

Medway Estuary and Swale Coastal Flood and Erosion Risk Strategy

Technical Appendix M - Carbon Optimisation
Report

5th October 2018

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1 Introduction

The Environment Agency has appointed Mott MacDonald (MM) to develop the Medway Estuary and Swale Coastal Flood and Erosion Strategy (hereafter known as MEASS), with the aim of providing a Flood and Coastal Risk Management (FCRM) Strategy for the Tidal Medway Estuary, the Swale Estuary, and the Isle of Sheppey. The aim of the MEASS is to assess how to best manage the coastline to protect people, properties, designated habitats, and agricultural land from coastal flood and erosion risk. As with all flood and coastal risk management work, the wider impacts must be considered. This means that the best technical solutions for defences need to be found, while also considering the impacts and benefits for local communities, the environment, and the cost to the tax payer.

1.1 Why the Strategy is being developed

There are currently coastal flooding and erosion risks to the communities and landowners around the Medway Estuary and Swale. Aging flood defences, rising sea levels and climate change mean that coastal flood and erosion risk to people, properties, habitats, and agricultural land will significantly increase in the coming years. Over the next 100 years it is predicted that 17,226 properties will be at an increased risk of tidal flooding (up to a 0.1%AEP event) within the MEASS area.

Currently most of the Strategy frontage is defended, especially around the Isle of Sheppey to protect the important port at Sheerness, and along the tidal River Medway to protect the Medway Towns. A significant proportion of the defences in the area are nearing the end of the design lives and the risk of failure during a storm event is high. However, it is not sustainable in the long term to continue to maintain all of the defences in their current position. Therefore, the MEASS will assess how this risk can be best managed, in line with government guidance, to deliver the most sustainable FCRM management approach.

The strategy area has large extents of both intertidal and freshwater habitats which are both nationally and internationally designated. Intertidal habitat is at risk as sea levels rise, 'squeezing' it against the existing defences. Freshwater habitat is at risk from the failure of the defences, resulting in the inundation of saltwater, as well as the increased overtopping which could be associated from sea level rise. Therefore, the MEASS is also legally obliged to assess how the adverse impacts to these designated habitats can be mitigated by realigning defences or creating compensatory areas in other locations.

1.2 Strategy Area

The Strategy area includes the Isle of Sheppey, the tidal extents of the Medway Estuary and the Swale estuary. The boundaries of the strategy area are:

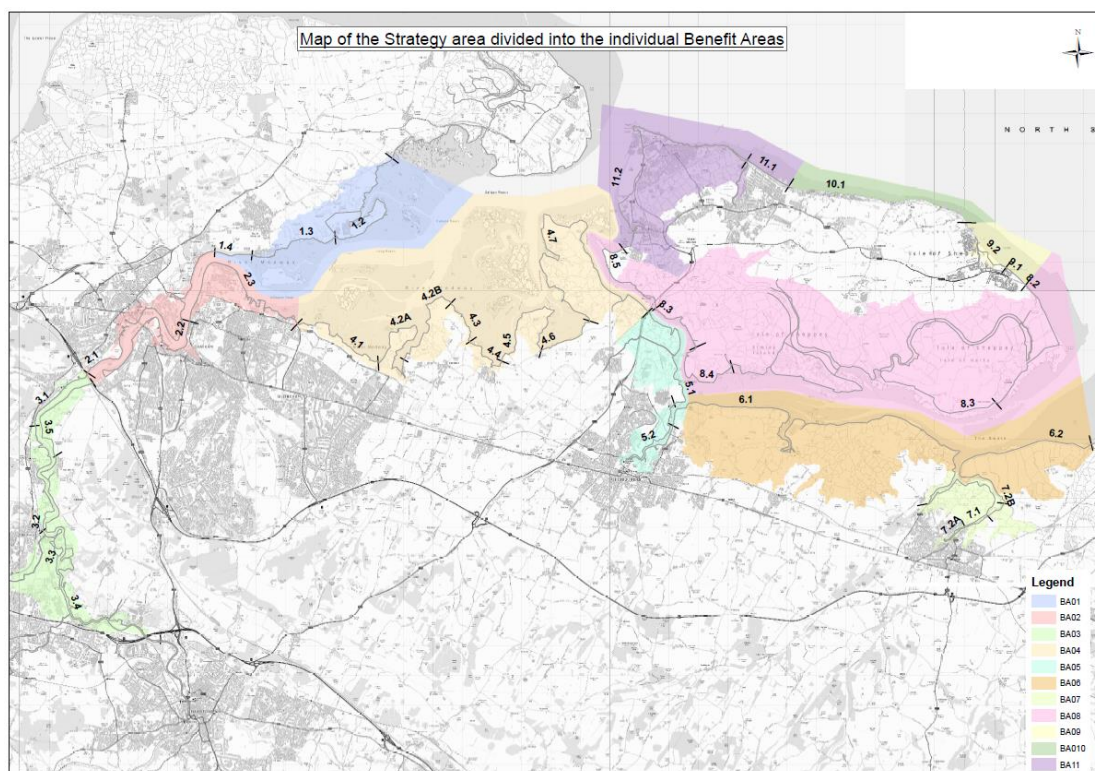
- Allington Sluice as the upstream tidal limit of the Medway;
- the village of Stoke on the Hoo Peninsula; and
- the Sportsman Public House on Cleve Marshes near Faversham.

