha of reclaimed land and impounding around 500 ha of the estuary. The scheme aims to combine flood defence for the city, a major relief road, urban regeneration and creation of an outer harbour (absorbing Green Port Hull). The project would also require suitable mitigation measures to offset any habitat losses locally and across the wider estuary.

4.3.5. Exemplar

The former oil refinery at Shell Haven, Thames Estuary, was redeveloped into a large deep water container terminal by DP World known as London Gateway. The facility was completed in 2017 with 2.6 km of realigned shoreline and a reclaimed area of around 92 ha. This project represents the largest contemporary land reclamation but also the largest capital dredge for a UK port (around 80 km to the outer Thames Estuary removing approximately 27 million m^3). The dredged material provided a source of material for the reclamation. The new quay was constructed significantly forward of the former low water mark and accompanied by dredging of the berth pockets out to the newly deepened channel. Reclamation filled the area between the new quay and former shoreline; extensive construction encompassed not only the newly reclaimed area but also the former coastal plain (including brownfield areas of the former refinery) reaching back to higher ground to the north and east. The associated compensation for habitat loss was delivered as the Stanford Wharf Nature Reserve (Section 4.4.3) and at Salt Fleet Flats Reserve, also referred to as Site X (https://www.londongateway.com/news-media/news/dp-world-london-gateway-creates-another-new-wildlife-habitat-on-the-river-thames).

Extensive archaeological investigations accompanied design, consenting and construction of London Gateway, including the port site and associated infrastructure (Biddulph, et al., 2020, Bates, et al., 2012), the dredging (Firth, Callan, Scott, Gane, & Arnott, 2012), and the habitat compensation sites (Biddulph et al. 2012, Biddulph, et al., 2020). Archaeological issues raised by capital dredging were concerned mainly with the channel further downstream, away from the principal shoreline intervention around the new quay and berthing. Geophysical and borehole investigations, accompanied by palaeo-environmental sampling, analysis and scientific dating, were used to develop an overall deposit model from the bedrock and gravels underlying the site at 15 to 25 m below OD through the deep alluvial sequence to the present-day surface. This model indicates the overall change from a dry environment characterised by freshwater deposition around 8,000 to 9,000 years ago through increasingly brackish to fully marine-influenced marshes, creeks and mudflats around 4,000 to5,000 years ago (Bates, et al., 2012). Evidence of earlier human occupation probably still lies beneath London Gateway port, protected by the depth of alluvium, but archaeological material in shallower deposits was implicated by development activities and was subject to a range of investigative methods before and during construction. These investigations demonstrated the importance of the marshland environment (including continuities in the landscape and its human use) from prehistory through to the modern period. Significant Bronze Age, Roman, Medieval and Post-medieval artefacts, features and structures were recorded, including flint tools and knapping waste from the Mesolithic and early Neolithic, important evidence of salt-making stretching back perhaps to the middle Bronze Age but intensive in the late Roman period, remains relating to fishing and agriculture, and a 16th to 17th Century timber wharf associated with a lost settlement. The archaeological investigations were accompanied by an extensive post-fieldwork programme of analysis, interpretation and dissemination, to include publication of a monograph in 2020 (Biddulph, et al., 2020).

4.4. Compensatory measures

4.4.1. Policy drivers

Compensatory measures provide the means to offset a net loss (direct and indirect) of protected inter-tidal habitat due to the assessed impacts of shoreline and waterfront developments. Similar to habitat creation schemes (Section 4.2), the requirements for compensatory measures originate with the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora). A draft statutory instrument known as The Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 is prepared to come into force on the day the UK leaves the EU with the intention to retain the Natura 2000 sites as a 'national site network'. On this basis, there is no anticipated change to the requirements for compensatory measures for net loss to areas within the national site network. To date, compensating for losses associated with shoreline developments may be up to a 1:3 ratio (to address uncertainties), although this ratio varies on a case by case basis.

4.4.2. Schemes

Compensation schemes may exist in their own right or be delivered as part of a combined initiative to address habitat creation and/or sustainable flood defence requirements.

Compensation schemes are expected to be provided in the same general region as the area of habitat loss and at the same time (or ahead) the development project is initiated.

4.4.3. Exemplar

As noted above, the major port development of London Gateway was accompanied by the creation of habitat compensation at Stanford Wharf Nature Reserve, which is a 44 ha site to the east of London Gateway Port. Documentary evidence suggests that the area had been reclaimed in the early 17th Century. Habitat creation comprised constructing a new sea wall along the landward edge the site, reducing ground levels to form new mudflat together with some deeper excavation, and breaching the old sea wall to allow tidal inundation (Biddulph et al. 2012).

Archaeological investigation of Stanford Wharf Nature Reserve uncovered intensive use of the location especially in the Iron Age and Roman periods for salt production. The overall sequence, however, extended back some 15,000 years when sea levels were much lower and the Thames at that point was a freshwater river. Flint tools, pottery and charcoal associated with the sandy underlying deposited pointed to prehistoric activity over 9,000 years in the Mesolithic, Neolithic and Bronze Age before rising sea levels were accompanied by the development of alluvial horizons. Thereafter, the environment developed as saltmarsh until land reclamation in the 17th Century. However, although this was saltmarsh, this location was used intensively and repeatedly for salt production in the Iron Age and Roman periods, in common with much of the coast of Essex and Kent, resulting in extensive and complex archaeological features and deposits, including structures. As well as salt making, the area seems have been used in the production of fish sauce in the Roman period and included a boathouse. Later, in the Medieval period, ditches and gullies indicate land division for arable or livestock farming. More recently, the site was used as a Second World War bombing decoy, represented by brick and concrete remains. Archaeological fieldwork was accompanied by analysis and interpretation, set out in an archaeological monograph by Oxford Archaeology for the port developer, DP World (Biddulph, Foreman, Stafford, Stansbie, & Nicholson, 2012). Dissemination also included a booklet for wider audiences and displays at the Nature Reserve visitor centre.

5. Potential impacts, assessment and mitigation

Section 3 outlined the general principles that have resulted in most coastal areas presenting a rich and complex historic environment, even though this may not be immediately apparent from presently recorded evidence.

Potential impacts on the historic environment and their effects on the significance of heritage assets will be determined by what is present in each case and the types of changes being brought about by each scheme. The typical fragility of heritage assets is such that impacts from shoreline interventions will usually be permanent (i.e. long-term and not reversable).

In the course of delivering a large-scale shoreline intervention there will often be scope to avoid damage to this heritage, together with opportunities to record, appreciate and learn. Nonetheless, the types of activities associated with shoreline intervention that could, in principle, impact upon heritage assets remain important to outline so that they can be properly assessed and mitigated where possible.

Major impacts are likely to occur in the construction phase or immediately afterwards, as the environment adjusts to its newly modified form. Construction phase impacts are likely to arise from the following processes, for example:

- Removal of upstanding heritage including breaching historic seawalls.
- Groundworks, including dredging in inter-tidal and sub-tidal areas, drainage, trenching for utilities, borrow pits, excavation of new habitat features and temporary works for access roads and compounds etc.
- Piling (including sheet piles, foundation piles, and associated structures like horizontal ground anchors – see https://historicengland.org.uk/images-books/publications/piling-and-archaeology/heag270-piling-and-archaeology/).
- Construction, including surcharging to consolidate deposits, installation of rock armour, etc.

Operational phase impacts that may occur rapidly or over a prolonged period include, for example:

- Erosion, including the erosion of outwash channels across the foreshore, as a result of breaching and erosion caused by the introduction of natural processes to deposits that were formerly protected.
- Reduced access where coastal routes are severed by breaches or where land becomes inter-tidal.

- Changing hydrology, such as formerly waterlogged deposits becoming subject to wetting and drying tidal cycles or the introduction of saltwater to previously freshwater environments, with concomitant changes to soil chemistry and biology, affecting buried archaeological materials.

- Changing vegetation where root growth causes physical damage to buried archaeological materials, for example.

- Changes to the setting of heritage assets in the vicinity of shoreline interventions, where the previous character of the area contributed to the significance of assets through people's appreciation and understanding of their surroundings.

5.1. Approaches to Archaeological Assessment and Mitigation

For any large-scale shoreline intervention, considerations for the historic environment will be most efficient if three issues are addressed at the outset of project development:

- Taking archaeological advice at an early stage;

- Integrating assessment and mitigation, as far as possible, with assessment and mitigation in respect of other topics, especially where field investigation might be required; and

- Developing a joined-up strategy for assessment and mitigation that balances the requirements of design, consenting and risk-avoidance with resourcing, timetabling and operational constraints, such as land ownership and environmental conditions.

Early archaeological advice should be obtained both in the development of strategies and plans, and in preparing individual schemes or projects. Archaeological advice is available from numerous parties. Several large organisations involved in shoreline interventions, including Environment Agency, Natural England and RSPB have their own internal archaeological advisors; Historic England is also available to engage in strategic discussions. Within consenting processes, curatorial advice will be available from local government archaeological officers attached to local planning authorities, and/or from Historic England if consenting is via MMO or National Planning Inspectorate, or if designated assets may be affected. Independent archaeological advice can also be obtained from private archaeological consultants and from archaeological contractors. In seeking independent advice, an important consideration is track record in dealing with the specific circumstances presented by shoreline environments. The Chartered Institute for Archaeologists has set out guidance for clients seeking to

employ professional archaeologists (https://www.archaeologists.net/sites/default/files/CIfA-Client-Guide-low-res.pdf).

Shoreline environments provide the opportunity for archaeology considerations to draw on the same or similar data to questions relating to other topics. The integration of data collation and acquisition makes sense not simply to avoid duplication and reduce costs, but also to enable cross-fertilisation in understanding the environment and the likely consequences of anticipated changes. Close integration of archaeology within the development of a scheme also enables refinement of scheme design to avoid archaeological impacts that may be costly to mitigate otherwise, but also to arrive at results that go with the grain of the historic landscape rather than being an obvious imposition. Integration is particularly important for the acquisition of field data, which is usually a costly exercise. Geotechnical, geophysical and UXO surveys are all examples where archaeologists can work directly alongside other specialists to maximise the value from the data that is returned.