The MEASS encompasses the large urban areas of the Medway Towns including Rochester, Strood, Chatham and Gillingham; major industrial and commercial areas along the estuaries; and large swathes of rural farmland and extensive salt marsh and mudflats. Many of the rural areas are highly designated and protected for their heritage, landscape and environmental value.

1.2.1 Benefit Areas

As the Strategy frontage is approximately 120km in length, and there are complex interactions between the different land uses, the MEASS area has been broken down into a series of Benefit Areas (BAs) based on the extent of discrete flood cells. These BAs have been broken down further into 35 sub-Benefit Areas based on the SMP Policy Units (Figure 1).

Figure 1: The division of the frontage into 11 BAs and 35 sub BAs based on discrete flood cells (determined from modelling) and land use. Please note that BA1.1 is now included in the Thames Estuary 2100 Strategy. BA8.1 and 8.2 were merged to form BA8.2 to reflect the interconnectivity between these areas.



Source: Mott MacDonald, 2017. Contains Ordnance Survey Data © Crown copyright and database right 2015

1.3 Aims of the strategy

The MEASS will assess and consider a variety of economic, environmental, and technical approaches to manage the coastal flood and erosion risk, in order to balance the wide range of features and interests within the area.

The vision statement of the MEASS is to “*work with the community to plan how we will sustainably reduce flood risk to 17,226 homes in the Medway Estuary, Swale and Sheppey over the next 100 years (under a 0.1% AEP event), whilst also protecting and enhancing the local environment.*”

Building on from this vision statement a series of primary and secondary objectives for the MEASS have been developed (Table 1) to drive the delivery of an effective FCRM strategy which supports as many local plans and aspirations as possible.

Table 1: MEASS Primary and Secondary Objectives

Primary Objectives		Secondary Objectives	
1)	Reduce flood and erosion risk to properties and infrastructure at significant or very significant risk in light of coastal change over the next 100 years.	3)	Favour options that reduce the whole life costs of current defences.
2)	Maintain the integrity of Natura 2000 sites (protected under the Habitats and Birds Directives) assuming the loss due to coastal squeeze of 113ha of saltmarsh habitat between years 0-20 and a further 140ha of saltmarsh habitat between years 20-50.	4)	Favour options that support delivery of the Thames River Basin Management Plan.
		5)	Help enable local plan objectives to be realised where possible.

1.4 Aims of this Report

This Report forms an appendix to the MEASS. The aim of this report is to present the results of the Environment Agency's Carbon Model outputs for each of the preferred options.