Integrating assessment and mitigation across engineering and environmental specialisms encourages – and facilitates – the development of archaeological deposit models, which are one of the most powerful tools in understanding areas subject to large-scale shoreline interventions. Archaeological deposit models are, in essence, a two- or three-dimensional representation of the sequence of sediments underlying an area. They indicate how and when the environment developed into its current form and, consequently, the likelihood of the presence of archaeological material both vertically and in plan. Deposit models can also include the vertical and lateral extents of likely physical changes arising from the anticipated scheme, and so help understand potential heritage impacts and the steps that might best be taken to clarify those impacts and, if necessary, to mitigate them. Archaeological deposit models can range in precision and in how they are prepared and displayed; digital approaches are increasingly prominent. Typically, deposit models are refined over the course of the project as additional data – including palaeo-environmental and dating evidence – is secured. The value of archaeological deposit modelling in shoreline and other contexts has been set out recently – with extensive case studies – by a project funded by Historic England ([] add ref: Carey, C., Howard, A., Knight D., Corcoran, J. & Heathcote, J. (eds). (2018) Deposit Modelling and Archaeology. Short Run Press: Exeter.) from which best practice guidance is anticipated.

Development of a large-scale shoreline intervention involves several interweaving processes, commonly including (multiple) consenting, financing, design and procurement. Certainty about the finalised scheme details may not be confirmed until quite close to commencement of construction, and even then, there will need to be flexibility given the characteristics and dynamic response of the environment to the intervention.

The organisations that are promoting and funding specific schemes or projects will, understandably, wish to hold off major expense on archaeology (and other matters) until there is greater certainty in the scheme

being approved; yet early outlay may be critical in resolving major uncertainties that might otherwise lead to project delays and increased costs.

A good practice recommendation for all new projects would be to develop an explicit archaeological strategy, in conjunction with archaeological advisors, for how archaeological investigations will be phased within the overall scheme development programme, from inception through to the end of post-construction monitoring. Where the circumstances warrant it, an archaeological deposit model can be very valuable in both informing and implementing the archaeological strategy. In formulating such a strategy, the opportunity to make use of data collected early in the process to support later requirements should be considered, as well as the steps required to achieve this. For example, geotechnical samples can be used for mitigation through analysis, scientific dating, interpretation and dissemination; but if the samples have been poorly treated or stored between 'evaluation' and 'mitigation', then their potential is wasted.

Achieving a coherent and efficient archaeological strategy for major schemes can be facilitated by continual review and updating of relevant documents, such as an Archaeological Mitigation Framework or Written Schemes of Investigation (WSI). Agreeing such approaches with regulators is likely to be a requirement of the licensing and consents process. This approach should also be used to inform project budgeting, design and procurement, noting that there may be a need for both planned and reactive measures, especially during construction works

Detailed advice is available on many aspects of archaeological assessment and mitigation relevant to shoreline interventions. Table 6 provides a list pertinent information.

Table 6. List of key guidance documents.

Subject / Title	Year	Link
Landscapes		
Understanding the Archaeology of Landscapes	2017	https://historicengland.org.uk/images-books/publications/understanding-archaeology-of-landscapes/
Land Contamination and Archaeology	2017	https://historicengland.org.uk/images-books/publications/land-contamination-and-archaeology/heag096-land-contamination-and-archaeology/
Desk-based Assessment		
CIfA Standard and guidance for historic environment desk-based assessment	2017	https://www.archaeologists.net/sites/default/files/CIfAS%26GDBA_3.pdf
LIDAR		
Using Airborne Lidar in Archaeological Survey	2018	https://historicengland.org.uk/images-books/publications/using-airborne-lidar-in-archaeological-survey/
Geophysics		

Subject / Title	Year	Link
EAC Guidelines for the Use of Geophysics in Archaeology	2016	https://historicengland.org.uk/images-books/publications/eac-guidelines-for-use-of-geophysics-in-archaeology/
CIfA Standard and guidance for archaeological geophysical survey	2014	https://www.archaeologists.net/sites/default/files/CIfAS%26GGeophysics_2.pdf
Marine Geophysics Data Acquisition, Processing and Interpretation	2013	https://historicengland.org.uk/images-books/publications/marine-geophysics-data-acquisition-processing-interpretation/
Geoarchaeology		
Geoarchaeology	2015	https://historicengland.org.uk/images-books/publications/geoarchaeology-earth-sciences-to-understand-archaeological-record/
Field Evaluation		
CIfA Standard and guidance for archaeological field evaluation	2014	https://www.archaeologists.net/sites/default/files/CIfAS&GFieldevaluation_1.pdf
Building Recording		
Understanding Historic Buildings	2016	https://historicengland.org.uk/images-books/publications/understanding-historic-buildings/
CIfA Standard and guidance for the archaeological investigation and recording of standing buildings or structures	2019	https://www.archaeologists.net/sites/default/files/CIfAS%26GBuildings_2.pdf
Mitigation		
CIfA Standard and guidance for an archaeologicalwatching brief	2014	https://www.archaeologists.net/sites/default/files/CIfAS&GWatchingbrief_2.pdf
CIfA Standard and guidance for archaeological excavation	2014	https://www.archaeologists.net/sites/default/files/CIfAS&GExcavation_1.pdf
Preserving Archaeological Remains	2016	https://historicengland.org.uk/images-books/publications/preserving-archaeological-remains/
Piling and Archaeology	2019	https://historicengland.org.uk/images-books/publications/piling-and-archaeology/
Post-fieldwork		
CIfA Standard and guidance for the collection, documentation, conservation and research of archaeological materials	2014	https://www.archaeologists.net/sites/default/files/CIfAS&GFinds_1.pdf
CIfA Standard and guidance for the creation, compilation, transfer and deposition of archaeological archive	2014	https://www.archaeologists.net/sites/default/files/CIFAS&GArchives_2.pdf

6. Current practice and experience

As part of the research, discussions were held with a cross-section of interested parties to draw on their experience and knowledge from the delivery of existing large-scale shoreline interventions. Pertinent observations and views from these discussions have been brought together and summarised.

6.1. Advice

Generally, the promoter or developer of a large-scale shoreline intervention will make an application for consent to the relevant regulators: the local planning authority; the Planning Inspectorate (for national infrastructure); and/or or the MMO (for any schemes requiring a licence for marine works). Historic England advises the regulator and, through them, the promoter or developer. Where the regulator is the local planning authority, heritage advice will come principally from the local government archaeological officer unless designated assets are implicated, or the proposal is of such scale or complexity that Historic England's assistance is also sought.

Historic England's practice is that Regional Teams lead on applications that are inter-tidal, coastal and nearshore, including most large-scale shoreline interventions. Members of the Regional Team will be advised by in-house Science Advisors (SA); SAs do not provide advice externally on specific applications.

The extent of formal consultation, and the point at which Historic England is contacted, is dependent on consent requirements. Historic England is one of MMO's statutory consultees on schemes subject to a marine licence (i.e. schemes involving works up to the existing Mean High Water Springs - MHWS), but there is rarely pre-application contact on schemes subject to MMO licences, unless the Environment Agency brings them forward to Historic England.

Historic England provides training for local authorities, regional agencies and national organisations through the Historic Environment Local Management (HELM) Training Programme (https://historicengland.org.uk/services-skills/training-skills/helmtraining). The HELM Training Programme includes events on coastal and marine archaeology that are relevant to large-scale shoreline interventions.

The Environment Agency archaeology team plays a key role in advising on large-scale shoreline interventions. Direct contact with Historic England often arises through Environment Agency staff, especially internal archaeologists, though there are also situations where contact does not occur. If schemes come through land-based planning, especially if they are sufficiently large to be accompanied by a formal EIA, then Historic England will generally be consulted as part of the application process (at stages such as project screening, scoping opinion, etc.). Schemes above (landward of) high water, that are not subject to EIA, may not come to Historic England; and there may be a gap between Historic England

and Local Authorities in terms of historic environment advice. One SA noted that they are the only person within their Regional Team who has sight of applications through both Marine Licencing (MMO) and land-based planning (Local Authorities).

6.2. Shoreline Management Plans

Historic England's involvement in the SMP processes, which provides an opportunity to influence the shoreline management community, can improve the awareness in that community of archaeological issues and, thereby, increase the likelihood of early contact. However, there are certainly instances where scheme promoters lack an understanding of the history of change at the coast, and of the implications of those changes for their proposed schemes. This lack of understanding can result in very poor initial engagement.

Although Historic England's involvement in coastal groups and shoreline management planning can have a positive influence when it comes to specific schemes, such involvement can be variable in effect and usefulness relative to input, as much meeting content will generally not relate to heritage. However, if Historic England does not engage, then it is likely that the 'voice' of heritage will be entirely absent, noting that historic environment staff from local authorities, and historic environment staff from other bodies that have such expertise, are unlikely to be present.

The Essex Historic Grazing Marsh Project (Essex County Council, 2014) represents an example where specific examination of the coastal margin for heritage significance and vulnerability was undertaken to align with the requirements of the associated SMP (Essex and South Suffolk SMP) and enabled more effective engagement with coastal flood risk management and other land management issues.

6.3. Designated Assets

The general absence of designated (heritage) assets at the coast is a major concern because designated assets often provide an initial prompt for attention to the historic environment by scheme promoters and their teams, even where policies also emphasise the presence or significance of non-designated assets.

The lack of designated assets in coastal areas also affects Historic England's capacity to engage with large-scale shoreline interventions. Historic England applies a public value framework (PVF) to provide assurance to stakeholders that public money is invested in ways that deliver public value. Designation is a clear index of significance; areas where designated assets are absent lack such a clear indicator that Historic England's input will generate public value. Although coastal areas are regarded as very important by Historic England's SAs, the consideration of large-scale shoreline interventions in areas not well-represented by designated assets may not be favoured by the organisation's overall approach to delivering public value.

In terms of providing an initial prompt and evidencing public value – as well as more fully recognising the significance of the historic environment of low-lying coastal areas and their heritage assets – further consideration is warranted towards options for designation.