2 Carbon calculator

Following Government guidance, carbon reduction is now a requirement of all infrastructure programmes within England. It is the Environment Agency's aim to promote low carbon solutions through the optioneering and decision-making process. As such an assessment of the whole-life carbon for all of the Leading Options has been undertaken using the Environment Agency's Carbon Modelling Tool.

The Carbon Model has been used because it enables a quick and simple carbon assessment of the leading options, which is suitable for the strategy stage. It is intended that the assessment will be built upon and refined at the project level to inform decision making and further promote low carbon solutions.

However it should also be noted that this has fed into the Implementation Plan for the Strategy, where specific actions to identify potential for further carbon reduction have been highlighted. Despite the high level nature of the Strategy, there is a need to highlight the importance of considering carbon reduction, as this early stage can have a large influence over the work undertaken down the line. Specifically this can also relate to opportunities for increasing carbon storage through the creation of saltmarsh habitat.

The carbon model assesses whole life carbon over 100 years. Within this 100 years, the tool takes account of carbon during the following stages:

- initial construction;
- replacement construction;
- refurbishment;
- operation (use); and
- demolition.

2.1 Assumptions

The model is populated by inputting the quantity, usually in m³ or tonnes, of each structure type which makes up the preferred option for each BA e.g. embankments and walls. Due to the relatively simple nature of the tool a number of assumptions have been made when inputting the information, as only pre-populated structure types can be selected. Table 2 outlines the assumptions that have been made:

Table 2: Assumptions used when inputting the structures to the Carbon Model

Structure Type in the Strategy	Corresponding Carbon Model Input Structure
Concrete Revetment	Tidal Wall – Retaining – Concrete
Culvert	Culvert
Earth Embankment	Embankment - New
Demountable	Culvert
Flood Gate	Culvert
Retaining Wall	Tidal Wall – Retaining – Concrete
Rock Armour Stone	Revetment Works – Rock Armour
Sheet Piling	Tidal Wall – Retaining – Sheetpiled
Beach Recharge	Not included as there is no corresponding input in the model. It is assumed that as this is not a significant part of the

Structure Type in the Strategy	Corresponding Carbon Model Input Structure
	options, and only applicable to 3 BAs, it will not significantly affect the values. It is recommended that this is reviewed in more detail at the project level.

2.2 Results and carbon drivers

The results are presented below. An assessment has only been undertaken for the frontages where an option involves capital works – either for new flood and/or erosion defences or for Managed Realignment (MR) sites. No assessment has been made for maintain schemes or the NAI frontages as no new works are proposed. It should also be noted that in areas where Managed Realignment sites and saltmarsh habitat creation are proposed, there will be a potential benefit in increasing the potential carbon storage provided – as recorded within the ASTs (Appendix E). This has not been included in the calculations below however should be noted when assessing the options.

The tables on the following page present the carbon values for each BA. All values are tonnes of CO₂e, and have been taken from the EA Carbon Model (2017).

The scheme preferred option is proposed to reduce the risk of flooding and coastal erosion to the Medway Estuary and Swale Estuary over the next 100 years. The option requires a significant amount of construction work and materials.

Material supply is a key carbon driver, as well as the operational carbon footprint. Further work should be undertaken at the outline Business Case stage to identify ways to reduce future maintenance requirements, as well as design structures for material which can be sourced locally.