6.4. Assessment and Evaluation Methods

Conventional desk-based assessment may not be suited to gauging the likely presence and significance of archaeological material in areas subject to shoreline intervention. Recorded assets (including designated assets), may be few in number, however, the richness of such areas has been repeatedly demonstrated, with considerable continuities in the landscape and its use. Emphasis needs to be placed on desk-based assessment being accompanied by deposit modelling using geoarchaeological techniques; understanding landscape evolution from earlier map sources (not just late 19th Century Ordnance Survey); LiDAR to identify low-relief features such as palaeo-channels, boundaries and routes; geophysics; and walkover surveys of equivalent deposits on the foreshore. Field evaluation using trenches has to take into account the specific findings of earlier assessment, including deposit modelling and the depth of proposed groundworks or anticipated erosion. Bearing in mind the operational difficulties of conducting archaeological evaluation or mitigation once construction has started (including waterlogged character of deposits, ingress of water and the magnitude and extent of plant being used) serious consideration should be given to front loading the overall approach as much as possible. Opportunities to avoid impacting significant material and to avoid halting construction are likely to be more cost-effective than pushing investigations to a later stage in the programme.

6.5. Post-intervention impacts

In some instances, there has been an issue to secure the evaluation and mitigation of post-intervention impacts even where they are a foreseeable effect of managed realignment or habitat creation. Scheme promoters have taken the view that post-construction erosion of significant archaeological material occurring caused by the shoreline adjusting to the intervention is not the responsibility of the scheme. This view would not be accepted if such impacts were attributable to shoreline interventions accompanying development of a port, for example, so it is unclear why it persists in these other circumstances.

If post-construction impacts are considered to be beyond the responsibility of the scheme, the scope of archaeological evaluation is then limited to the footprint of construction, rather than encompassing the area where 'natural' erosion will also occur. Clearly, this substantially increases the level of risk and decreases the capability to deal efficiently with significant archaeological material becoming exposed.

7. Discussion and Recommendations

This research has indicated a potential for more and larger shoreline intervention schemes driven by several different requirements. Climate change adaptation is a key consideration driving the need for further shoreline interventions, whether these schemes are designed to deliver more sustainable flood defence options around the coast or to compensate for coastal squeeze on existing inter-tidal habitats. Seaward developments involving land reclamation may be more *ad hoc* and of a generally smaller size in comparison, although the inclusion of associated compensatory measures can amount to an overall relatively large shoreline intervention.

The areas where new schemes may be considered in the future is also identified, noting this is not a reflection of any commitment to develop a scheme at such locations or when that might happen, if at all. These areas may span both the landward and seaward margin of the present shoreline and are expected to have a high potential to be rich in heritage, even though this may not be immediately apparent (visible) or reflected in existing designations. Given the shoreline is often taken as an administrative and legal boundary then different consent regimes may be operated by different authorities; however, the risk of impact on the historic environment largely remains the same, irrespective. A consistency of approach should be sought across different kinds of shoreline intervention and irrespective of the type of project, the requirements of the consenting process or the competent authority responsible for granting permission.

The demand for large-scale shoreline interventions is expected to increase under the dual pressures of adaptation to climate change and biodiversity loss on one hand, and economic regeneration at the coast on the other. However, undefended coastlines, and associated heritage assets, will also be impacted by climate change, while heritage in 'hold the line' locations may also be affected by the enhancement and rebuilding of existing defences to provide a sufficient standard of protection against increasing sea levels. Hence, shoreline heritage faces intense pressures as a result of climate change, irrespective of large-scale shoreline interventions. The approach to shoreline interventions, as explored here, must form part of a comprehensive overarching strategy towards heritage and climate change at the coast, as a whole.

There are numerous examples of good practice from developing previous large-scale shoreline interventions, demonstrating how archaeological investigations can inform and mitigate schemes, as well as generating data on environmental change and engaging the public. Nonetheless, 'best practice' does not necessarily mean 'common practice'. Work is required to ensure that shoreline heritage is consistently considered and planned for when developing schemes.

There is an urgent need to confirm that impacts arising as a consequence of shoreline intervention are the responsibility of the scheme's promoter, even if the impacts arise from 'natural' processes such as increased erosion. The assessment, evaluation and, if necessary, mitigation of such potential impacts

should be integral to the scheme. This would be a normal expectation of a commercial development at the coast, such as dredging or construction of a new quay for a port The same chain of responsibility for 'secondary' impacts also applies to the reconfiguration of shorelines for managed realignment and/or habitat creation, whether this relates to an impact on the historic environment or any other feature of interest.

7.1. Recommendations

The main recommendations from this research are as follows:

- **Historic England is advised to develop an overall approach to heritage affected by coastal change, within which its approach to large-scale shoreline interventions can be situated.** Large-scale shoreline interventions for which key drivers are managed realignment, habitat creation or compensatory measures are a necessary adaptation to the climate emergency and biodiversity crisis. As such, the implications of large-scale shoreline interventions for heritage at the coast sit alongside other effects on heritage attributable to climate change, such as the erosion of heritage assets on shorelines subject to no active intervention, and impacts on the historic environment from construction of coastal defences where the option is hold the line. A joined-up approach to all the mechanisms through which climate change is affecting coastal heritage will help Historic England in delivering the best overall outcome given its limited resources: making the most of different funding and consenting mechanisms; sharing learning across coastal change casework; and building an overarching understanding of the significance of coastal heritage to inform individual decisions. As well as seeking to conserve the historic environment for future generations, this overall approach must encompass the potential to inform the public about climate change and adaptation based on archaeological sources.

- **The approach Historic England should develop for large-scale shoreline interventions should be based on an understanding of the overall scale of forthcoming interventions across all four major drivers: managed realignment, habitat creation, shoreline development and compensatory measures**. Whether framed in kilometres of shoreline or the hectarage of shoreline schemes, this study has helped to clarify that the overall footprint of shoreline interventions in the next few decades will be very large. Historic England needs to anticipate this scale in resourcing anticipated requirements for engagement at both strategic and scheme-specific levels.

- **Historic England should work with planning and consenting authorities to ensure that archaeological advice is consistent in both content and availability: at strategic and scheme-specific levels; and irrespective of the planning/consenting mechanism that applies.** The archaeological advice receved by the promoters of individual large-scale shoreline interventions should exhibit coherent and consistent messaging whether the advice is received from any part

of Historic England or from a local authority heritage service. Broad arrangements should be made for determining whether the lead in providing advice for a particular scheme will rest with Historic England or with the local authority heritage service; and how their views will be balanced where both have responsibilities to fulfil. Equally, broad arrangements should be made to integrate and balance the advice of Historic England and local authority heritage service in strategic processes such as preparation of further iterations of shoreline management plans.

- **Historic England should seek to work more closely with the parties responsible for promoting large-scale shoreline interventions, including closer working with their heritage advisers.** Organisations responsible for large areas of low-lying coastal land and/or promoting large-scale shoreline interventions include, for example, Environment Agency, National Trust, RSPB, The Wildlife Trusts, Natural England and the Defence Infrastructure Organisation. Historic England could gain a better understanding of strategic initiatives, schemes under development, and opportunities to share learning across the sector by hosting a periodic (e.g. annual) shoreline heritage seminar.

- **Historic England should address the apparent invisibility of archaeology in low-lying coastal areas.** The potential for significance and sensitivity of archaeological features is not apparent in many areas of low-lying land bordering the present shoreline, especially where they are unrecorded or buried. The number of designated heritage assets – which are often a de facto indicator that heritage should be a matter for concern – is often low in these areas. Historic England could boost the visibility of heritage as an issue for large-scale shoreline interventions by carrying out a review of designation in shoreline areas with a view to increasing the number of designated heritage assets. Historic England could also develop a non-statutory designation or GIS mapping of shoreline areas that are considered to be sensitive to shoreline intervention on archaeological grounds, to help trigger archaeological advice. Non-statutory designation or mapping could draw on a number of previous Historic-England initiatives, including the results of the RCZAS programme; the approach developed for the Essex Historic Grazing Marsh Project (Essex County Council, 2014); data and methods being developed by LUC for the Coastal Risk and Priority Places project (https://landuse.co.uk/news/coastal-heritage-priority/); landscape vulnerability frameworks (e.g. Cook, Johnston, & Sleby, 2019); and the map sources of anticipated shoreline intervention used by this study. In conjunction, Historic England should confirm that the PVF adequately recognises the provision of advice in respect of large-scale shoreline interventions as achieving outcomes that deliver public value.

- **Historic England should develop its understanding of the significance of shoreline heritage as a basis for decision-making.** The overall quantity of heritage assets affected by shoreline interventions in the next few decades will be very large, especially in the wider context of heritage

assets affected by erosion in areas of no active intervention or coastal defence construction where the option is hold the line. Mobilising resources to manage the impact of coastal change on the historic environment through strategic engagement or consenting processes requires resources itself: Historic England will need both to be selective itself and to encourage selectivity by others in addressing archaeological considerations arising from shoreline intervention. Such selectivity should be based on an understanding of the significance of heritage assets and the historic environment in shoreline areas. Whilst there is much useful work on which to draw—including the archaeological results of shoreline interventions in the exemplars discussed in this research – there is no national overview of the archaeological significance of low-lying coastal lowlands and the heritage assets associated with them. Such an overview, framed as an introduction to heritage assets or similar, would assist in raising awareness of the importance of these landscapes generally amongst institutions involved in shoreline interventions, as well as providing practical guidance for decisions about areas and assets.

- **Historic England should insist that 'secondary' impacts arising from natural processes prompted by shoreline interventions are to be regarded as attributable to the intervention as much as primary impacts, and are the responsibility of the scheme promoter to assess, evaluate and mitigate.** Where heritage assets in an area that was formerly protected are then exposed to erosion by the sea as a result of a large-scale shoreline intervention, such as breaching a sea wall, the impact of the scheme for which the promoter is responsible includes not just the breach but the erosion that it may introduce. Responsibility for secondary impacts is widely understood in respect of shoreline developments such as ports; it must be equally understood in respect of managed realignment and habitat creation or compensation. The impacts on the historic environment of secondary impacts may be far more extensive than those arising directly from groundworks and may arise over a longer period following the initial intervention; scheme promoters must be required to make appropriate provision to monitor secondary impacts and to address them as they occur.