Stage	BA 1.2	BA 1.3	BA 2.1	BA 2.2	BA 2.3	BA 3.2	BA 3.3	BA 3.4
Capital carbon	8,376	9	15,720	3,082	8,228	2,085	11,236	14,804
Operational carbon	58,385	34,065	83,362	12,924	35,960	8,806	48,669	63,631
Replacement carbon	0	0	0	0	0	0	0	0
Refurbishment carbon	0	0	75	0	0	0	0	0
Demolition carbon	0	0	0	0	0	0	0	0
Residual carbon	0	0	0	0	0	0	0	0
Whole Life carbon	72,444	42,441	99,157	16,006	44,188	10,890	59,905	78,435

Stage	BA 4.1	BA 4.4	BA 4.7	BA 5.1	BA 5.2	BA 6.2	BA 7.2a	BA 7.2b
Capital carbon	6,148	55	2,449	1,891	689	282	4,034	590
Operational carbon	24,656	353	13,572	10,055	5,988	4,104	17,676	2,711
Replacement carbon	0	0	0	0	0	0	0	0
Refurbishment carbon	0	0	0	0	0	0	0	0
Demolition carbon	0	0	0	0	0	0	0	0
Residual carbon	0	0	0	0	0	0	0	0
Whole Life carbon	30,804	408	16,021	11,946	6,677	4,386	21,710	3,301

Stage	BA 8.3	BA 8.4	BA 9.1	BA 9.2	BA 11.1	BA 11.2
Capital carbon	375	4	14,059	286	8,532	9,034
Operational carbon	5,456	56	58,385	1,739	35,433	38,365
Replacement carbon	0	0	0	0	0	0
Refurbishment carbon	0	0	0	0	0	0
Demolition carbon	0	0	0	0	0	0
Residual carbon	0	0	0	0	0	0
Whole Life carbon	5,832	60	72,444	2,025	43,965	47,399

3 Reducing Carbon through Strategy Appraisal

The following steps have been taken to reduce the carbon footprint of the preferred options:

- Carbon considerations have been included within the ASTs (Appendix E) which were used to inform the shortlist assessment. This includes consideration of not just impacts on carbon use, but also potential benefits of increased carbon associated with the Managed Realignment options through the creation of salt marshes.
- Where appropriate, the lowest carbon solutions have been taken forward as preferred options within the BAs.
- Structure types have been reviewed, and where appropriate lower carbon solutions have been selected, e.g. earth embankments as opposed to concrete seawalls.
- If possible, structures have been enhanced/raised as opposed to new structures entirely. Furthermore, options have preferentially been selected which include part raising initially, then raising the defence crest levels in year 50 for sea level rise. This provides a more flexible option in the context of uncertainty around sea level rise. If projected sea level rise is lower, the overall raising and therefore carbon footprint will be adjusted, ensuring unnecessary works are not undertaken.

4 Carbon Actions / Opportunities

The EA should liaise with the Consultant, Designer and Contractor throughout the duration of the Project to ensure carbon efficient solutions are recorded and delivered.

The following carbon optimisations should be considered as the project progresses to achieve carbon efficiencies. These have also been highlighted for the specific Benefit Area sections within the risk and opportunity sections in Appendix A of the Implementation Plan for the Strategy.

- Carbon efficiency savings should be considered throughout each scheme that is progressed, however there are greater opportunities when carbon is considered in a strategic approach across the BAs.
- During the development of any schemes under the strategy, more detailed carbon calculators will be used to assess and compare potential carbon savings in more detail. This will include the project team ensuring they are liaising with different teams within the Environment Agency and the wider engineering community to keep up to date with innovations and best practice in design and construction related to carbon savings.
- The following actions should be considered across the schemes as the project progresses:
 - High carbon activities/materials to be designed out of the schemes;
 - Carbon calculator to be produced during design with reference to the Environment Agency Carbon Hierarchy;
 - For Managed Realignment sites, undertake Ground Investigation works at OBC stage early in the process so design can be developed to use Borrow Pit material where suitable;
 - Reduce transport carbon by using local materials where possible;
 - Possibility to source rock and/or beach recharge as part of other construction contracts in the region;
 - Local or regional sources of beach recharge that meets the scheme's beach recharge specification;
 - Electric or hybrid site and delivery vehicles/plant;
 - Reduce transport carbon by packaging schemes that progress to use similar materials; and
 - Consider low carbon concrete options where possible.