- **Historic England should encourage scheme promoters to address uncertainty about the presence and significance of heritage assets in shoreline areas across assessment, evaluation and mitigation.** A common characteristic of low-lying coastal areas is that significant heritage assets may be buried and largely invisible until they are uncovered in the course of groundworks when delays will be especially costly to accommodate. Although they are improving, methods of assessment and evaluation are not capable, in a proportionate manner, of resolving the presence or absence of all forms of archaeological material in the deep alluvial sequences typical of shoreline areas. Mechanisms are therefore required to balance, at different stages, the degree of investigation with the level of risk that significant heritage assets may be impacted. It is essential that initial proposals for large-scale shoreline interventions are accompanied by an appropriate

desk-based assessment to enable curators to provide the relevant regulator with suitably informed advice. As the scheme progresses, a Written Scheme of Investigation (WSI) is likely to provide a useful tool in balancing uncertainty and risk in a form that all parties can have confidence in. Deposits models – which can evolve over the course of developing a scheme as more detail is obtained – are a further useful tool that can inform the WSI and provide the core of a mitigation strategy.

- **Historic England should prepare and publish accessible guidance on large-scale shoreline interventions and the historic environment.** Despite the growing scale of overall impact on the historic environment, there is currently no suitable guidance that addresses large-scale shoreline interventions across the major drivers of managed realignment, habitat creation, shoreline development and compensatory measures. The range of processes through which schemes are developed, promoted and consented is broad, as is the range of institutions that may be involved. Importantly, institutions involved in many large-scale shoreline interventions may have had little exposure to established archaeological processes and expectations, which are experienced predominantly through the planning process for development rather than shoreline management and habitat creation. However, the preparation of clear guidance depends on clarity having already been established on matters of process and responsibility; therefore, the preparation of guidance requires that the recommendations outlined above are being implemented.

8. References

ABP. (2016). *Port of Southampton. Port Master Plan. 2016 - 2035. Consultation Draft.*

Allen, M. J., & Gardiner, J. (2000). *Our Changing Coast: a survey of the intertidal archaeology of Langstone Harbour, Hampshire. CBA Research Report 124. York: Council for British Archaeology.*

Ashton, N., Lewis, S., De Groote, I., Duffy, S., Bates, M., Hoare, P., . . . Stringer, C. (2014). Hominin Footprints from Early Pleistocene Deposits at Happisburgh, UK. *PLoS ONE9.*

Bates, M. R., Bates, C. R., Cameron, N., Huckerby, E., Nicholson, R., & Whittaker, J. E. (2012). *A Multi-disciplinary Investigation of the Sediments at the London Gateway Site, Essex: geophysics, palaeoenvironment and dating – final deposit model update. Unpublished report by Oxford Archaeology South.*

Bell, M. (2007). *Prehistoric Coastal Communities: the Mesolithic in western Britain. CBA Research Report 149. York: Council for British Archaeology.*

Bell, M. (2013). *The Bronze Age in the Severn Estuary. CBA Research Report 172. York: Council for British Archaeology.*

Biddulph, E., Foreman, S., Hayden, C., Poole, C., Smith, K., & Stafford, E. (2020). *London Gateway: Prehistoric, Roman, Medieval and Post-Medieval Landscapes in the Thames Estuary. Oxford: Oxford Archaeology.*

Biddulph, E., Foreman, S., Stafford, E., Stansbie, D., & Nicholson, R. (2012). *London Gateway Iron Age and Roman salt making in the Thames Estuary: Excavation at Stanford Wharf Nature Reserve, Essex.* Oxford: Oxford Archaeology.

Cook, I., Johnston, R., & Sleby, K. (2019). Climate Change and Cultural Heritage: a landscape vulnerability framework. *Journal of Island and Coastal Archaeology, 0,* 1-19. doi:https://doi.org/10.1080/15564894.2019.1605430

DCLG. (2010). *Planning Policy Statement 25 Supplement:: Development an Coastal Change. Practice Guide.*

DCLG. (2012). *National Planning Policy Framework.* London: HM Government.

DECC. (2011). *National Policy Statement for Renewable Energy Infrastructure (EN-3). July 2011.*

Defra. (2006). *Shoreline management plan guidance. Volume 1: Aims and requirements.*

Defra. (2009). *Appraisal of flood and coastal erosion risk management. A Defra policy statement.*

Department for Exiting the European Union. (2018, January 31). The Withdrawl Bill. Factsheet 8: Environmental Protection. Retrieved from https://www.gov.uk: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/678335/Factsheet_8_-_environmental_protections.pdf

DfT. (2008). *Guidance on the Preparation of Port Master Plans.*

DfT. (2012). *National Policy Statement for Ports.*

ECCFAU. (2004). *Wallasea Island Proposed Managed Realignment Scheme: Archaeological Desk Based Assessment.*

English Heritage. (2006). *Shoreline Management Plan Review and the Historic Environment: English Heritage Guidance.*

English Heritage. (2013). *Historic Environment Guidance for Wave and Tidal Energy.*

Environment Agency. (2007). *Pagham to East Head Coastal Defence Strategy 2007. Initial consultation – a guide for local communities. Environment Agency in partnership with Chichester District Council and Arun District Council.*

Environment Agency. (2008). *The Humber Flood Risk Management Strategy.*

Environment Agency. (2010). *Flood and Coastal Erosion Risk Management appraisal guidance. FCERM-AG .*

Environment Agency. (2016). *Medmerry Managed Realignment - Monitoring Update: Summer 2016. Report - ENVIMSE100291.*

Environment Agency. (2018). *National Review of Statutory Habitat Compensation Associated with Flood and Coastal Risk Management Activity. Progess Report.*

Environment Agency. (2018). *Working with Natural Processes – Evidence Directory. SC15005.*

Environment Agency. (2019). *Draft National Flood and Coastal Erosion Risk Management Strategy for England.*

Environment Agency. (2019). *Draft National Flood and Coastal Erosion Risk Management Strategy for England: Draft Habitats Regulation Assessment Main Report. Consultation Draft.*

Essex County Council. (2014). *Essex Historic Grazing Marsh Project.*

Firth, A., Callan, N., Scott, G., Gane, T., & Arnott, S. (2012). *London Gateway: maritime archaeology in the Thames Estuary. Wessex Archaeology Report No. 30.*

Fisher Associates. (2014). *Ports and the Historic Envrionment. NHPP 4A3 (Historic Ports, Dockyards, Harbours and Coastal Resorts). Project No. 6264.*

Fulford, M., Champion, T., & Long, A. (1997). *England's Coastal Heritage: A survey for English Heritage and the RCHME.* London: English Heritage : Royal Commission on the Historical Monuments of England.

Higbee, L., & Mepham, L. (2017). *Living on the Edge: Archaeological Investigations at Steart Point, Somerset.* Wessex Archaeology.

Historic England. (2015). *GPA 2 - Managing Significance in Decision-Taking in the Historic Environment.* London: Historic England.

Historic England. (2016). *Climate Change Adaptation Report. Research Report Series no. 28/2016.*

Historic England. (2017). *Historic Environment Good Practice Advice in Planning: 3 (Second Edition). The Setting of Heritage Assets.* . London: Historic England.

Historic England. (2018). *Tidal Range Developments: Considerations for the Histroic Environment. Research Report Series no. 39-2018.*

HM Government. (2011). *UK Marine Policy Statement. HM Government, Northern Ireland Executive, Scottish Government, Welsh Assembly Government, March 2011.*

HM Government. (2018). *A Green Future: Our 25 Year Plan to Improve the Environment.*

Krawiec, K. (2017). Medmerry, West Sussex, UK: Coastal Evolution from the Neolithic to the Medieval Period and Community Resilience to Environmental Change. *Historic Environment: Policy and Practice*, 8, 2: 101-112.

Manhood Peninsula Partnership. (2019). *Archaeology at Medmerry*. Retrieved from https://peninsulapartnership.org.uk/environment/coastal-management/medmerry/archaeology-at-medmerry/: https://peninsulapartnership.org.uk/environment/coastal-management/medmerry/archaeology-at-medmerry/

MHCLG. (2019). *National Planning Policy Framework. Ministry of Housing, Communities and Local Government. February 2019.*

Ministry of Housing, Communities & Local Government. (2019). *National Planning Policy Framework.*

MMO. (2019). *Identifying sites suitable for marine habitat restoration or creation (MMO1135).*

Murphy, P. (2014). *England's Coastal Heritage: a review of progress since 1997.* Swindon: Historic England.

Murphy, P. (2016). Archaeological Investigations on the Beach at Medmerry, West Sussex. presentation to Citizan Conference, Bristol, 8th October 2016. Retrieved from http://www.cdas.info/PDF/Citizan%20Medmerry%20September%202016.pdf

NFDC. (2004). *New Forest District Coastal Management Plan. Zone 11: Dibden to Marchwood.*

NFDC. (2010). *North Solent Shoreline Management Plan. NSSMP CPW1839.*

Pontee, N. (2013). Defining coastal squeeze: A discussion. *Ocean & Coastal Management, 84*, 204-207.

Rippon, S. (2001). *Estuarine Archaeology: the Severn and beyond. Archaeology in the Severn Estuary 11. Bristol: Severn Estuary Levels Research.*

Tizzard, L., Bicket, A., & De Locecker, D. (2015). *Seabed Prehistory: investigating the palaeogeography and Early Middle Palaeolithic archaeology in the southern North Sea.* Salisbury: Wessex Archaeology.

UK Parliment. (2018). *European Union (Withdrawal) Bill. (HL Bill 79).*

Wessex Archaeology. (2016). *The Assessment and Management of Marine Archaeology in Port and Harbour Development.*

Wilkinson, T. J., Murphy, P. L., Brown, N., & Heppell, E. M. (2012). *The Archaeology of the Essex Coast, Volume II: excavations at the prehistoric site of the Stumble. East Anglian Archaeology Report No. 144. Chelmsford: Essex County Council.*

COOPER
MARINE ADVISORS

Fjordr
Marine and Historic Environment Consulting
info@fjordr.com www. fjordr.com

www.CooperMarineAdvisors.co.uk

www.Fjordr.com